

# ANNUAL REPORT

OF THE

## SUPERINTENDENT

OF THE

## UNITED STATES MILITARY ACADEMY.

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1896.

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SUPERINTENDENT UNITED STATES MILITARY ACADEMY.

HEADQUARTERS U. S. MILITARY ACADEMY,  
*West Point, N. Y., September 26, 1896.*

SIR: I have the honor to submit this my annual report for the Military Academy for the year ending September 1, 1896.

PERSONNEL.

The number of officers and instructors on duty at West Point September 1, 1896, was 7 professors, 1 associate professor, 55 commissioned officers, 1 chaplain, 1 sword master, and 1 teacher of music; a total of 66. (See roster appended, marked A.) The number September 1, 1895, was 65. The increase during the year was due to a gain of 1 officer for duty in the department of law and history, made necessary by the reorganization of that department.

One professorship became vacant and was abolished. The office of chaplain was created and filled. In all 20 officers joined during the year, 3 died, and 16 were relieved.

The Academy has to mourn the loss by death during the year of a number of its most valued members.

On the 10th of January, 1896, Rev. William M. Postlethwaite, chaplain and professor of history, geography, and ethics, died after a service at the Academy of over fourteen years. He had been successful to a remarkable degree in awakening and cultivating religious interest among cadets, the number of Protestant communicants at the time of his death being 86; the number when he assumed his duties in 1881 is said to have been 4. It was the opinion of the academic board that he had been hampered in this great work by his duties as professor, and that the results would have been still greater if he had had no duties other than those of chaplain. This matter having been presented to Congress by the War Department, an act was passed, approved February 18, 1896, which enacted, "That so much of section thirteen hundred and nine of the Revised Statutes of the United States as provides for the appointment at the United States Military Academy at West Point of one chaplain, who shall also be professor of history, geography, and ethics, and one assistant professor of the same, is hereby repealed: *Provided*, That the duties of chaplain at the Military Academy shall hereafter be performed by a clergyman to be appointed by the President for a term of four years, and the said chaplain shall be eligible for reappointment for an additional term or terms, and shall, while so serving, receive the same pay and allowances as are now allowed to a captain mounted." Under this act Rev. Herbert Shipman was appointed chaplain, and assumed the duties on the 25th of April last. The Academy has been fortunate in securing his services. The order issued from this office upon the occasion of Professor Postlethwaite's death is hereto attached, marked B.

On the 21st of April, 1896, the Academy suffered another heavy blow in the death of James Mercur, professor of civil and military engineering. The order from this office upon that occasion is hereto appended, marked C. One of the ablest officers in the Corps of Engineers, Capt. G. J. Piebeger, was appointed to succeed him as professor on the 4th of May last.

On the 13th of October, 1895, a brilliant and promising young officer, First Lieut. A. M. D'Armit, of the Corps of Engineers, died after a brief service of a few weeks at the Academy.

Cadet Thomas C. Butterly, of the third class, died September 11, 1896.

The number of cadets present and absent September 1, 1896, was 332, including 1 foreigner receiving instruction by special authority of Congress. This is the largest number of cadets that has ever belonged to the Academy at one time. The number September 1, 1895, was 324, including 1 foreigner. During the year 19 were discharged for deficiency in studies, 7 resigned, 1 died, 2 were dismissed, and 73 were graduated, a total loss of 102, while there were admitted in all at the examinations held in March, June, and August, 110. For the three examinations referred to, there were appointed in all 307 candidates, including 125 alternates. Of these 59 failed to appear and 119 were found not duly qualified, either mentally or physically, or both. Of the remaining 129 who passed, 1 declined to take the oath, and 18 were alternates whose principals also passed, and for whom there were therefore no vacancies, leaving 110 who were admitted.

The number of cadets now authorized by law is 371, omitting the foreigner. There are therefore 40 vacancies. There will be many more before the end of the academic year. It is not possible to keep the corps of cadets full. I beg leave to renew the recommendation of former reports that a moderate increase be made in the number authorized by law, such for example as would be obtained by appointing two at large from each State to be nominated by the Senators representing the State in Congress.

#### ACADEMIC DEPARTMENTS.

The readjustment of the course of study in the department of modern languages, by which instruction in Spanish is transferred from the first-class to the third-class course, was completed during the year. Instruction in that department is now continuous during the fourth and third class years. Better results are obtained, and this in less time than under the old arrangement. The time left vacant by this change in the first-class course, amounting to about 60 recitations, was distributed among other subjects, as follows: Twenty recitations added to the course in law, 22 added to the course in history, 6 to the course in ordnance and gunnery, and 12 to the course in drill regulations.

Instruction in the department of history under the old programme extended only from September to January. It had therefore been completed for the year at the time when the act already referred to abolishing the separate professorship was passed. The instruction in history and historical geography heretofore given in that department has been transferred to the department of law. The advantages of this change are (1) a more compact organization, one department being fully able to perform the duties formerly divided between two, neither of which was fully occupied; (2) economy; (3) greater simplicity of administration, it being necessary to detail as instructors officers who shall be satisfactory to only one head of department instead of to two, as before. Moreover, the chaplain is left untrammelled in the discharge of his highly important duties.

All of the departments have derived great advantage from the increased facilities offered by the new Academy building. The first year's occupation of this building is an epoch in the history of the Academy. The occasion seemed to be appropriate for the preparation of a full account of the course of studies and methods of instruction employed here. Such an account, though often needed, is nowhere to be found in print. I called upon each head of department for a report which should give for his department a brief historical sketch, a statement of the present course, the organization of the personnel, description of a recitation, class reports, examinations, and a critical review. These reports have been prepared with care. They present a description of the Academy as an educational institution, and of the various stages of its development, which has not before been given, and which will be of great interest and value to all persons interested in the institution or in military education. The reports are hereto appended, marked D, E, F, G, H, I, K, L, M, and N.

The departments of practical military engineering and of ordnance and gunnery are now the only departments in which the senior assistants receive no extra compensation. It seems but just that in this respect they should be placed upon the same footing as the other departments, and that the senior assistants should receive the pay of captain mounted.

#### THE LIBRARY.

During the year ending August 31, 630 volumes were purchased for the library and 779 volumes were presented to it, making a gain of 1,409 volumes. There were returned to the War Records office 347 volumes of the records of the war of the rebellion, 99 volumes of the same work were transferred to the department of engineering, and 25 miscellaneous volumes were transferred or exchanged, making a loss of 471 volumes. These were all duplicates. The net gain during the year was 938 volumes and 218 pamphlets, making the total number of books and pamphlets in the library September 1, 1896, 39,141 volumes and 6,132 pamphlets.

As stated in former reports the library has entirely outgrown the space heretofore allotted to it, and one of the most pressing needs of the Academy is the reconstruction of the library building. The need becomes more and more pressing each year. Full plans, specifications, and estimates for the work were obtained under an appropriation contained in the act approved January 16, 1895. As it will be necessary to find temporary storage room for the books while the work is in progress, the Academy will be subjected to much inconvenience, and in order that that may be kept at a minimum, the work when undertaken should be pushed to completion as rapidly as possible. The recommendation of last year that the full amount of the estimate, \$70,000, be appropriated at one time is renewed.

The report of the librarian is hereto appended, marked O. His recommendation that the salary of the assistant librarian be increased from \$1,200 to \$1,500 per annum is concurred in.

#### HEALTH.

The health of the command during the year was far from satisfactory. There were epidemics of influenza, malarial fevers, measles, and whooping cough. The last two prevailed among the civilians and enlisted men, and by careful quarantine arrangements were kept out of

the corps of cadets. Besides the deaths already mentioned, there were two deaths among the civilians residing upon the post. There were several cases of appendicitis, and several other desperate illnesses of various kinds in addition to those which proved fatal.

The post is well drained and well policed, and its general situation and condition are the same as in former years, when the health was good. Its water supply is the same, or at least it is derived from the same sources. The improvements in the latter which have been in progress for several years include more perfect filtering arrangements. Among my estimates for last year was an item for permanent filter beds, but the appropriation was not made. It is again submitted this year.

Under special instructions of the War Department an investigation of the causes of the prevalence of malarial fevers was made during the month of June by Maj. Charles Smart, of the Medical Department of the Army. Under date of June 21, Major Smart rendered to the Adjutant-General an able and interesting report, in which he attributed the difficulty to the water, and recommended filtration. He explained the fact that water gathered from the same grounds under apparently the same circumstances is healthy one year and unhealthy another by the different effects upon the soil and vegetation of differing climatic conditions. If hot weather occurs in the early spring, before vegetation has made a certain advance, the condition of the drainage basins and of the water gathered therefrom is different from that which pertains when the spring season opens gradually and regularly. The opinion of this distinguished officer is a powerful reenforcement to that of the authorities here that more perfect arrangements for filtering the water should be provided. No satisfactory explanation of the many forms of illness other than malarial with which the post has been afflicted has been discovered.

The report of the surgeon is hereto appended, marked P.

#### DISCIPLINE.

The state of discipline of the corps of cadets has been generally excellent. A few exceptional characters came into collision with the authorities during the summer encampment. Two of these were dismissed, after trial by court-martial, for hazing new cadets, and the others were suitably dealt with. The precision of movement of the battalion and the general excellence of drill in all of the military exercises in which cadets are instructed have never been greater than in the last year. A practical demonstration has been made that the omission of the drills on Wednesday afternoons has not been attended by any ill effects to counteract the benefits which were expected from it. The exhibition drills before the Board of Visitors in June have never been surpassed.

#### ACCOUNTS AND SUPPLIES.

The system of keeping the accounts and of furnishing the cadets with supplies continued essentially as heretofore reported. An abundance of good, healthy food in sufficient variety was furnished at an average cost of 53 cents per man per day, including extras for patients in the hospital. Clothing, books, and other articles were furnished of good quality and usually at low rates. The principal exception to the latter rule is the case of drawing instruments which each cadet is required to purchase. The price charged for these is \$23.05, or more than half a month's pay. The instruments are imported, none of suitable quality being made in this country. The duty upon them is 35

per cent. Neither the quantity nor the quality should be reduced, and the price is as low as it can be made if the custom-house dues are paid. Legislation is recommended remitting the duty.

Attention is invited to the report of the quartermaster and commissary of cadets, hereto appended, marked Q.

#### ORDNANCE.

During the year the old rifles of the cadets were exchanged for the new magazine rifles, caliber .30. Important additions were made to the list of models and sample guns for the general theoretical instruction of cadets. Much study and labor were employed in the arrangement of the ordnance museum in the new Academy building. Particular care was given to the preservation of the battle and trophy flags, which were placed in glass cases hermetically sealed. All of the models and war relics were taken from their places of storage, cleaned, repaired, and set up, and the room was thrown open to visitors. Attention is invited to the report of the instructor of ordnance and gunnery, hereto appended, marked R.

I beg leave to repeat my remarks of last year upon the subject of the band, the master of the sword, and the adjutant of the Academy.

#### BAND.

By the act of March 3, 1877, the Military Academy band was reduced to 1 teacher of music and 24 enlisted men, which is its present authorized strength. Of the enlisted men 6 receive \$34 per month, 6 \$20, and the remaining 12 \$17, with the usual allowances of enlisted men. At the time of this reduction the band consisted of 1 teacher of music and 40 enlisted musicians, of whom 10 received \$34, and the remaining 30 received \$30 per month, with the usual allowances of enlisted men. Since that date every Superintendent of the Academy, with perhaps one exception, and many or all Boards of Visitors have recommended an increase of the band. To anyone familiar with music it needs no argument to prove that the present numbers and pay are not sufficient. Is a good band really necessary to the practical efficiency of the Academy, is the only question which can be asked. The answer is plain when the purpose which the band subserves is considered. Military pomp has a serious and practical object—the cultivation of the military spirit. It is in the same category with patriotic songs, discipline, and monuments to dead heroes. There is no more essential part of it than good music. I recommend that the band be restored to the numbers and pay which it had before the reduction in 1877. I recommend further that the leader receive the rank, pay, and emoluments of a second lieutenant of infantry. The increase is desired not for the purpose of gratifying an idle vanity or merely to provide pleasure, but to improve the finer polish given to the finished product of the Academy.

#### MASTER OF THE SWORD.

The swordmaster is also the instructor in gymnastics and swimming. He is a civilian, appointed by the Secretary of War. The present incumbent has worked up an admirable course of gymnastics for the corps of cadets. His system of calisthenics has been adopted by the War Department for the use of the Army. He is required to preserve discipline and to exercise control of cadets while under his instruction.

It would greatly strengthen his hand if he should have military rank, and, in view of the great and increasing importance of his department, I recommend that legislation be solicited giving him the rank, pay, and emoluments of a first lieutenant of infantry.

#### ADJUTANT OF THE ACADEMY.

The adjutant of the Academy is also secretary of the academic board, and upon occasions of ceremony acts as aid-de-camp to the Superintendent. His duties are at least as important as those of an assistant professor, and they are more onerous, while his personal expenses are greater. It seems but just that the officer holding this position should receive the pay of captain, mounted, as in the case of assistant professors. Legislation to that effect is recommended.

#### WATER SUPPLY.

Good progress was made during the year in the construction of the new reservoir. The body of the main dam was completed and the coping set. The work remaining to be done upon this structure includes the parapet wall, paving carriage way on top, building the overflow and spillway, and the road connections at the end. An estimate of funds for completing the dam is submitted. Good progress was made in the removal of the deposit of soil and peat in the reservoir basin under an appropriation for the current year. It is hoped that this work will be completed by December 1, and that the reservoir may be used for the storage of water during the current year. The recommendation contained in my last annual report that filters of adequate size be provided is renewed. An estimate for that purpose is submitted.

Attention is invited, for details, to the report of the instructor of practical military engineering, hereto appended, marked S.

#### BUILDINGS AND GROUNDS.

Important improvements in the grounds were made near the cadet barracks and the Academy building, the streets being cut down and regraded, and a sidewalk of artificial stone being laid to embrace the fronts of both buildings. The grounds near the new quarters for unmarried officers were rearranged, graded, and sodded, and a concrete walk was laid. Many minor improvements were made. Attention is invited to the report of the quartermaster, heretofore appended, marked T.

The new figure of Fame for the battle monument was finally received and placed in position in May last. The new tablets, carrying the names of the enlisted men, were accepted and placed about the same time. The monument is now completed in a manner worthy of the place it occupies and of the names it perpetuates. Arrangements for dedicating it are still to be made.

Bids were again invited by public advertisement for the construction of the Cullum Memorial Hall, and a contract was made with the Probst Construction Company on the 22d of January, 1896. The contractors began the work promptly and have pushed it with commendable energy. By the 1st of September the walls of the basement and sub-basement had been completed, the cut stone for the main building had arrived in large quantity, and several courses of it had been set.

## ESTIMATES.

The estimates for the next fiscal year are essentially the same as those of last year. To the list of costly improvements such as the reconstruction of the library building, new water main, new filter beds, and completion of the new reservoir, it has been necessary to add the reconstruction of the south dock. Among the less costly improvements an item has been added for placing electric clocks in the Academy building, public offices, and barracks with a view to the distribution of time by modern methods. A few of the least pressing items submitted last year have been omitted this year, in order to keep down the total, which is considerably larger than the amount appropriated for the current year. The necessity of each item is explained in the remarks accompanying the estimates.

## CONCLUSION.

In conclusion, I have to repeat my report of last year that the Academy is in a flourishing condition. It is passing through an era of improvement, so far as its equipment and outward physical condition are concerned, due to the greater liberality of Congress in recent years. The curriculum, both theoretical and practical, is the result of many years' experience, and has proved itself well adapted to the objects of the institution. Improvements in that direction are less rapid and less radical than in the other, but there also the Academy is advancing, as will appear from a perusal of the appendices already referred to as attached to this report. The professors and officers are accomplished, each in his sphere, and devoted to their work, and deserve well of the Government.

Very respectfully, your obedient servant,

O. H. ERNST,

*Colonel of Engineers, Superintendent.*

The ADJUTANT-GENERAL, UNITED STATES ARMY,  
Washington, D. C.

## LIST OF APPENDICES.

- A.—Roster of officers.
- B.—Obituary order. Professor Postlethwaite (G. O. 1, U. S. M. A., January 11, 1896).
- C.—Obituary order. Professor Mercur (G. O. 8, U. S. M. A., April 22, 1896).
- D.—Professor Michie's report.
- E.—Professor Larned's report.
- F.—Professor Bass's report.
- G.—Professor Tillman's report.
- H.—Lieutenant-Colonel Mills's report.
- I.—Professor Wood's report.
- K.—Professor Davis's report.
- L.—Professor Fiebeger's report.
- M.—Captain Lusk's report.
- N.—Captain Bruff's report.
- O.—Report of librarian.
- P.—Report of surgeon.
- Q.—Report of quartermaster and commissary of cadets.
- R.—Report of instructor of ordnance and gunnery.
- S.—Report of instructor of practical military engineering.
- T.—Report of quartermaster.

A.  
UNITED STATES MILITARY ACADEMY,  
WEST POINT, NEW YORK.

SUPERINTENDENT.

Col. O. H. ERNST, Lieutenant-Colonel, Corps of Engineers.

MILITARY STAFF.

Capt. WILBER E. WILDER, Fourth Cavalry, adjutant of the Military Academy and of the post; recruiting officer; commanding band and detachment of field music.

Capt. WILLIAM F. SPURGIN, Twenty-first Infantry, treasurer of the Military Academy, and quartermaster and commissary of cadets.

Capt. JOHN B. BELLINGER, assistant quartermaster, U. S. A., quartermaster of the Military Academy and of the post; disbursing officer.

First Lieut. BARRINGTON K. WEST, Sixth Cavalry, commissary and treasurer; in charge of post exchange.

First Lieut. WILLIAM WEIGEL, Eleventh Infantry, assistant to the quartermaster, and officer of police.

Maj. GEORGE H. TORNEY, surgeon, U. S. A., surgeon.

Capt. CHARLES F. MASON, assistant surgeon, U. S. A.

Capt. CHARLES WILLCOX, assistant surgeon, U. S. A.

ACADEMIC STAFF.

Professors whose service at the Academy as professor exceeds ten years have the assimilated rank of colonel, and all other professors the assimilated rank of lieutenant-colonel.

DEPARTMENT OF NATURAL AND EXPERIMENTAL PHILOSOPHY.

Peter S. Michie, professor (February 14, 1871).

Capt. William B. Gordon, Ordnance Department, assistant professor.

First Lieut. Henry C. Davis, Third Artillery; Second Lieut. Joseph T. Crabbs, Eighth Cavalry, instructors.

First Lieut. Samuel D. Freeman, Tenth Cavalry, in charge of observatory and astronomical observations.

DEPARTMENT OF DRAWING.

Charles W. Larned, professor (July 25, 1876).

First Lieut. Charles B. Hagadorn, Seventeenth Infantry, assistant professor.

Second Lieut. Horace M. Reeve, Third Infantry; Second Lieut. Walter C. Babcock, Eighth Cavalry, instructors.

DEPARTMENT OF MATHEMATICS.

Edgar W. Bass, professor (April 17, 1878).

Wright P. Edgerton,<sup>1</sup> associate professor (July 1, 1893).

First Lieut. Daniel B. Devore, Twenty-third Infantry, assistant professor.

First Lieut. Charles P. Echols, Corps of Engineers; Second Lieut. George Blakely, Second Artillery; Second Lieut. Jay E. Hoffer, Third Artillery; Second Lieut. William M. Cruikshank, First Artillery; Second Lieut. John H. Rice, Third Cavalry; Second Lieut. David M. King, Fourth Artillery; Second Lieut. John W. Joyes, Fifth Artillery, instructors.

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<sup>1</sup> Associate professor with rank of captain.

## DEPARTMENT OF CHEMISTRY, MINERALOGY, AND GEOLOGY.

Samuel E. Tillman, professor (December 21, 1880).  
 First Lieut. Richmond P. Davis, Second Artillery, assistant professor.  
 First Lieut. Edgar Russel, Fifth Artillery; Second Lieut. Palmer E. Pierce, Sixth Infantry; Second Lieut. William R. Smith, First Artillery, instructors.

## DEPARTMENT OF TACTICS.

Lieut. Col. Samuel M. Mills, captain Fifth Artillery, commandant of cadets and instructor of tactics (September 1, 1892).

Capt. James Parker, Fourth Cavalry, senior instructor of cavalry tactics.

First Lieut. Alexander B. Dyer, Fourth Artillery, senior instructor of artillery tactics.

First Lieut. Granger Adams, Fifth Artillery, assistant instructor of tactics, commanding company of cadets.

First Lieut. Wilds P. Richardson, Eighth Infantry, senior instructor of infantry tactics.

First Lieut. William H. Allaire, Twenty-third Infantry, assistant instructor of tactics, commanding company of cadets.

First Lieut. Willard A. Holbrook, Seventh Cavalry, assistant instructor of tactics, commanding company of cadets.

First Lieut. Robert L. Howze, Sixth Cavalry, assistant instructor of tactics, commanding company of cadets.

First Lieut. Matthew C. Butler, jr., Seventh Cavalry, assistant instructor of cavalry tactics.

## DEPARTMENT OF MODERN LANGUAGES.

Edward E. Wood, professor (October 1, 1892).

First Lieut. Charles H. Hunter, First Artillery, assistant professor of the Spanish language.

First Lieut. Peter E. Traub, First Cavalry, assistant professor of the French language.

First Lieut. Marcus D. Cronin, Twenty-fifth Infantry; Second Lieut. Samuel C. Hazzard, First Artillery; Second Lieut. William R. Smedberg, jr., Fourth Cavalry; Second Lieut. Edward B. Cassatt, Fourth Cavalry; Second Lieut. James M. Williams, First Artillery, instructors.

## DEPARTMENT OF LAW AND HISTORY.

George B. Davis, lieutenant-colonel and deputy judge-advocate-general, U. S. A., professor (August 20, 1895). (By assignment under act June 6, 1874.)

First Lieut. Barrington K. West, Sixth Cavalry, assistant professor.

First Lieut. Walter A. Bethel, Third Artillery; Second Lieut. Frank G. Mauldin, Third Artillery; Second Lieut. Robertson Honey, Fourth Artillery, instructors.

## DEPARTMENT OF CIVIL AND MILITARY ENGINEERING.

Gustav J. Fiebeger, professor (May 4, 1896).

First Lieut. Thomas H. Rees, Corps of Engineers, assistant professor.

First Lieut. Francis R. Shunk, Corps of Engineers; First Lieut. Chester Harding, Corps of Engineers, instructors.

## DEPARTMENT OF PRACTICAL MILITARY ENGINEERING.

Capt. James L. Lusk, Corps of Engineers, instructor (March 31, 1893).

First Lieut. E. Eveleth Winslow, Corps of Engineers, assistant instructor.

## DEPARTMENT OF ORDNANCE AND GUNNERY.

Capt. Lawrence L. Bruff, Ordnance Department, instructor (August 17, 1891).

First Lieut. John T. Thompson, Ordnance Department; Second Lieut. Henry D. Todd, jr., Third Artillery, assistant instructors.

## CHAPLAIN.

Rev. Herbert Shipman (April 22, 1896).

Herman J. Koehler, master of the sword.  
 George Essigke, teacher of music.

*List of officers, with relative rank, at the United States Military Academy.*

| Names.                         | Corps or regiment.  | On duty at Academy since— |
|--------------------------------|---|---------------------------|
| <i>Colonels.</i>               |   |                           |
| Ernst, Oswald H. ....          | Corps of Engineers .....                                  | Apr. 1, 1893              |
| Michie, Peter S. ....          | Professor (Feb. 14, 1871) .....                           | Apr. 23, 1867             |
| Larned, Charles W. ....        | Professor (July 25, 1876) .....                           | Aug. 28, 1874             |
| Bass, Edgar W. ....            | Professor (Apr. 17, 1878) .....                           | Sept. 15, 1876            |
| Tillman, Samuel E. ....        | Professor (Dec. 21, 1880) .....                           | Aug. 28, 1879             |
| <i>Lieutenant-colonels.</i>    |   |                           |
| Mills, Samuel M. ....          | Captain, Fifth Artillery, commandant of cadets .....      | Sept. 1, 1892             |
| Wood, Edward E. ....           | Professor (Oct. 1, 1892) .....                            | Aug. 28, 1889             |
| Davis, George B. ....          | Professor (Aug. 20, 1895) .....                           | Aug. 20, 1895             |
| Fiebeger, Gustav J. ....       | Professor (May 4, 1896) .....                             | May 30, 1896              |
| <i>Major.</i>                  |   |                           |
| Torney, George H. ....         | Surgeon, Medical Department. ....                         | July 17, 1894             |
| <i>Captains.</i>               |   |                           |
| Spurgin, William F. ....       | Twenty-first Infantry .....                               | Sept. 2, 1881             |
| Lusk, James L. ....            | Corps of Engineers .....                                  | Mar. 31, 1893             |
| Parker, James. ....            | Fourth Cavalry .....                                      | Aug. 13, 1894             |
| Bruff, Lawrence E. ....        | Ordnance Department .....                                 | Aug. 17, 1891             |
| Wilder, Wilber E. ....         | Fourth Cavalry .....                                      | May 15, 1895              |
| Gordon, William B. ....        | Ordnance Department .....                                 | Aug. 20, 1894             |
| Edgerton, Wright P. ....       | Associate professor (July 1, 1893) .....                  | Jan. 28, 1889             |
| Mason, Charles F. ....         | Assistant surgeon, Medical Department. ....               | July 16, 1894             |
| Bellinger, John B. ....        | Assistant quartermaster, Quartermaster's Department. .... | Sept. 17, 1894            |
| Willcox, Charles. ....         | Assistant surgeon, Medical Department. ....               | May 2, 1895               |
| Shipman, Herbert. ....         | Chaplain (Apr. 22, 1896) .....                            | Apr. 25, 1896             |
| <i>First lieutenants.</i>      |   |                           |
| Dyer, Alexander B. ....        | Fourth Artillery .....                                    | Aug. 31, 1892             |
| Adams, Granger. ....           | Fifth Artillery .....                                     | July 15, 1895             |
| Hunter, Charles H. ....        | First Artillery .....                                     | Aug. 20, 1896             |
| Freeman, Samuel D. ....        | Tenth Cavalry .....                                       | June 30, 1893             |
| Richardson, Wilds P. ....      | Eighth Infantry .....                                     | Feb. 10, 1892             |
| Rees, Thomas H. ....           | Corps of Engineers. ....                                  | Aug. 22, 1893             |
| Allaire, William H. ....       | Twenty-third Infantry .....                               | June 15, 1893             |
| Thompson, John T. ....         | Ordnance Department. ....                                 | Aug. 20, 1896             |
| Davis, Henry C. ....           | Third Artillery .....                                     | Do.                       |
| West, Barrington K. ....       | Sixth Cavalry .....                                       | Feb. 18, 1893             |
| Shunk, Francis R. ....         | Corps of Engineers. ....                                  | Aug. 20, 1895             |
| Holbrook, Willard A. ....      | Seventh Cavalry .....                                     | Aug. 20, 1892             |
| Devore, Daniel B. ....         | Twenty-third Infantry .....                               | Do.                       |
| Traub, Peter E. ....           | First Cavalry .....                                       | Nov. 11, 1892             |
| Davis, Richmond P. ....        | Second Artillery .....                                    | Aug. 17, 1891             |
| Russel, Edgar. ....            | Fifth Artillery .....                                     | Aug. 22, 1893             |
| Winslow, E. Eveleth. ....      | Corps of Engineers. ....                                  | May 12, 1896              |
| Weigel, William. ....          | Eleventh Infantry .....                                   | Apr. 9, 1894              |
| Cronin, Marcus D. ....         | Twenty-fifth Infantry .....                               | Aug. 22, 1893             |
| Harding, Chester. ....         | Corps of Engineers. ....                                  | Aug. 20, 1896             |
| Howze, Robert L. ....          | Sixth Cavalry .....                                       | Mar. 24, 1896             |
| Echols, Charles P. ....        | Corps of Engineers. ....                                  | Aug. 20, 1895             |
| Hagadorn, Charles B. ....      | Seventeenth Infantry .....                                | Aug. 20, 1894             |
| Butler, Matthew C., jr* .....  | Seventh Cavalry .....                                     | June 15, 1893             |
| Bethel, Walter A. ....         | Third Artillery .....                                     | Aug. 20, 1894             |
| <i>Second lieutenants.</i>     |   |                           |
| Todd, Henry D., jr. ....       | Third Artillery .....                                     | Aug. 20, 1894             |
| Mauldin, Frank G. ....         | do .....  | Aug. 20, 1896             |
| Crabbs, Joseph T. ....         | Eighth Cavalry .....                                      | Sept. 7, 1896             |
| Pierce, Palmer E. ....         | Sixth Infantry .....                                      | Aug. 20, 1895             |
| Blakely, George. ....          | Second Artillery .....                                    | Aug. 20, 1896             |
| Hoffer, Jay E. ....            | Third Artillery .....                                     | Do.                       |
| Smith, William R. ....         | First Artillery .....                                     | Nov. 11, 1895             |
| Reeve, Horace M. ....          | Third Infantry .....                                      | Aug. 20, 1895             |
| Cruikshank, William M. ....    | First Artillery .....                                     | Aug. 28, 1895             |
| Rice, John H. ....             | Third Cavalry .....                                       | Aug. 20, 1895             |
| King, David M. ....            | Fourth Artillery .....                                    | Aug. 20, 1896             |
| Hazzard, Samuel C. ....        | First Artillery .....                                     | Aug. 20, 1895             |
| Smedberg, William R., jr. .... | Fourth Cavalry .....                                      | Aug. 20, 1896             |
| Honey, Robertson. ....         | Fourth Artillery .....                                    | Aug. 20, 1896             |
| Babcock, Walter C. ....        | Eighth Cavalry .....                                      | Do.                       |
| Cassatt, Edward B. ....        | Fourth Cavalry .....                                      | Do.                       |
| Williams, James M. ....        | First Artillery .....                                     | Aug. 20, 1895             |
| Joyes, John W. ....            | Fifth Artillery .....                                     | Aug. 20, 1896             |
|                                |   | Do.                       |

\* Relieved from duty at the Military Academy September 12, 1896.

## TROOPS.

*Battalion of cadets.*

Lieut. Col. Samuel M. Mills, captain, Fifth Artillery, commanding.  
 Company A, First Lieut. Robert L. Howze, Sixth Cavalry, commanding.  
 Company B, First Lieut. William H. Allaire, Twenty-third Infantry, commanding.  
 Company C, First Lieut. Granger Adams, Fifth Artillery, commanding.  
 Company D, First Lieut. Willard A. Holbrook, Seventh Cavalry commanding.

*Hospital corps.*

Maj. George H. Torney, surgeon, U. S. A., commanding.  
 Capt. Charles F. Mason, assistant surgeon, U. S. A.  
 Capt. Charles Willcox, assistant surgeon, U. S. A.

*United States Military Academy detachment of army service men.*

Capt. John B. Bellinger, A. Q. M., quartermaster, commanding.  
 First Lieut. William Weigel, Eleventh Infantry.

*Company E, battalion of engineers.*

Capt. James L. Lusk, Corps of Engineers, commanding.  
 First Lieut. E. Eveleth Winslow, Corps of Engineers.

*United States Military Academy detachment of ordnance.*

Capt. Lawrence L. Bruff, Ordnance Department, commanding.  
 First Lieut. John T. Thompson, Ordnance Department.

*United States Military Academy detachment of cavalry.*

Capt. James Parker, Fourth Cavalry, commanding.  
 First Lieut. Robert L. Howze, Sixth Cavalry (on temporary duty).  
 First Lieut. Matthew C. Butler, jr., Seventh Cavalry. Relieved from duty at the Military Academy September 12, 1896.

*United States Military Academy band and detachment of field music.*

Capt. Wilber E. Wilder, Fourth Cavalry, commanding.

HEADQUARTERS U. S. MILITARY ACADEMY,  
*West Point, N. Y., September 14, 1896.*

Official:

W. E. WILDER,  
*Captain, Fourth Cavalry, Adjutant.*

## B.

GENERAL ORDERS, }  
 No. 1. }

HEADQUARTERS U. S. MILITARY ACADEMY,  
*West Point, N. Y., January 11, 1896.*

The acting superintendent announces with sorrow to the officers and cadets of the United States Military Academy the death of the Rev. William M. Postlethwaite, D. D., chaplain and professor of history, geography, and ethics of the United States Military Academy, at West Point, N. Y., at 9.30 a. m., on the 10th instant.

Professor Postlethwaite graduated from Kenyon College, Gambier, Ohio, in 1862, and from the seminary at same place four years later. He immediately entered the ministry and labored faithfully in his chosen profession until appointed to the chaplaincy and professorship at the United States Military Academy, December 21, 1881.

His services at the Academy since that date have been faithful, zealous, and efficient, and form a bright page in the history of the institution. His sterling sense of duty, his frank, manly character, together with his genial and sympathetic nature, gave him ready access to the friendship and confidence of his associates and pupils. These admirable traits greatly enlarged his opportunities and usefulness for good in every relation.

The general attendance and voluntary interest in religious exercises of every kind during his entire service at the Military Academy have constantly borne testimony

to his great moral influence with cadets. It is one of the noblest results of his service that this beneficent influence continues and lives after him to the increasing advantage of the institution and of the Army.

He labored conscientiously and unselfishly for the good of the Academy. In his death his pupils lose an able teacher, considerate friend, and safe counselor, his colleagues a capable and ever-courteous associate, the country a ready and devoted servant.

The officers and professors and the officers of the battalion of cadets will wear the usual badge of military mourning upon the sword hilt for the period of thirty days.

By order of Lieutenant-Colonel Mills:

W. E. WILDER,  
*Captain, Fourth Cavalry, Adjutant.*

### C.

GENERAL ORDERS, }  
No. 8. }

HEADQUARTERS U. S. MILITARY ACADEMY,  
*West Point, N. Y., April 22, 1896.*

The Superintendent has to make to the officers and cadets of the Military Academy the painful announcement of the death yesterday at Fort Monroe, Va., of James Mercur, professor of civil and military engineering.

Professor Mercur was graduated at the Military Academy with distinguished honor June 18, 1866, and appointed to the Corps of Engineers. He served as assistant engineer upon the survey of the Northern Lakes, October 1, 1866, to August 23, 1867; at the Military Academy as instructor in philosophy, August 31, 1867, to July 31, 1872; with the engineer battalion at Willets Point, N. Y., August 3, 1872, to July 31, 1876; as assistant engineer in the removal of obstructions at Hell Gate, New York Harbor, and upon other civil works and upon fortifications in New York, August 5, 1876, to June 14, 1881; in charge of various river and harbor improvements, defensive works, and surveys in Virginia and the Carolinas, June 15, 1881, to March 31, 1884; and of similar works in New York, April 1, 1884, to September 29, 1884. The great ability, sound judgment, and high personal character displayed by him in all of these varied duties led to his appointment in 1884 to the chair which he afterwards so nobly filled and which he has just vacated by death.

The Military Academy has never sent out a graduate exemplifying to a higher degree the qualities of truth, courage, loyalty, faith, and charity, which it aims to cultivate; nor has it ever received back, to aid in the transmission of its traditions to others, any more perfect character than James Mercur. Firm but gentle, acute but charitable, critical but sympathetic, he commanded the love and confidence of all. To the cadet he was the kind and lucid teacher, to his colleagues the genial and clear-headed friend, to his commanding officer the able and trusted support. To all of these his death is a severe personal loss.

The officers of the Academy and of the battalion of cadets will wear the usual badge of mourning upon the sword hilt for thirty days.

By order of Colonel Ernst:

W. E. WILDER,  
*Captain, Fourth Cavalry, Adjutant.*

### D.

UNITED STATES MILITARY ACADEMY,  
*West Point, N. Y., June 25, 1896.*

SIR: In accordance with the provisions of the circular dated October 3, 1895, Headquarters United States Military Academy, I have the honor to submit the following report:

#### 1. HISTORICAL SKETCH OF THE DEPARTMENT OF NATURAL AND EXPERIMENTAL PHILOSOPHY, UNITED STATES MILITARY ACADEMY.

Its origin is to be found in the act of Congress, April 29, 1812, reorganizing the Military Academy, where provision was made for one professor and one assistant professor of natural and experimental philosophy. From the time of the foundation of the Academy, in 1802, till the passage of this act, natural philosophy constituted no part of the course of instruction, although occasionally some of the more advanced students were taught mechanics and practical astronomy from "Enfield's Institutes of Natural Philosophy."

Four professors have administered this department since its establishment, and its history can probably be best outlined by considering each administration in succession.

(a.) *Lieut. Col. Jared Mansfield, Corps of Engineers, professor from October 7, 1812, to August 31, 1828.*

Mansfield, after graduating at Yale College, taught mathematics, navigation, and the classics at New Haven and at Philadelphia. For the purpose of securing his services at the Military Academy, he was appointed captain of engineers in the Army May 3, 1802, and from this date till November 14, 1803, he served as acting professor of mathematics. He was then detached to do duty as surveyor-general of Ohio and the Northwest Territory, in which occupation he was engaged until October 7, 1812; in the meanwhile he had resigned his Army commission July 23, 1810. Although his appointment as professor occurred October 7, 1812, he did not enter upon his duties until April 10, 1814.

But little information is obtainable from the staff records in regard to the details of instruction in this department during the administration of Mansfield. The regulations approved July 2, 1816, by Secretary of War Crawford, provided for "Philosophy, embracing mechanics, hydraulics, pneumatics, optics, chemistry, magnetism, and astronomy." The standard of proficiency, though not very high, was apparently somewhat difficult of attainment, due mainly to a lack of competent instructors; for, 9 members of the class examined in June, 1818, were required to review the course in philosophy, 6 to review it with the condition of passing it at the coming winter examination, and 3 were turned back to the next class, making 18 out of a class of 38 not well qualified.

In the January examination (1819) only 18 were found well qualified in Gregory's mechanics, 7 imperfectly qualified, 7 deficient, and 6 grossly deficient. From this time on the class was so arranged that the better qualified men were placed in the first section and the others in the second section. The sections contained 19 or 20 men each and recited two hours. Up to the summer of 1817 the instruction in philosophy is stated to have been of the most elementary character, "not a few graduates leaving the academy without having had any instruction whatever therein, and that the only apparatus in the professor's possession to illustrate his subject were a field transit and a clock."

"Enfield's Institutes of Natural Philosophy" appears to have been the first text-book used in this department for instruction, but in the fall of 1818 a treatise on mechanics, by Dr. Olinthus Gregory, of the Royal Military Academy, Woolwich, was introduced and taught to the first section of the class. It was apparently too difficult for the second section, for we find recorded "Cadet W. Morris, at present of the third, but late of the second class (having been reduced on account of inability to proceed in Gregory), prayed to be restored to the second section of the second class on the ground that that section would hereafter study only Enfield, in which he gave assurances of capacity to succeed."

Owing apparently to the unsatisfactory progress made in the study of philosophy, a committee consisting of Professor Mansfield and Assistant Professor Douglass was appointed to revise the course; their report approved, and adopted by the academic board April 19, 1819, was as follows:

"First. The first section, as now organized, to study and review the mechanics of Dr. Gregory, embracing the subjects of statics, dynamics, hydrostatics, hydrodynamics, and pneumatics in the first volume; the practical considerations in the second volume, and the description and theory of some of the most important machines. This part of the course to commence on the 1st of September and end at the commencement of the winter examination of this class in January.

"Second. The second section in the same time to go through with a corresponding, but more easy and familiar, course of mechanics, including hydrostatics, hydraulics, and pneumatics. The text-book for this purpose it has not been in the power of the committee as yet to decide certainly upon. They have reason to believe, however, that Parkinson's Mechanics, of which they have ordered a copy from England, will be found suitable and they propose a temporary course out of the books now on hand until this point can be determined.

"Third. From the close of the winter examination to the 20th of February following, sooner or later, both sections to study Hauy's Philosophy; this will comprehend the subjects of optics, electricity, galvanism, magnetism, and meteorology.

"Fourth. The remainder of the academic year, with the exception of one month for reviewing, to be devoted by both sections to a course of descriptive, physical, and practical astronomy, omitting only the more profound parts in the course for the second section. On this subject the committee have hopes of finding a suitable text-book in Woodhouse's Astronomy, a copy of which will be examined as soon as it can be received from England, and reported on in season for the next class.

"Fifth. Should the genius and capacity of the first section be such in any instance as to afford a redundancy of time, the committee propose to conduct them through the more valuable portions of Newton's *Principia* (Davis's edition)."

On the 29th of January, 1820, the academic board adopted a definite course in philosophy based upon the treatise of Dr. Gregory, as follows:

"*Statics*.—Equilibrium of forces; center of gravity; mechanical powers; strength and stress of materials; theory of arches.

"*Dynamics*.—Principles of uniform and variable motion; laws of falling bodies; motion of projectiles in vacuo; vibrations of pendulum; central forces and theory of planetary motion; percussion, and the phenomena of rotation of bodies.

"*Hydrostatics*.—The pressure of fluids; specific gravity; theory of the stability of vessels.

"*Hydrodynamics and hydraulics*.—Theory of effluent fluids; principles for estimating the force, motion, and resistance of fluids; application of these principles to the construction of water mills and other hydraulic works.

"*Pneumatics*.—Compression, density, and elasticity of air; theory of acoustics; constitution of the atmosphere and physical causes of winds, etc.; measurement of heights by the barometer; theory of pumps.

"*Machinery*.—Application of philosophical principles in the construction of the steam engine, pile engine, etc., and to the construction of the powers and maximum effects of machines. Experimental investigation of the properties of heat;

"Experimental investigation of the principles of common and galvanic electricity;

"Experimental investigation of the principles of magnetism.

"*Optics*.—General principles of light and colors; refraction and reflection of light; theory and use of lenses; construction of optical instruments as telescopes, microscopes, etc.

"*Astronomy (descriptive and physical)*.—General account of the solar system and of the celestial and terrestrial spheres; motions of the earth and the various appearances and vicissitudes arising from them; solution of problems on the globes; figure of the earth; equation of time; motions, phases, and irregularities of the moon; eclipses of the sun and moon; theory of the tide; physical causes of the motion of the planets, satellites, and comets, and determination of their orbits; the fixed stars; theory of the connections arising from parallax, refraction, aberration, precession, and nutation.

"*Practical astronomy*.—Application of spherical trigonometry to astronomy; use of instruments and tables; observations for time, azimuth, etc.; different methods of determining geographical points; application of astronomy to navigation, and the construction of maps.

"The instruction in natural philosophy, like that in mathematics, will be proportional in extent, and in the manner of conveying it to the rank and capacity of the different sections, reserving always the more abstruse and profound operations under each particular head to the higher sections."

This was certainly a very comprehensive course for the time, and the text-book employed was a remarkably good one.

It seems, however, that it proved too difficult for the lower section, as Bridge's *Mechanics* was adopted January 22, 1824, for the lower sections. Professor Mansfield was much beloved and respected by the cadets and deemed an efficient instructor. He was extremely nearsighted and of such a delicate structure as to convey the idea of decrepitude; his manner was very gentle, and as a professor he was by no means rigid. As an astronomical observer he was quite renowned, and he had been engaged, before coming to the Academy, in extensive surveys of boundary lines.

(b) *Edward H. Courtenay*, second lieutenant of engineers, acting professor from September 1, 1823, to February 16, 1829, and professor from February 16, 1829, to December 31, 1834.

The staff records embracing the period of Professor Courtenay's administration are lacking in definite information in regard to the text-books used by the different sections of the class, and the times of their adoption by the academic board. For example, no record has been found of the introduction of Francoeur's *Traité Élémentaire de Mécanique*; yet it is certain that the first section studied this book in the fall of 1830, and presumably for some years thereafter; for in General Cullum's *Biographical Register of the Graduates of the Military Academy*, in Courtenay's record, it is stated that "the lower sections of the class studied Boucharlat's *Traité de Mécanique*, which Courtenay in 1833 translated into English and made additions and emendations to adapt it to the use of the cadets of the Military Academy." The French edition of Boucharlat was adopted as a text-book June 23, 1831, and the translation on the 12th of June, 1833. The only other changes in text-books were Brewster's *Optics*, adopted June 16, 1832, and Gummere's *Astronomy*, in place of Farrar's, June 16, 1834.

The points of special importance to be noted during the administration of Professor Courtenay are that the text-books used were of a very high grade, involving the use

of the calculus, and thus permitting the adoption of the analytic methods of investigation in place of the geometrical previously employed, and the evolution of a course especially adapted to the needs of a military education. Courtenay was peculiarly fitted for this task, for he was exceptionally able, erudite, and clear in his methods of instruction. It was extremely unfortunate for the interests of the Academy that the needs of his growing family forced him to seek more remunerative employment, for it is certain that his remarkable attainments would have left their impress upon its course of instruction, as strikingly as did those of his colleague, Mahan, in the engineering course.

(c) *William H. C. Bartlett, second lieutenant of engineers, acting professor from November 22, 1834, to April 20, 1836, and professor from April 20, 1836, to February 14, 1871.*

The administration of Professor Bartlett, extending as it did for more than thirty-six years, exhibits some abrupt changes of methods of instruction and of text-books until about the year 1857, when the course had been crystallized to satisfy his conception of its scope and character. Upon his recommendation the study of electricity was omitted from the course of natural philosophy February 12, 1839. Bartlett's treatise on optics replaced Brewster's February 26, 1839, and Roget's treatises on magnetism, electro-magnetism, and electro-dynamics replaced the "Library of useful knowledge" from which these subjects had been previously taught.

The "Programme of the course of instruction in natural and experimental philosophy," adopted by the academic board March 13, 1840, is given at length in volume 3 of the staff records. It is sufficient here to state that this programme is essentially the same as the tables of contents of Courtenay's Boucharlat, Bartlett's Optics, Gummere's Astronomy, and the treatises of Dr. Roget. Apparatus for the experimental illustration of the principles of natural philosophy was purchased from time to time, so that by the date of the establishment of the course referred to above Professor Bartlett was enabled to give instructive experimental lectures to his classes. The Ertel transit instrument, 72-inch focal length, 52 lines (French) aperture, was ordered November 7, 1842, and after completion was mounted in the east tower of the new library and observatory building. Subsequently a Fitz equatorial and a Troughton mural circle were mounted in the middle and west towers, respectively, thus providing an excellent equipment for observational astronomy.

For more than thirty years, and up to the autumn of 1850, the philosophical course had been based upon a knowledge of the differential and integral calculus, but for some reason that does not appear Bartlett recommended a text-book which he had prepared based upon Poncelet's work entitled "Synthetical Mechanics," to replace Courtenay's Boucharlat. This recommendation was approved and the book adopted September 6, 1850. It was rightly considered by some members of the academic board as a lowering of the high standard heretofore maintained at the military academy in the scientific courses. When "Bartlett's Optics and Acoustics" was proposed as a substitute for "Bartlett's Optics," September 13, 1852, the professor of engineering and the instructor of practical engineering submitted written papers in opposition to this change (see staff records, September 27, 1852), basing their objections upon the omission of the analytical methods of treatment and the use of the calculus in the new text-book. Notwithstanding these protests the academic board recommended the adoption of the book, and the War Department approved the action of the board. The following resolutions, submitted by the professor of engineering, were made a matter of record:

*Resolved, first,* That the present academic board fully concur in the views and opinions expressed in a report of the academic board October 18, 1843, on the subject of the scientific instruction in the United States Military Academy, viz, 'With these views, and in the firm belief that the Government, having the opportunity of securing from a large body of the youth of the country, ought and is disposed to fix a high standard of talent and attainments for those who would secure the important advantages resulting from a term of study at the Academy, the board are unwilling to unite in any recommendation that a less extensive scientific course than the one now taught should be adopted for any of the cadets.'

*Resolved, second,* That, in accordance with the spirit of the language above cited, the present board regard the method of the higher analysis as the best means of treating most of the subjects embraced in the branches of mechanics, optics, etc., and regard them as indispensable elements in the composition of any text-books for instruction in these branches, to the end that such books may be, in the spirit of paragraph 11, United States Military Academy Regulations, 'the class books best suited for instruction in the department of natural and experimental philosophy.'

*Resolved, third,* That the attainments made by the cadets in analytical geometry and the differential and integral calculus are sufficient to enable them to acquire understandingly the elements of natural and experimental philosophy as treated by these methods in the best text-books on these subjects."

Though no formal action was taken on this paper, it, in connection with the protests of those members of the academic board who had pronounced in favor of a higher standard, undoubtedly had a strong influence in bringing about a marked change in the character of the text-books, for on the 29th of August, 1853, the academic board, on the recommendation of the professor of philosophy, adopted the following resolution:

"Resolved, That it is hereby recommended to the Secretary of War to authorize the use of 'Bartlett's Elements of Analytical Mechanics' as a text-book upon mechanics in the place of the one now in use, the reason for this recommendation being that in the new work the calculus is employed as the means of discussion, whereas in the old one the subject is treated mostly by the aid of geometry."

"Gummere's Astronomy" was superseded by "Bartlett's Spherical Astronomy" September 5, 1855, and this was the last change of text-books that occurred during Bartlett's administration, except to replace from time to time an old edition by a new one. A very important modification of the course was made, however, December 8, 1856, upon the recommendation of a committee of the board by which the subject of electricity was transferred to the department of chemistry on the ground that "it was more immediately connected with chemistry than with the course where it is now taught, and in the expectation that in this way time may be found to make the present course of electricity more complete."

Professor Bartlett's long service at the Military Academy ended February 14, 1871, by his voluntary retirement at the age of 66 years. He left a permanent impress of his marked ability upon his course of instruction and enriched it with certain important characteristics that are certain to endure for many years. He possessed the rare faculty of perceiving essential and fundamental principles and of being able to formulate them by a mathematical expression of a single law from which the whole of analytical mechanics could be deduced. As early as 1853, in the preface to his work on analytical mechanics, he published this great generalization: "All physical phenomena are but the necessary results of a perpetual conflict of equal and opposing forces, and the mathematical formula expressive of the laws of this conflict must involve the whole doctrine of mechanics. The study of mechanics should, therefore, be made to consist simply in the discussion of this formula, and in it should be sought the explanation of all effects that arise from the action of forces." This law is now generally recognized as that of the conservation of energy, and too much credit can not be given to Professor Bartlett for the clear perception which enabled him to anticipate by so many years the introduction of this great law of generalization in the course of instruction at the Military Academy before it was adopted in the schools. He considered this as his greatest contribution to the course of instruction, and in this opinion the great body of his pupils heartily concur. Professor Bartlett had the gift of being able to engage the respect and affection of his pupils. He was very happy in his illustrative lectures, which were known as "experiments," and which he employed mainly to fix principles in the minds of his pupils. His mind was essentially analytic in character, but at the same time capable of enlarged generalization. In his later years he discarded those geometrical methods of proof which so markedly characterized the earlier years of his teaching, replacing them wherever possible by analytic methods. He left his department well equipped with apparatus for experimental illustration of the principles taught in his course for that time, and his successor found nothing that needed immediate modification in the course.

(d)—*Peter S. Michie, captain, Corps of Engineers, professor of philosophy from February 14, 1871, to the present time.*

The following brief outline of the successive changes will complete this historical sketch:

On the recommendation of a committee consisting of the professors of mathematics, philosophy, and engineering, appointed February 24, 1872, to "inquire and report whether any change of instruction can be made in the departments of mathematics, philosophy, or engineering the better to conform the instruction of either to the requirements of the others, and also to fix definitely what investigations and subjects in those branches of instruction shall be confined to the higher sections," a definite schedule was reported on the 6th of April and adopted. It embodied no change of text-books, but merely the omission of some of the more difficult subjects for the lower sections of the class. It is recorded in full in volume 8, Staff Records, pp. 375 et seq. A committee consisting of the professors of chemistry, philosophy, and the instructor of ordnance and gunnery, appointed June 8, 1872, for a similar purpose relating to those departments, recommended that "the subject of projectiles in mechanics" be transferred to the course in ordnance and gunnery.

On June 26, 1874, the ninth edition of Bartlett's Mechanics was adopted, for in this edition there were important modifications which adapted it better to modern

scientific usage, without sacrificing the excellent scientific treatment of former editions. Again, on June 10, 1876, Part 3 or Mechanics of Molecules was authorized to be taught in place of the corresponding parts of the text in "Optics and Acoustics."

The capability of the class to master the mathematical treatment of vibratory motion having been demonstrated by their success in the study of the mechanics of molecules led to the preparation of a text-book on wave motion relating to the principles of sound and light, which was submitted to the critical examination of a committee of the academic board, November 1, 1881, consisting of the professors of French, engineering, mathematics, and chemistry. The favorable indorsement of this book by the committee resulted in the substitution of it for Bartlett's Mechanics of Molecules and the Optics and Acoustics for use with the second class in the spring of 1882.

"Michie's Elements of Analytical Mechanics" superseded the corresponding parts of Bartlett's (Parts 1 and 4) June 21, 1886, and the second edition replaced the first August 29, 1887. Michie's "Hydrodynamics," adopted November 7, 1887, replaced Part 2 of Bartlett's Mechanics, which latter book ceased from this time to be a text-book at the Military Academy. The third edition of Michie's Mechanics was adopted September 4, 1888, which was subsequently superseded by the fourth edition.

The adoption of Professor Young's General Astronomy to be used in connection with Bartlett's Spherical Astronomy was approved February 5, 1889; and finally that part of the latter book which had been retained was superseded by "Michie and Harlow's Practical Astronomy" April 30, 1891, and the latter by its second edition March 16, 1893. An addition was made to the course of instruction, by reason of these changes, in the following provision: "Practical instruction shall be given to the first class in the use of astronomical instruments and in making observations for time, latitude, longitude, and true meridian, from 9 to 10.30 a. m., and from 11.30 a. m., to 12.15 p. m., and on such nights as are favorable for observations from 8 p. m., to 10.30 p. m., on every week day from July 5 to July 31, both inclusive."

In the opinion of the undersigned the following important changes have been introduced into the course since the retirement of Professor Bartlett: The prominence given to the fundamental law of energy as the controlling law of all physical phenomena; the clearing up of many ideas that were vaguely impressed upon the minds of the cadets; the total excision of the idea that inertia can properly be regarded as a force and which was the source of a great deal of trouble; and a more systematic treatment of each branch of the course so as to connect them more intimately with the preliminary definitions and the fundamental equation. That these are decided improvements is clearly indicated by results of examinations in recent years as compared with former ones and the fact that it is not now impossible for those cadets who pass the mathematical standard to succeed in the course in philosophy.

Other modifications that have proved valuable are, in giving a definite value to each subject of the course, and to examine and fix the standard of merit when the subject is completed, so that mechanics is completed in January, wave motion, sound, and light by the middle of March, and astronomy in June.

## 2. COMPLETE STATEMENT OF THE PRESENT COURSE.

(a) ANALYTICAL MECHANICS.—Text-book, "Michie's Elements of Analytical Mechanics," divided into the subheads of mechanics of solids, of fluids, and theory of machines.

*Mechanics.*—First. General definitions of matter, force, and motion; systems of physical units; stresses and motive forces and the laws of their composition and resolution; gravity, weight, and centers of gravity; graphical statics; work and energy; the fundamental law of the conservation of energy, its application to a free rigid solid, and the deduction of the equations of translation and rotation.

Second. Mechanics of solids: General theorem of energy applied to a single free body; laws of motion of translation; of motion of rotation; moments of inertia; momental ellipsoid; instantaneous axis; a rigid solid under impulsion; permanent and stable axes of rotation; a rigid solid under incessant forces; the gyroscope; impact; spontaneous rotation; constrained motion in translation and about fixed axes; equilibrium.

Third. Mechanics of a system of bodies: The potential; conservation of motion of the center of the system; conservation of areas and of moments; relative acceleration; differential equations of orbits, with illustrative examples; central forces and their laws; planetary orbits; the anomalies; the solar system; Kepler's laws and the law of universal gravitation.

Fourth. Theory of the simple mechanical machines: Resistances of friction and stiffness of cordage; the lever, balance, wheel and axle, the pulleys, inclined plane, wedge, screw, and cord.

Fifth. Mechanics of fluids: Definitions and classification of fluids; laws of perfect gases; fundamental equation of the mechanical theory of heat; differential equations of the specific heat; Boyle's, Charles', and Poisson's laws. Hydrostatics: Center of pressure; buoyant effort; specific gravity; equilibrium and stability of floating bodies. Hydrodynamics: General theorem applied and equations deduced for liquid and gaseous flow; steady flow; Bernouilli's and Torricelli's laws. Hydraulics: Viscosity; formulas for flow through mouthpieces; hydraulic machines; water wheels, turbines, pumps; barometer and barometric formula.

(b) WAVE MOTION, ACOUSTICS AND OPTICS.—Text-book, Michie's Elements of Wave Motion Relating to Sound and Light.

1. *Wave Motion*.—General definition of elasticity; deduction of analytical expression for elastic forces developed in a medium; surfaces of elasticity; waves and wave function; harmonic curves and their composition; wave interference and general principles relating to wave motion; plane waves; wave surface determined and discussed.

2. *Acoustics*.—Propagation of a disturbance in air; properties of sound and of the ear; musical intervals and scales; resonance; velocity of sound in different media and its modifications; general equation for vibratory motion of stretched string and its modifications; the corresponding relations for vibrations of rods and columns of different material deduced; harmonic vibration, and of plates and membranes.

3. *Optics*.—Assumed properties of the luminiferous ether, photometry; velocity of light. Geometrical optics: Deviation of light by plane and spherical surfaces; lenses and their properties; secondary foci of oblique pencils; spherical aberration; caustics; optical images; optical instruments; telescopes and microscopes and their magnifying powers. Physical optics: Solar spectrum and fixed lines; dispersion; color; absorption and emission; achromatism and chromatic aberration; rainbow; interference of light; colors of thin plates; diffraction and wave lengths of light; polarization of light, and phenomena resulting therefrom.

(c) GENERAL ASTRONOMY.—Text-book, Young's General Astronomy.

1. The doctrine of the sphere; definitions and general considerations; astronomical instruments; corrections to astronomical observations, as dip, parallax, semi-diameter, and refraction; dimensions and form of the earth, its rotation, mass and density; its orbital motion; precession, nutation and aberration; the calendar; the moon's distance, dimensions, mass, density, and orbital motion; its librations, phases and physical condition; the sun's distance, dimensions, mass, and density; sun spots; spectroscopic study of sun's light; study of sun's light and heat, and recent conclusions as to constitution of the sun; eclipses and occultations.

2. Geometrical illustration of central forces applied to planetary motions; lunar perturbations and tides; the planets, their motions, apparent and real; determinations of the diameters, masses, densities, rotation periods, etc.; the sun's horizontal parallax, and methods of computing it; comets, meteors, stars, clusters and nebulae.

(d) PRACTICAL ASTRONOMY.—Text-book, Michie's and Harlow's Practical Astronomy.

Explanation of the construction of solar, lunar, and planetary ephemerides; description and study of the field transit and its adjustments; determination of the instrumental constants; deduction of the equation of the transit in the meridian; determination of instrumental errors; time and equation of time; solar and sidereal intervals; problems of finding the clock error by meridian transits of stars and the sun; description of the sextant, its adjustments and errors; problems of time by single altitudes of a star and the sun; by equal altitudes; the form and dimensions of the earth; eccentricity of the meridian; the radii of the earth, lengths of a degree of latitude and longitude and the reduction of latitude; solution of latitude problems by circumpolars, by meridian altitudes, by circummeridian altitudes, by opposite and equal zenith distances, by Polaris and by equal altitudes of two stars; description of zenith telescope, and its errors, adjustments, and corrections; solution of longitude problems by portable chronometers, by telegraph, by lunar culminations and distances; the time of opposition and conjunction; the time of meridian passage; azimuths and the altazimuth instrument; declination of the magnetic needle; sundials and their construction; projection of a solar eclipse; the use of established forms for the practical solution of the foregoing problems in practical astronomy.

During a portion of the summer encampment practical instruction is given in the use of the sextant, field transit, and zenith telescope, to obtain the necessary data for the problems above referred to. At present this time is from July 5 to July 31, both inclusive.

(e) LESSONS IN EACH SUBJECT.—(1) The text on mechanics contains 362 octavo pages, and it is mastered in 50 advance lessons averaging 7 pages for each, 25 first-review lessons of about 14 pages each, and 20 general-review lessons preparatory to the examination. The usual practice is to advance 4 lessons and then to review them in 2. After the completion of these 6 lessons the class is brought together in the

lecture room, where the professor illustrates the principles contained in these lessons, by means of the apparatus provided for that purpose, in an informal lecture. As far as may be this apparatus is then taken to the different section rooms, to be used by the cadets themselves.

(2) Synopsis of lectures in mechanics:

(a) Introductory to the science; its fundamental concepts, assumptions, and definitions.

(b) Parallelogram of forces; methods of resolving and combining forces; bodies under stress, etc.

(c) Parallel forces, couples, moments and their composition and resolution.

(d) Impulsions and impact.

(e) Acceleration and laws of constant forces.

(f) Rotary motion, angular velocity, and acceleration.

(g) Constrained motion, spontaneous axis, pendulums.

(h) Machines.

(i) Laws of the gaseous state.

(j) Hydrostatics, buoyant effort, etc.

(k) Hydrodynamics, flow of liquids, Torricelli's and Bernoulli's laws.

(l) Air and water pumps, hydraulic ram, etc.

In addition to these, one or more sections, or the whole class is frequently brought into the lecture room from the recitation rooms to have some particular illustration given, as the necessity arises.

(3) The text on wave motion, sound, and light contains 272 pages, and to it is assigned 32 advance, 14 first-review, and 8 general-review lessons; the advance lessons being about 8 pages long. The same method of progress is pursued in this as in mechanics.

(4) Lectures in sound and light:

(a) Methods of transfer of vibratory energy; properties of sound; vibrational numbers.

(b) Musical intervals, consonant and dissonant; diatonic and harmonic scales; sympathetic resonance.

(c) Scheibler's tonometer; analysis and composition of tones; use of Helmholtz's resonators.

(d) Harmonic overtones; velocity of sound in different material; organ pipes.

(e) Vibrations of plates, bells, strings, rods, etc.; Lissajous's curves.

(f) Theory of beats and resultant sounds; phenomena of interference.

(g) Graphical and optical methods of the study of sound.

(h) Introductory to light; pencils, beams, and formation of images through small apertures.

(i) Reflection and refraction of light by prisms, lenses, and reflectors.

(j) Determination of focal distances; caustics; astigmatism.

(k) Telescopes, microscopes, and the cameras.

(l) The solar spectrum; color by dispersion and diffraction; absorption.

(m) Fluorescence; achromatism; the rainbow.

(n) Interference of light by Fresnel's mirrors; phenomena of diffraction.

(o) Polarization by double refraction, by reflection, refraction, and by the Nicol prism.

(p) Interference of polarized light and production of color.

(q) Uniaxal and biaxal crystals, rotatory polarization and saccharimetry.

(5) The general astronomy contains 526 pages, and to it is assigned 26 advance lessons, 10 first-review, and 6 general-review lessons. Several general lectures, with stereopticon illustrations, are given during the time of its study.

(6) Practical astronomy, 182 pages of text, is accomplished in 16 advance, 6 first, and 5 general-review lessons. During this period the field astronomical instruments are set up in the lecture room, where the cadets are instructed in their use and purpose. Ten problems, with data obtained from observation, are given out for solution, to determine the mean solar and sidereal clock errors, latitude, and longitude of the place of observation.

(7) Hours of study, etc.: In the department of philosophy the lessons are so proportioned as to require from three to three and one-half hours of study for preparation for each lesson and one and one-half hours for recitation in the section room. There are six recitations per week throughout the term.

### 3. ORGANIZATION OF THE DEPARTMENT OF PHILOSOPHY.

One professor, one assistant professor, and one or more instructors (there are now two), depending upon the number of cadets in the class. Each section contains not more than 12 cadets, and each instructor has charge of two sections, thus requiring of him three hours' personal instruction daily. To the assistant professor it is usual to assign the instruction of the first and last sections, and to the

other instructors the remaining sections, according to their rank. In addition to the instructors above mentioned the officer in charge of the observatory conducts the instruction in practical astronomy, under the direction of the professor of philosophy.

#### 4. DESCRIPTION OF A RECITATION, ETC.

The section rooms assigned to the department of philosophy are large and well ventilated, furnished with individual desks and seats for the cadets. Blackboards for 12 men line two walls of the room. The instructor sits on a raised platform and is in his place before the section enters the room.

Each cadet, upon entering, takes the position of a soldier at the desk assigned to him, and after the section-marcher has reported to the instructor he then takes his seat. The lesson for the next day is then announced, it having been previously recorded on the blackboard behind the instructor's desk. The question is then put, "Are there any questions on the lesson of the day?" The utmost freedom is permitted for every member of the section to make known now every difficulty he has experienced in studying his lesson. The instructor, who is accomplished in his art, will, by a judicious explanation or a helpful suggestion, seek to lessen the step by which the student may be able to pass from what he comprehends to that which was before obscure, the aim being to make the student feel that the elucidation has in the main been accomplished by himself. By this means the self-reliant faculty is cultivated. After all the difficulties have been satisfactorily removed the instructor proceeds to portion out the lesson of the day and of the previous day among ten members of the section, reserving the remaining two for a searching examination by questions. The ten are sent to blackboards, where first they are required to write their names in the upper right-hand corner, and then to put their work down in a neat and orderly manner and in logical sequence, so that the instructor can, by a glance, note their progress and proficiency. When the cadet is ready to recite he takes up a pointer, faces the instructor, and assumes the position of a soldier. This is a general rule which, however, is departed from when a portion of the section-room time is to be employed in working out practical examples or in using the apparatus upon the experimental table; in such cases he is permitted to leave his blackboard after his work is made ready for recitation, and when his turn comes to be called on he resumes his place and position.

The manners of the section room are polite, formal, and soldierly. The instructor opens with, "Are you ready, Mr. Blank?" then, "Proceed, sir." The cadet then begins, "I am required to demonstrate the" (here follows the proposition given him). He then proceeds in a logical manner to point out the data he may assume, the successive steps in his reasoning, and the conclusions which legitimately follow. If he be perfect he will meet the cross-examination of his instructor at every point, and will then be entitled to the maximum mark on the lesson of the day. The marks are recorded in a section book kept by the instructor, and at the end of the week are transferred to a weekly report made out by him and submitted to the Superintendent of the Academy through the head of the department. These reports are open to the inspection of the cadets on the following Saturday, and they can then compare their standing with that of their comrades in the same section and in different sections.

In assigning subjects for recitation, the general practice followed is to give them out in such a way as to impress the cadets that strict impartiality is the rule, and that each shall have about the same task, the main thing being to secure from each the full time for study upon the lesson of the day and to make the penalty of negligence so severe as to be almost prohibitory. In delineations upon the blackboard colored chalks are used, so that the drawings will exhibit a neatness as well as an intimate knowledge of the subject. The head of the department employs the three hours during which the recitations continue in visiting the different sections, so that he may thoroughly examine at least twice a week every man in the class. His purpose is to keep himself well informed of each man's progress, to study their characters, to encourage the modest, and to temper the choleric and presuming. He consults freely with his assistants upon the proper transfers from one section to another, and in case of nonagreement defers action until further evidence brings concord of opinion.

#### 5. WEEKLY CLASS REPORTS, TRANSFERS, ETC.

As previously stated, the weekly class reports are submitted to the Superintendent by the head of the department. Upon these are also recorded the progress made by the sections during the week and any recommendations of the professor for transfer. These he explains to the Superintendent, who, if the reasons commend them, so orders, and this order is published to the battalion of cadets at the next parade. The cadets so transferred, without further notice, join their new sections.

## 6. EXAMINATIONS.

The character of examinations, whether they are to be written or oral, has wisely been left to the decision of the head of the department, and while written examinations have been tried in the department of philosophy, in the opinion of the present head the oral method is much the better when the method of instruction is considered. By this method his colleagues on the academic board are kept informed of the progress of the department, the attainments of the instructors, and the thoroughness of instruction; besides these advantages, the opportunity of a close cross-examination upon doubtful points can be had and thus bring out the mental operations of the pupil, an advantage which a mere written test does not afford. In cases of doubtful proficiency the rule of the academic board is to subject such cases to a thorough written test after a doubtful oral examination. The subjects selected for an oral examination cover the entire course, and to make the choice impartial, they are drawn by lot by each cadet as he is called up. The weight of each oral examination is equal to that of five ordinary recitations. To determine the relative standing of the class in each subject of the course, the following method is pursued: To the aggregate obtained on the advance and first review add double the marks of the general review, and to this add five times the examination mark. The standard for proficiency has of late years come to be considered to be two-thirds of the possible maximum, especially if this be the case on the general review.

## 7. CRITICAL REVIEW OF THE PRESENT COURSE AND INSTRUCTION.

The undersigned, when he was appointed a cadet, was old enough to appreciate the value in mental training and the sound educational advantages derived from the methods of instruction pursued at the Military Academy. Graduating during the war, he found himself within a fortnight in charge of important military duties where he was thrown upon his own resources, and in every case he found that the methods of reasoning in which he had been trained here and the self-reliance which had been inculcated in him by the methods of study were sufficient to solve his problems to the satisfaction of his superior officers. Since those days he has had a long experience as a teacher, and has kept constantly in mind his own efforts as an ambitious young officer as well as the purpose of the Government in establishing this institution. He believes that the elements of character developed in the student by the course of instruction at the Military Academy are increased confidence in his own powers, reliance on his own individual effort, and capacity to test accurately his sources of information. These elements in the development of a man are of essential importance in a profession where he may be called upon in emergencies to exercise self-control and to meet manfully unforeseen difficulties. To accomplish these purposes the daily tasks are made of the requisite strength so as to demand all the study time allotted, and thus are secured the invaluable mental effort and discipline derived from hard study; second, the daily tasks are made progressive, based upon acceptable fundamental principles, continually exercise the reason, beget a growing confidence, and establish a belief in his ability to master every new difficulty; and finally, when the course is completed, the student finds himself equipped with a satisfactory knowledge of the essential principles of the branch of science, to which he may add by individual study without feeling the necessity of reconstructing his foundation. These the undersigned believes to be the true governing principles of all sound education.

Upon beginning the course in philosophy last September it was ascertained that few of the members of the class had studied physics. The improvement in mental strength, as exhibited at their final examination in June, was very marked, and I have not the slightest hesitation in affirming that the two courses of chemistry, chemical physics, etc., and philosophy, which together cover ten branches of physics, are to be credited with a substantial portion of this development. The course in philosophy has grown from the time of its first establishment, keeping pace with each new development of scientific truth and discarding that which could not stand the test of experience, and yet has always maintained a conservative character. It may be said, in conclusion, that, taking into consideration the object of the Military Academy, it does not seem possible to suggest any material change in the methods of instruction, the subjects taught, or appliances of instruction that would prove of substantial benefit.

Very respectfully, your obedient servant,

P. S. MICHIE,  
*Professor of Philosophy, U. S. M. A.*

The ADJUTANT, UNITED STATES MILITARY ACADEMY,  
*West Point, N. Y.*

## E.

DEPARTMENT OF DRAWING, U. S. MILITARY ACADEMY,  
*West Point, N. Y., July 10, 1896.*

SIR: In conformity with the wishes of the Superintendent as expressed in your communication of October 3, 1895, relative to "a full, definite, and concise account of studies and methods of instruction" at the Military Academy, I have the honor to submit the following relating to the department of drawing:

## HISTORICAL SKETCH.

The subject of drawing is the second one to be mentioned during that period when the germ of the Military Academy was in process of creation by legislative acts of Congress. By the act of February 28, 1803, fixing the military peace establishment of the United States, section 2, the President of the United States is "authorized to appoint one teacher of the French language and one teacher of drawing, to be attached to the Corps of Engineers, whose compensation shall not exceed the pay and emoluments of a captain in the Army." The act of April 29, 1812, making further provision for the Corps of Engineers, section 2, gives explicit definition of the Military Academy and its personnel as consisting "of the Corps of Engineers and the following professors, in addition to the teachers of the French language and drawing already provided," etc.

The first mention of drawing as an organic "department" of instruction is in the appropriation act of March 25, 1826, making appropriation "for articles required for the mathematical, drawing, chemical, and mineralogical departments." From that date on, this, with other departments of instruction, is regularly appropriated for in the annual acts for the Military Academy. In the act of March 2, 1837, there is appropriated \$800 "for a painting room for the professor of drawing." The professorship, however, was created by the act of August 8, 1846, section 3, enacting "That the teacher of drawing and the first teacher of French at the Military Academy shall hereafter be, respectively, professor of drawing and professor of the French language." The act of September 16, 1850, established the pay of the professor of drawing at \$1,500 per annum, and that of the following year defined this as in lieu of the pay proper and allowances received under the provisions of the act of April 12, 1812.

By the act of March 3, 1855, the pay of the professorship was placed on the same footing as that of the other professors of the Military Academy.

The course in drawing commences with the appointment of Francis Desiré Masson as teacher in that branch in connection with the French language, under the provisions of the act of February 28, 1803. In September, 1808, he was succeeded by Mr. Christian E. Zoeller, a Swiss of limited education, who seems to have been unequal to the requirements of his position. At the end of April, 1810, he gave up the office, but was reappointed July 1, 1812, there being no incumbent during the disorganization of the Academy in the interim. Mr. Zoeller was succeeded January 5, 1819, by Thomas Gimbrede, a Frenchman of eccentric character, who was reputed to be a painter of miniatures previous to his appointment. Work now extant executed by him shows him to have had but little ability even in the stiff and dry academic methods of that time. In 1833 the distinguished artist, Charles Albert Leslie, was induced to accept the position after the death of Mr. Gimbrede, December 25, 1832. Mr. Leslie, who was appointed March 2, 1833, was of American parentage, although born in England. From the age of 5 to 17 he lived in Philadelphia, but after that period his life belongs to the history of English art. The dry and rigid environment of a military school in a country destitute of art could not but be distasteful to a man of Leslie's temperament and education, and his stay was therefore exceedingly brief. In June of the same year he was succeeded by Robert Weir, an American artist who had already achieved distinction, and who was destined to take honorable place among the American painters of the first half of the nineteenth century. Mr. Weir was born in New Rochelle, N. Y., in 1803; studied in Italy from 1824 to 1827, and at the time of his appointment had a studio in New York City. As teacher of drawing Mr. Weir became a member of the academic board of the Military Academy August 8, 1834, his long and honorable career in this institution closing with his retirement July 25, 1876, after forty-two years of continuous service. He was succeeded at this time by Charles William Larned, the present incumbent, then first lieutenant, Seventh Cavalry, acting assistant professor in the department of drawing, a graduate of the Military Academy of the class of 1870.

During the early period of the Academy—from 1802 to 1810—the course in drawing, like that of other departments, appears to have been of a very elementary character, confined to the use of instruments, such as they were, with a little topography and fortification drawing. The regulations of May 22, 1816, define the course as consisting of the drawing of figures, fortifications, and topographical plans, but

the demoralization of the Academy during the two subsequent years made all instruction abortive until the period signalized by the appointment of Colonel Thayer to the superintendency of the institution. At the beginning of his administration instruction in the use of pen and ink, and color, and the use of surveying instruments in the field was nominally given by Mr. Zoeller, but under existing conditions must have been both crude and ineffectual. Under the stimulating influence of the great Superintendent, however, work in this department soon took on a new character and embraced a much wider field, covering both figure and landscape work in pencil and ink, crayon, and color, and all forms of topographical drawing. In 1818 the relative count of drawing was as follows: Drawing, 1; mathematics, 2; descriptive geometry,  $\frac{1}{2}$ ; engineering and art of war, 2; French, 1; natural philosophy, 2; drill and discipline,  $1\frac{1}{2}$ . It appears from the staff records that appointments to the corps of topographical engineers were at this time made according to proficiency in drawing, a practice that continued at least as late as 1830. Cadet Bache was appointed a captain in that corps for this reason, and so held in spite of protest, completing a long, useful, and distinguished career in that branch of the service. Until 1817 drawing was confined to the first class. In that year the collateral course of the second class was established.

In 1820 the course was defined to be: Elements of heads and figures in crayons, elements of landscape in crayons, practice in taking actual sketches in landscape from nature, elements of topography and the raising of maps.

In 1822 the course of drawing in the third class (second year) was established and dropped out of the first class (fourth year).

In 1823 the relative weights for the different years were established as follows: Third class—Mathematics, 3; French, 1; drawing  $\frac{1}{2}$ . Second class—Philosophy, 3; chemistry, 1; drawing, 1.

The method of instruction appears to have been wholly that of copying from other drawings, a method pursued for many years to come, and which, while devoid of practical value or permanent results except to a very limited degree, is fruitful in deception and false pretenses. An investigation made in 1826 by a committee of the academic board into the practices of cadets in this work revealed an extensive demoralization, and the prevalence of fraudulent methods such as tracing, substitution, and the like.

In 1821 the course was further defined to embrace a series of elementary studies in landscape, the art of shading geometrical figures with India ink, sketches from nature, and elements of topography with pen, pencil, India ink, and colors. Instruction was given daily to the second class from 2 to 4 p. m., and alternate days to the third class during the same hours.

In 1825 it was further modified as follows: (1) Elements of the human figure; (2) a series of elementary studies in landscape with the pencil; (3) the art of shading geometrical figures with India ink; (4) the shading and finishing of landscapes in India ink; and (5) sketches from nature, and elements of topography with the pen and pencil, and with India ink, and colors.

At this time the relative count was made: Second class—Philosophy, 3; chemistry, 1; drawing 1. Third class—Mathematics, 3; French, 1; drawing 1. Fourth class—Mathematics, 2; French, 1.

In the distribution of time the second class attended drawing daily from 2 to 4 p. m., taking landscape and topography; the third class, Mondays, Wednesdays, and Fridays, from 2 to 4 p. m., taking the human figure.

In 1839 "the art of shading geometrical figures with India ink," and "the shading and finishing of landscapes in India ink," together with "sketching from nature," are omitted from the prescribed course. The relative count of the third-class course in drawing was changed to one-half, although it appears that daily attendance was required. The course was somewhat elaborated under Mr. Weir's direction, and in this year is described in the Staff Records as consisting of the following subjects, with a text-book, probably as a book of reference, on topography, prepared by Lieutenant Eastman, and adopted in 1837:

1. Geographical signs.
2. Topographical delineation of rocks and hills; wild and uncultured grounds; rivers; lakes, marshes, etc.
3. Formation of letters.
4. A course of topography with the brush, laying flat; broken and blended tints (symbolical of various grounds, etc.); shading mountains, rocks, trees, and other objects appertaining to wild or uncultivated countries. This completes the course in topography.

The course in free-hand work began with outline drawings of the human figure (anatomical) in three positions, and outline drawings from Flaxman and Retzsch which conclude the third-class course. In the second class, landscape is taken up under the following heads: (1) Measurement; (2) form, simple and compound; (3) aerial perspective; (4) light, copying same size and different scales; (6) drawing on tinted

paper; (7) use of brush (sepia); (8) coloring; (9) finished drawings from standard works. The entire work seems to have been copied from models in the flat.

In 1848, at the instance of the professor of drawing, the count of drawing in the third-class year was raised to 1.

In 1865 the following scale of relative credits was adopted:

Second class—Philosophy, 300; chemistry, 150; drawing, 100; infantry tactics, 50; artillery, 50; discipline, 100.

Third class—Mathematics, 300; French, 100; drawing, 100; discipline, 100.

In 1867 the inspector of the Military Academy recommended that penmanship be made a part of the course of drawing and be assigned a separate value of 100 in credits. The academic board in accordance with this recommended that one hour each day be given to that subject in the beginning of the third-class course until each cadet shall have acquired, in the opinion of the professor of drawing, a sufficient proficiency. It also recommended that no additional count be given in the course of drawing to that branch.

In 1872, upon the recommendation of the academic board instruction in penmanship was discontinued for the reason that little benefit accrued to cadets from its study, and that the time could be more profitably employed on the elements of drawing.

In 1879 the construction of various problems in descriptive geometry, shades, shadows, and perspective, then undertaken by the third class in the department of mathematics, was made a part of the course in drawing.

In 1880 the professor of drawing submitted to the academic board the following propositions regarding the course of instruction in that department:

1. That there should be a written examination in the course of drawing covering the subjects therein taught by lecture.
2. That a course of instruction by lecture, coupled with drawing from models, be given in the subject of mechanical engineering, embracing the elementary machines and movements.
3. That a portion of the time of the encampment be employed in practical surveying.
4. A detailed programme of the course in drawing.

A committee of the academic board was appointed to report upon these propositions, and recommended that there should be no written examinations in drawing; that such lectures as the professor of drawing shall deem necessary shall be prepared; that lectures and instruction upon the subject of mechanical engineering be wholly omitted; that the proposition regarding surveying during the encampment be so modified as to apply to the hours now devoted to drawing; and that the course as submitted with those modifications be adopted.

The following is the detailed programme submitted by the professor of drawing March 2, 1880, embodying the foregoing suggestions:

The following is respectfully returned as a detailed programme of the course of drawing in lieu of the recommendations contained in the accompanying documents.

#### FIRST YEAR, THIRD CLASS.

Topography; construction of problems in descriptive geometry, shades and shadows, and perspective.

Divided into two periods: Beginning with the academic year instruction in topography to be given to March 1 in each year. From March 1 to April 15, construction of geometrical problems.

From April 15 to close of term, practical topography in the field, reconnoissance, etc.

*Course of instruction.*—Beginning with the academic year the third class shall be instructed in the conventional signs of topography, and shortly after the inception of that work a lecture on that subject shall be delivered by the head of the department.

After the completion of the conventional signs a second lecture shall be given, covering the following subjects: Drawing instruments, their use and care; drawing papers, names, qualities, and uses; method of preparing paper for use; general rules to be observed in rectilinear and map drawing; construction of borders; lettering, explanation of different styles and principles of construction; scales, proportional, vernier, and scales of distance, their varieties and construction.

Immediately thereafter a third lecture covering the following subjects: Definition of topography and its objects; historical sketch of its progress and methods; explanation of the different systems and their relative merits; method of hill shading; construction of scales of shade and their application; principles of contours and sections.

Following these lectures the work of drawing scales of shade, inclination, distance, proportion, the drawing of maps from skeleton and plaster models, and the study of hill shading in ink shall be carried on.

Before the semiannual examination a fourth lecture covering the following subjects shall be delivered: Methods of projection of meridians and parallels; method of plotting from field work; plotting meridian and compass variation; the metric system of measure.

Between the close of the semiannual examination and the 1st of March instruction in colored topography, beginning with conventional tints and including the construction of maps from skeleton model.

From March 1 to April 15 construction of problems in descriptive geometry, shades and shadows, and perspective, to include problems in each of these subjects embracing fundamental principles, and generally variations in problems in text-books as follows: (1) Problems in descriptive geometry; (2) problems in shades and shadows (upper); (3) problems in shades and shadows (lower half); (4) problems in perspective (upper half); (5) problems in perspective (lower half).

From April 15 until close of year practical topography in the field, reconnaissance, etc.

Before going into the field a lecture shall be delivered covering the following subjects: Preparation and arrangement of note book; use of prismatic compass; manner of field sketches; use of odometer; pacing and hill sketching; method of running contours, including method of simultaneous location as used in United States Coast Survey; precautions necessary in reconnaissance and field sketching; improvised methods of leveling and measuring angles; practicability of slopes for troops.

Before the close of the academic year a sixth lecture shall be delivered covering the following subjects: General methods of large surveys; measurement of bases; general principles of triangulation and plotting; "filling in" and establishment of stations; method of survey west of the one-hundredth meridian; method of coast survey.

An examination (written) in the subjects embraced in the foregoing lectures shall be had at the close of the academic year. Cadets shall be required to take careful notes of the lectures and retain the same for use and reference.

#### SECOND YEAR, SECOND CLASS.

Free-hand drawing; machine, architectural, and geometrical drawing; theory of color and tinting.

Divided into two periods: First, free-hand drawing from September 1 to January 1; second, machine, etc., from close of semiannual examination to June 1.

Beginning with the academic year, a lecture shall be delivered by the head of the department on the subject of free-hand drawing, and perspective; outline; light and shade; methods and materials.

The class shall be instructed in free-hand drawing in black and white, beginning with simple block models of rectangular form in outline and increasing in difficulty until a fair proficiency in outline is attained. Shading shall then be applied to the simpler forms, and the models increased in difficulty according to the proficiency of the student. One copy from the flat may be made as examples of perfected drawing in the best methods. Instruction in landscape sketching in black and white shall also be given.

Beginning after the close of the semiannual examination a lecture shall be delivered by the head of the department covering the following subjects: Theory of color; quality and character of pigments; methods of coloring and tinting in water colors.

Instruction in this course shall begin by the laying of flat and graded tints illustrating the laws of harmonious contrast and the formation of compound and broken colors.

After their completion a lecture shall be delivered by the head of the department covering the following subjects: Construction of machines; fundamental parts of machines; classification of the elementary combinations; classification of the methods of connection; explanation of the principles of rolling contact, sliding contact, wrapping contact, link-work, and reduplication; toothed gear and method of construction; application of involute and cycloidal curves; pitch and methods of computation; relation of parts in spurwheels; screws, different kinds and construction; eccentrics, forms and applications; shafts and beams.

A second lecture explaining in detail the drawing of screws, toothed gear, eccentrics and their various curves shall be delivered before the close of the academic year.

A third lecture covering the subject of the orders of architecture, their origin and general proportions; fundamental architectural forms, and drawing of plans shall conclude the course of lectures in this department.

Careful notes of foregoing shall be taken and retained by the members of the second class.

It is also earnestly and respectfully recommended that a portion of the time of the third class during the encampment shall be devoted to the subject of practical surveying in the field, including use of the plane table, theodolite, level, and transit, the theoretical instruction being given as heretofore by the department of mathematics in the section room during the academic year.

I believe a greater practical familiarity with the details of surveying and plotting is very much needed by all classes of graduates. As this work is inseparable from its graphic delineation I believe it can be best and most economically taught in this department. So far as I know such is the practice in all the best technical and military schools in Europe.

CHARLES W. LARNED,  
*Professor of Drawing.*

The academic board adopted the recommendation of the committee rejecting written examinations; recommended that no study upon the matter given in lectures of the professor of drawing shall be required in any time other than that allotted to drawing; rejected the instruction in mechanical engineering and applied mechanics, and recommended the appointment of a new committee for the consideration of the matter of surveying.

In 1883 a committee was appointed to consider and report upon the relative value given different subjects in the preparation of the merit roll. This committee recommended that a total count of 150 be given the subject of drawing in making up the general merit roll of the graduating class, divided as follows: Course, third class, September to June, 90; second class, September to June, 60.

This was modified by the academic board so as to make the total count 125, divided as follows: Course, third class, September to June, 75; second class, September to June, 50.

The attendance in drawing, which up to 1839 appears to have been daily for both classes, was changed between that date and 1842 so that the third class attended only on alternate days, excluding Saturdays, giving five attendances in two weeks. The second class continued to attend daily. This disposition appears to have remained undisturbed until 1857, at which time the hours of attendance of the third class were changed so as to permit instruction in riding to be given after November 1. Up to that day the whole class attended daily; thereafter it was divided into two sections, alternating in attendance until March 15, after which daily attendance was resumed. It does not appear from the Staff Records at what time the daily attendance of the second class was changed so as to substitute an alternating attendance of sections of one-half the class. This is, however, the arrangement at the present writing, and has been so for over thirty years.

#### PRESENT COURSE, JUNE, 1896.

Based upon the detailed programme submitted by the professor of drawing in 1881 as modified and adopted by the academic board the present course of instruction is arranged as given below, being the programme approved by the Secretary of War and incorporated in the academic regulations of October 1, 1894.

#### *Course of technical and free-hand drawing.*

##### FIRST YEAR.—PLANE AND DESCRIPTIVE GEOMETRY—TOPOGRAPHY—COLOR RECONNAISSANCE.

[September to January.]

Instruction in the course of the first year is as follows:

1. Problems of construction in the applications of plane geometry, ranging from the laying out of angles and polygons to the construction of the various plane curves, including the ovals and conic sections. Drawn in pencil. (4 sheets.)
2. The conventional signs of topography. Drawn in pencil and in ink. (2 sheets.)
3. Determination of lines of screen and construction of sections and gradients on contoured map. Explanation of contours and study of terrain. (1 sheet.)
4. Exercise in hachure work. Explanation of scales of shade. Drawn in ink. (1 sheet.)
5. Exercise in contouring from dictation. (1 sheet.)
6. Construction of scales of distance. Diagonal scales. Verniers. Explanations of their uses. Drawn in ink. (1 sheet.)
7. Plotting of triangulation for completed map from field record. General explanation of triangulation methods and measuring of bases. (1 sheet.)
8. Plotting of details of completed map from traverse notes. Explanation of methods of field notes and contouring. Inking and finish of completed topographical map. (1 sheet.)

[January to June.]

1. Theory of color. Color standards and constants. Color tests. Laying of washes. Complementary colors. Hues, tints, and shades laid in water colors. (2 sheets.)
2. Construction of problems in Descriptive Geometry. Shades, shadows, and perspective. (9 sheets.)

3. Topography in colors. Conventional signs. Completed map in colors. (1 sheet.)
4. Field reconnaissance and sketching. Methods and materials. Instruments and their use. Descriptions and explanations. Practic sketch from dictation. (1 sheet.)
5. Work in the field. Reconnaissance map of position with hand level, prismatic compass, and clinometer. Drawn on regulation form prescribed by General Orders, Headquarters United States Army. (1 sheet.)

SECOND YEAR.—FREE-HAND DRAWING—MEMORY DRAWING—MECHANICAL, ARCHITECTURAL, AND ORDNANCE CONSTRUCTION DRAWING.

*Free-hand drawing.*

[September to January.]

1. Lectures on form, light, and shade. Proportion, outline, technical and pictorial art, practical and aerial perspective. Drawing from wood blocks in outline in pencil. (7 sheets.)
  2. Shaded drawing from blocks and plaster. (2 sheets.)
  3. Drawing from memory. Originals—first, flat; second, blocks; third, buildings. (8 sheets.)
  4. Mechanical free-hand drawing. Dictated. Parallels, angles, proportional parts, polygons and stars, frets, gear teeth. Isometric working drawings to scale. Isometric building to scale. Cavalier projections. Cavalier machine casting to scale. No ruler or implements allowed. (6 sheets.)
  5. Free-hand drawing from flat. Figure outline. (2 sheets.)
  6. Free-hand drawing from flat. Figure and landscape. Pen and ink and pencil. (2 sheets.)
- Lectures on the above from time to time.

[January to June.]

*Technical drawing (architectural, mechanical, ordnance construction).*

1. Project. Plan, section, and elevation of barrack for a company of infantry—drawn to scale, printed specifications and data furnished. Finished in ink. Measurements figured. (1 sheet.)
2. Working drawings to scale of steam engine and principal parts. (1 sheet.)
3. Working drawings to scale of parts of buildings. (1 sheet.)
4. Elevation and working drawings to scale of ordnance constructions. (1 sheet.)
5. Plan, section, and elevation drawings of civil and military engineering constructions. (1 sheet.)

All of the above in color or ink alone, according to character. Nos. 2, 3, 4, and 5 occupy the time remaining after completion of No. 1. No. 1 is taken by entire class. The others are assigned according to corps to which cadet will probably be assigned on graduation. Engineers, No. 5; ordnance and artillery, No. 4; line corps, Nos. 2 and 3.

6. Fifteen to twenty short lectures on the graphics of building construction and forms; methods and drawings in the planning and construction of buildings; the steam engine and its essential parts; machine drawings. These are accompanied by diagrams and models, and the use of the stereopticon.

Sheets of data, working drawings, blue prints, and photographs used for data in the foregoing are from the following sources: Corps of Engineers and Report of Chief of Engineers, U. S. A.; Ordnance Bureau and Reports of Chief of Ordnance, U. S. A.; Pneumatic Gun Carriage and Power Company, United States; Baldwin Locomotive Works, United States; Krupp's and Gruson's Werke, Prussia; Canet System, Forges et Chantiers de la Méditerranée, France; Maxim-Nordenfelt Gun and Arms Company, England; construction details, Austrian Military and Geographical Institute, Vienna, Austria; Notes on Building Construction, South Kensington, London, England; Details of Building Construction, Professor Chandler, Boston Institute of Technology; Senior Course in Mechanical Drawing, Professor Thorne, Franklin Institute, Philadelphia. Ordnance material and models in relief also used as models.

The Third Class attends daily, Saturdays and Sundays excepted, from 2 p. m. to 4 p. m., until November 1, after which day the class is divided into two sections—the first section, until January 1, consisting of the odd numbers in general class standing; the second section of the even, these sections alternating in attendance. After January 1 the division of the class is similarly obtained from the standing in drawing at that examination, and alternation continues until March 15, after which daily attendance, Saturdays and Sundays excepted, is resumed until the end of the term.

The Second Class alternates in sections throughout the term, being divided into two sections of odd and even numbers, obtained from the standing in drawing at the end of the third-class year. Its hours of attendance are from 2 p. m. to 4 p. m. For

the better preservation of order the third class when attending daily is divided into four sections, which, at the close of attendance, are dismissed and retire separately under charge of separate section marchers, who are responsible for infractions of discipline.

## HOURS OF ATTENDANCE.

*Total number of hours of attendance of third class, first year.*

|  | Hours. |
|--|--------|
| September 1 to October 31, daily, two hours .....  | 88     |
| November 1 to December 31, alternate days, two hours .....   | 42     |
| January 12 to March 15, alternate days, two hours .....  | 45     |
| March 15 to May 31, daily, two hours .....   | 110    |
| Giving, out of 172 hours' total attendance during first term, 130 hours for each cadet, and out of 200 hours' total attendance during second term, 155 hours for each cadet. |        |

*Number of hours devoted to each subject for each cadet.*

|   | Hours. |
|---|--------|
| First term:   |        |
| Problems in application of plane geometry .....   | 28     |
| Conventional signs of topography in pencil .....  | 22     |
| Conventional signs of topography in ink .....   | 18     |
| Line of screens, gradients, construction of roads, sections, and study of terrain ..... | 6      |
| Contouring from dictation .....   | 6      |
| Exercise in hachures .....  | 2      |
| Construction of scales, etc. ....   | 8      |
| Platting triangulation for map from notes .....   | 6      |
| Platting details and finishing map from notes .....                                     | 34     |
| Total .....   | 130    |

Second term:

|  |     |
|--|-----|
| Theory of color, etc., laying flat and graded washes in water colors ..... | 20  |
| Problems in descriptive geometry .....                                     | 75  |
| Topography in colors .....   | 30  |
| Practice in plotting from dictation by field reconnaissance methods .....  | 4   |
| Reconnaissance work in the field with compass and protractor sheet .....   | 18  |
| Platting contours in the field .....                                       | 4   |
| Reconnaissance without instruments .....                                   | 4   |
| Total .....  | 155 |

*Total number of hours of attendance of second class, second year.*

[Attendance alternate days throughout year.]

|   | Hours. |
|---|--------|
| First term, September 1 to December 31:   |        |
| Number of hours, 172; half of which for each cadet .....  | 86     |
| Second term, January 12 to May 31:  |        |
| Number of hours, 200; half of which for each cadet .....  | 100    |
| Number of hours devoted to each subject:  |        |
| Drawing from wood blocks in outline .....   | 28     |
| Shaded drawings .....   | 12     |
| Drawing from memory .....   | 12     |
| Mechanical free-hand drawing, including isometric and cavalier projections ..   | 18     |
| Hill outlines .....   | 4      |
| Free-hand drawing from the flat .....   | 12     |
| Total .....   | 86     |
| Second term, January 12 to May 31:  |        |
| Barrack project, about .....  | 40     |
| Working drawings to scale of steam engine, engineering and fortification drawings, ordnance and architectural construction, etc., about ..... | 60     |
| Total .....   | 100    |
| Total number of hours' attendance, for entire second year .....   | 372    |
| Half of which for each cadet .....  | 186    |
| Total number of hours for department in two years .....   | 744    |
| For each cadet .....  | 471    |

## CLASS REPORTS AND MERIT MARKS.

Class reports are submitted weekly, each cadet being given a merit mark on his week's work. These marks are scaled on a maximum of 3, and are determined from a consideration of two factors, i. e., progress and quality. A time schedule compiled from the records of the department and the result of several years' experience is maintained for each separate piece of work. If a cadet begins a piece of work on Monday and has on Saturday completed the full amount of work according to the schedule, he is marked accordingly for progress. Going a second time over the class, the element of progress is entirely ignored and a mark for quality alone is given.

In work of certain character, where quality is considered most important, e. g., conventional signs in color, the quality mark is given a multiplier of 2, and the resulting mark for the week would be determined as in the following example: Quality mark,  $2.5 \times 2 = 5$ ; progress mark, 2.4; total, 7.4; reduced to a scale of  $3 = 2.47 =$  mark for week.

In certain other portions of the work, as, for example, descriptive geometry, quality and progress are rated equal and given the same weight in the determination of the mark.

Exact record of progress is kept by recording against each cadet at the end of every week the number of hours to his credit according to schedule in the particular piece of work upon which he is engaged. By this method a glance at the record tells exactly what each cadet has done each week of the term, and as the work is filed away as fast as completed in the drawer allotted to him, the most complete information is always immediately available as to the status of every member of the class at any period of his instruction. The marks, with rating both for quality and progress, are posted in the classroom weekly, so that cadets know in what element of their work they are deficient.

As each problem, construction, or drawing to be inked is completed in penciling, it is examined by an instructor, and if approved is so marked by him over his initials in pencil; the cadet is thereby authorized to proceed to the inking, and upon the completion of this stage of the work it is again brought to the instructor for final approval, which, if accorded, is stamped in ink, with the instructor's name; otherwise the word "disapproved" is stamped in a similar manner. Upon each drawing is also stamped the name of the cadet and date of completion, a brief of the course of drawing to which it belongs, and, if a problem, an enunciation of its requirements.

At the examinations closing the year's course, drawings of special excellence are retained by the head of the department for preservation in the academy gallery—a custom which has been adhered to for over seventy years, and, as a result, a collection of drawings dating back to the early twenties, and bearing the names of graduates whose reputations are national, is exhibited on the walls of the Academies.

## PLANT.

The halls and rooms devoted to the department of drawing in the academic building completed in 1895 were planned by the head of the department to meet the requirements of the special and comprehensive course taught. They were designed also to give a maximum amount of light and a perfect system of ventilation, together with abundant space for both student and instructor. Besides these requirements of the drawing academies, there was to be provided a lecture room, with complete illustrative apparatus, and an auditorium which should accommodate 150 spectators, each of whom should have an unobstructed view of the platform; a photograph gallery with developing, enlarging, and chemical rooms; a model room; and a workshop for repairs, preparation of material, etc. All of these were to be so disposed as to occupy the same relative space in the new as in the old building.

The two main halls or academies are devoted to the work of the second and third classes, respectively. They are located upon the top floor, the ceilings being formed by the arched iron trusses supporting the roof, giving a maximum height of 29 feet at the crown of the arch. The second-class academy accommodates comfortably 50 students on a floor plan of 50 by 42, or approximately 2,000 square feet. The cubic contents of the room is 49,000 cubic feet, affording nearly 1,000 cubic feet of air per man for a maximum seating of 50 men. As a matter of fact the size of sections has not yet exceeded 40 men. The room may be lighted either from sides or from above. Side light is given by four large double windows, 7 by  $8\frac{1}{2}$  feet, two of which are on the east and two on the north side of the room. These are closed by double iron rolling shutters, meeting at the meeting rail and rolling up and down. Light from above is supplied by a north skylight on slope of roof, screened by draw shades of white cotton and of dark green holland, working separately. The skylight is 20 by  $22\frac{1}{2}$  feet, covered with one-fourth inch hammered glass. With side windows closed the skylight gives abundant light for the most exacting work on the darkest days. By the use of screens and side windows any desired effect of light and shade can be produced for free-hand model work.

The Third-class Academy is considerably larger, and is designed to accommodate a maximum of 100 men on a floor plan of 3,025 square feet—50 by 60½ feet. Its cubic contents is 74,000 cubic feet, giving 740 cubic feet per man for a class of 100 men. It has a north skylight 20 by 44 feet, screened as in the second-class academy, and has eight similar windows, arranged three on north, three on west, and two on south side of room. Heated air is supplied through openings at middle height of north and west walls by the indirect system, being forced in by steam fan and extracted through ventilators at bottom and top of walls. In addition large ventilators are built on ridge of roof, operated from side walls through universal joints. As a result the air of the academies is at all times fresh and odorless and sufficiently warm in the coldest weather. One large porcelain double sink in second-class and two in third-class academy, set in Tennessee marble with floor drip and facings, supply washing facilities.

The Lecture Room, 40 by 48 feet, is provided with a lantern gallery and Colt dissolving electric stereopticon. At the opposite end are black and white roller curtains, 20 by 25 feet, and the platform, when lantern is not in use, is lighted by a skylight over the auditorium, provided with roller iron shutters worked by a crank and gear from platform. The seats are arranged as in a clinic and the space beneath is utilized for storage.

The Photographing Rooms open from lecture room, and are arranged in two stories. Above is located the gallery, 23 by 23 feet, with skylight; below are dark room with small and large developing tanks, the latter capable of 9 feet enlargements; the Chemical Room, with tank, retouching table, and negative closet; the Enlarging Room, furnished with 9-foot enlarging screen on railway, sensitizing table, and lens screen, with light closet wired for electric arc light.

The Model Room, 46 by 22 feet, contains models in plaster of the Propyleum (restored), the Parthenon, the Temple of Paestum, and others; also of anatomical figure, the flying Mercury of John of Bologna, the Apollo, the Germanicus (so called), and others (casts from the Louvre); a large collection of hands and feet and ornamental details; a complete framed house in perfect detail, to a scale of one-sixth; a working model of four horsepower, direct-acting vertical steam engine, scale of one-half; topographical facsimile model in plaster of the Military Academy and post of West Point, constructed by Lieut. C. P. Townsley, Fourth Artillery, under the direction of the head of the department; topographical models in plaster; a collection of original water colors by English water-colorists; large cubes, spheres, and cylinders for lectures on light, shade, and form, besides a large number of smaller block models for free-hand drawing; a great variety of lithographs, engravings, prints, diagrams, and charts covering the field of genre and landscape drawing, studies of the human figure, architecture, building construction, steam engines and machinery, engineering and ordnance constructions, topography and cartography, including the complete issue of the Coast and Geodetic Survey and the United States Corps of Engineers. It is intended to complete the collection of topographical and cartographic prints so as to include the work of the principal European nations. Complete working shop drawings of the principal constructions of the ordnance department are on file, together with others of civil manufactories. In connection with descriptive geometrical drawing there is also a demonstrative apparatus with models, designed by the head of the department to overcome the difficulties experienced by many in understanding the graphical elements and practical applications of this subject. This apparatus presents the demonstration of all the elementary problems in descriptive geometry, shades, shadows, and perspective as actually seen in space.

#### EXAMINATIONS AND STANDARD OF PROFICIENCY.

Examinations are held and class standing determined by inspection of marks and drawings. The latter are displayed upon racks and tables so as to be easily examined and compared. As the course is mainly technical and constructive, the marking is according to schedule and very close, so that very little deviation from the standing resulting from marks is found necessary after a comparison of the work. In the course of free-hand work, from September until January of the second-class year, more change results from the final inspection of work than at other times. No special weight is given the examinations as in other departments, since, as they are a full presentation of the entire work, they are of necessity wholly determinative of standing.

The standard of proficiency exacted is such as long experience has demonstrated to be fully within the grasp of the diligent and fairly intelligent student, without reference to natural pictorial gifts. As three-fourths of the course is geometrical in its elements, and technical or constructive in its character, mainly executed with drawing instruments, and as the free-hand work is confined to practicing and developing the perception of proportion and relation in the simpler elementary forms, beginning with blocks and elementary analysis of landscape, it is found that

students with no natural pictorial powers whatever find no difficulty in passing and even in standing well in this study. A cadet, therefore, who constructs with correctness and accuracy the problems in plane and descriptive geometry, plots and completes from traverse notes and triangulation sheet with correctness and fair neatness of finish the required topographical map, and shows ability to draw a fairly accurate reconnaissance field sketch, will be declared proficient in that portion of the course, although the pictorial finish may be 50 per cent inferior to that of the head man. In free-hand work the student must show a very rare incapacity for perception of form to be declared deficient therein. In the course of architectural, building construction, engineering, and ordnance drawing the same conditions obtain as in the geometrical and topographical work.

The course of drawing at the Military Academy at the present time is based mainly upon the fact that the practical language of modern construction of every sort is technical drawing. The most casual investigation of any one of the many constructive arts of the world from architecture and engineering—all the machinery of peace and the engineering of war—to the humblest of manufactures will show that from the beginning to the end its operations depend upon the line; that its original conception must appear as a design upon a plane surface; that its operatives perform their allotted tasks under the guidance of linear drawings upon which they are absolutely dependent; that in turn the tools with which they work and the machinery they control owe their creation to the same medium, and that only by and through this medium is that great differentiation of labor possible which brings to birth the modern arts of peace and war. It is because the constructive drawing of form has so enormously outgrown the limits of pictorial art, is so practically and vitally associated with every activity of modern creative energy, and is such an indispensable medium of expression to the entire industrial world, that it is imperative that every school of technical science, civil or military, should require of its students a sufficient proficiency in this graphic language both to use it as vehicle of plan and design and to read and correctly interpret from the designs of others.

The foregoing expresses the practical considerations upon which the instruction of this course is based. There are others, educational as well as practical. These are the cultivation of the visual faculties of apprehension; the clear, vivid, and accurate perception of the objective world; judgment—the power of comparison and discrimination between formal relations, shape, proportion, distance, quality; memory—the clear and accurate retention of formal images, involving correct and luminous description; and sensibility—involving ideas of beauty, harmony, grace, and refinement. Of these the first three are directly and practically of the highest importance to the officer both as commander and subordinate. Although the eye has always been the most important of the faculties of sense in the decision of tactical questions, and both general and individual action in the crises of battles, there has never been a time when a clear vision and accurate memory of objective facts was of such importance as it is at present to the general and to the subordinates. Estimates of configuration, of distance, of relation, of shape, are vital in the disposition of troops where the slightest disadvantage of position may, with modern weapons, prove fatal, and these must be decided by the eye of the commanding general. He also requires for strategical dispositions the fullest and most accurate information possible, obtained by his subordinate officers through scouting and reconnaissance, and to this end a good eye and a retentive memory for formal facts are indispensable, together with sufficient graphical ability to put them clearly upon paper. Free-hand drawing is the direct educator of these faculties, and although with the majority the pictorial result will be small from the artistic point of view, yet a comparatively short training under careful instruction will stimulate all these faculties, even in those of small natural gifts, in a remarkable degree and develop habits of observation entirely dormant.

Technical drawing, also, aside from its practical bearing, is a direct educator of the mind and habits of thought. The technical drawing deals with facts, with exact relations, with geometrical laws. Correctly done it can not lie; and incorrectly done it exposes its own errors. It holds the student in the grip of visible and tangible demonstration; the smallest error can not be evaded or hidden. Like analytics, every step in a constructive drawing has logical and positive connection with what has gone before; but unlike the methods of quantity, the work can not be done by formulæ. It demands a perpetual watchfulness and foresightedness—a knowledge at every moment of precisely what is to be done and its effect upon the whole; a clear knowledge at the beginning of the conditions involved, their accurate development, and the exact correspondence of every detail at the completion of the work. A working drawing must take apart with such perfect accuracy that the reassembling produces facsimile, so that the body of independent coworkers can be held to strict conformity. It produces a strong sense of responsibility in the draftsman, because a wrongly placed bolt in a complex mechanism, or a beam out of place in a building may have fatal results in the construction. The project drawing locates

theory and develop self-reliance and practical ability. Its lines and dots constitute the actual doing of that which theory has expounded, and bring into play judgment, foresight, and creative ability.

It is unfortunately true that in the educational systems of the United States there is a most lamentable neglect of training in the elements of drawing. No other civilized nation of commercial greatness neglects this subject, and in the schools of Germany, France, and Austria on the Continent instruction is continuous from the primary schools through to the highest. England, with her elaborate system of science and art instruction radiating from South Kensington, has spread it broadcast throughout the kingdom. The representatives of our system, however, who present themselves at the Military Academy are for the greater part wholly deficient in any, even the most rudimentary, instruction in drawing. I do not find that an average of 10 per cent have had elementary training—in some classes not 5 per cent. It is therefore necessary that instruction here should begin at the illiteracy in this branch—a condition that is not paralleled in any other subject.

The result to be achieved is therefore twofold. First, to train the faculties of vision and those of execution through the hand when at a period of comparative maturity they are entirely dormant; second, to teach the general principles of technical drawing so that the graduate shall have an intelligent acquaintance with the constructive language of engineering, architecture and building construction, topography and cartography, and machinery, and shall be able to make a fairly good free-hand drawing of natural and artificial form. In his capacity as commanding general, commanding officer of a post, engineer, ordnance, and artillery officer, quartermaster, surveyor, subaltern on reconnaissance or supervising construction, he is liable to require any or all of this knowledge, and at least to translate it to his subordinates. The instruction is therefore twofold—in the practical graphical work and by lectures copiously illustrated, coupled with constant oral criticism.

The cardinal principle upon which instruction is based is that all work shall be *original*, that is to say, that every project or problem shall be the student's own work, constructed from the data or model according to the principles governing it. The only copies from drawings permitted are in the case of a few outline studies of the human form and landscape at the close of the course of free-hand instruction. The next condition exacted is accuracy, after which comes pictorial excellence and neatness. The ultimate purpose is to give a sound general training in the elements of technical and free-hand drawing so as to familiarize the student with the methods of graphical work in the various fields of topographical, geometrical, structural, and mechanical drawing to a sufficient extent to enable them to understand the graphics of these subjects when required to interpret them, and to possess a reasonable facility of design therein, rather than to attempt to carry any one of them to a degree of development appropriate only to special courses in schools of application. As a matter of fact the more apt students do attain a facility and skill which enables their work to bear comparison with that of the best of the special schools either in this country or abroad. In the free-hand course the ultimate aim, after the cultivation of the perceptive faculties, is to give a sufficient pictorial skill to enable the graduate to make outline sketches of general landscape and hill forms to accompany topographical and reconnaissance reports. Further than this with the average man it is not possible to go. Artistic power can not be taught; it must be innate in the same way as are poetic, rhetorical, or dramatic gifts. But the whole range of technical graphics, which is the language of the constructive and industrial world, and a certain ability to render ordinary form by free hand can be taught to all in precisely the same degree as any of the various branches of study; the eye faculties of judgment, memory, and apprehension can be trained to a very high point, and the taste and appreciation can be developed in those in whom the artistic and creative power is lacking.

#### METHODS OF INSTRUCTION.

##### *First year's course.*

##### GEOMETRICAL AND TOPOGRAPHICAL DRAWING.

*Plane geometry.*—About 40 problems covering various applications from laying out of angles to plane curves and conic sections (see programme). These are done in pencil and constitute the first work of the student. The data are issued on printed sheets giving a brief general analysis of method. This refreshes the memory of plane geometry and gives the first practice in the use of instruments. Accuracy and neatness are here inculcated as primary requirements.

*Conventional signs of topography.*—Topography is assigned to this first year's course because surveying and trigonometry are taught in this year. The general signs are first executed in pencil and afterwards repeated in ink. The repetition impresses them upon the memory besides making the transition to ink work gradual. In these

signs there is a partial free-hand element which needs the practice in pencil before attempting ink. Clearness and neatness of finish emphasized. Examples in large maps of coast survey and foreign countries displayed for inspection upon tables.

*Determination of lines of screens and sections, etc.*—Lithographed sheets giving the contours of a particular region are issued. The lines of section required are indicated and the section is made by student. Position of batteries indicated and lines of screen from fire determined on different slope by student. Gradient of required road given; position of road platted by student. Maps of American battlefields displayed on tables. Students required to go to them and answer a series of hectographed questions touching topographical relation of different positions and dispositions.

*Exercises in hachure work.*—This work is now confined to a short exercise in the use of hachures, with an explanation of scales of shade of different methods of hachuring.

*Exercise in contouring from dictation.*—To familiarize the student with the function of contours and their plating, bearings and gradients are given on hectograph sheets, together with topographical features by textual description, from which the terrene is platted by the student.

*Construction of scales of distance, etc.*—These scales are thoroughly explained in theory and then accurately constructed to given representative fractions and units by the student.

*Platting of triangulation for completed map, etc.*—The class at this point begins the final work of the first term, which is a practical application of the foregoing preliminary instruction. This consists in the actual work of plating and drawing a finished map from the triangulation sheet and field traverse notes, and demonstrates the extent to which the student has understood the principles of topography and acquired the necessary facility for the execution of a correct map. The data for establishing the triangulation points are given as if taken by observation, and a book containing all of the traverse notes as taken in the field book for the area to be mapped. The plating is carefully tested as it progresses and all errors noted. After final approval of the plating the finishing work in ink is proceeded with.

*Theory of color, etc.: hues, tints, etc.*—The subject of modern chromatics is taken up at the commencement of the second term. After an explanation of the modern theory of color of Young and Helmholtz is taught the laying of flat tints of the primary and complementary hues, shading of cylinders and curved surfaces.

*Construction of problems in descriptive geometry.*—As this subject is the foundation of technical drawing, its practical application in graphical problems is given the most careful attention. In order that the difficulties of a practical grasp of the subject shall be overcome the first work deals with the simplest problems. The class receives in the course of mathematics most thorough and careful theoretical instruction, and comes to this work as fully equipped in the theory of the subject as can be desired. The problems given are selected with a view to practical bearing upon graphical work in architectural and mechanical construction. Each problem as given is carefully explained, and questions as to obscure points invited and answered. The principal problems as they are reached are then set up on the demonstration frame and the explanation repeated from the actual objects and projections in space. The students are then required to make the construction. The demonstration frame may be at any time consulted to resolve difficulties and forgotten points. Cadets are not allowed to help each other, and the signature of the cadet is held to be a guaranty of the integrity of the work. The first problems are constructed in pencil alone, and consist of the projections and revolutions in various planes of simple plane figures, cubes, and prisms, with sections and developments. These are quickly done, and give confidence and flexibility in the use of projective methods. After these the problems increase in complexity and are finished with greater care and accuracy in ink. They include determination of intersections of different solids with developments, shades and shadows of crosses, cylinders, rings, spheres, or ellipsoids; the column with abacus and base with taurus; chimney and dormer window on roof, vase, etc.; the perspective of rings, shafts, spheres, monuments, groined arches, buildings, or composed subjects. These are executed with the utmost accuracy and a high degree of finish, which will compare with anything done by students elsewhere, at home or abroad.

*Topography in colors.*—Water-color washes as applied to topographical maps. First, a sheet of conventional signs, followed by a completed map.

*Field reconnaissance and sketching.*—Careful lectures and explanation, with exhibition of implements and illustration by the lantern, precedes this most important branch of military graphics. Methods of work in this country and abroad are explained and illustrated, and preliminary practice given by dictating courses and data viva voce, requiring a topographical sketch to be platted from the description. The class is then taken into the field, formerly with prismatic compass and regulation protractor sheet, but now with the reconnaissance sketching board of Major Vernor, of the English service, as modified and greatly improved by Lieut. Charles B. Hagadorn,

first lieutenant, Twenty-third Infantry, instructor of drawing. This is a simple application of plane table methods to field topography, and vastly superior both in accuracy and rapidity of result to the older methods. A sketch is made of a portion of the military reservation, and contours are determined and platted both with levels and clinometer. Practice is also given in sketching without compass or implement of any sort. This work closes the first year's instruction.

*Second year's course.*

FREE-HAND DRAWING.

*Outline drawings from blocks and plasters.*—This work is addressed to the dormant faculties of vision and is of the simplest and most elementary character. The objects are at first white cubes which are carefully drawn "by eye," the knowledge of perspective laws acquired in the preceding year being here applied in the judgment of form. According as the student progresses other blocks are substituted, and then groups of two, three, four, and many blocks in irregular masses. Finally, rough buildings are constructed with blocks and sketched from different points of view, and, if sufficient skill is developed, plaster forms. Succeeding this a series of memory drawings are required, beginning with simple rectilinear shapes, increasing in complexity, which the student is allowed to view for a very short period and must then reproduce. More complex forms succeed these, and finally the students are sent out to examine buildings for a short time which they must then draw from memory.

*Mechanical free-hand drawing.*—This work is done without any implement or artificial aid whatever other than the lead pencil. This must not be used as a ruler. Beginning with simple subdivision of lines into equal parts, scales are drawn by eye showing subdivisions as high as sixtieths. The various constructions of frets, polyhedrons, stars, plotting and division of angles, etc., are gone through with, and finally scale drawings of objects giving sections and dimensions are done, concluding with isometric scale dimensioned drawings and cavalier projections of machine castings of the same kind. The class is then practiced in sketching hill forms from lantern projections on a large screen, beginning with very elementary forms and gradually leading up to views of the region of the Colorado Canyon. This work is followed with study from lithographed studies of landscape in the flat and landscape sketching in the field. The course concludes with a few figure outlines by Bargue and Gérôme, and studies of figure and landscape from the flat in pen and ink as an example of good method and to afford some slight facility in execution within the very limited time and range of this course. This concludes the first term.

*Project—Barrack for a company of infantry.*—This begins the final course of constructive drawing. This project is a practical one and is given out to the individual members of the class by a printed sheet of specifications and two sheets giving detail dimensions. The plan, section, and one elevation of the building are then constructed to the required scale. This important piece of work gives a very thorough practice in the preparation of general drawings for a building, and is undertaken in connection with a course of explanatory lectures fully illustrated by the stereopticon. In this work the student learns to relate drawings in plan, section, and elevation, and to understand the working out of detail and shop drawings. It is a double study for the student, teaching both construction and interpretation of working drawings. The drawings are carefully figured and colored in flat wash if the progress of the individual work justifies it.

*Working drawings—Steam, building construction, ordnance, civil and military engineering.*—After the completion of the project above described, the class is divided into groups according to the general class standing of the men. The final work is then assigned according to the corps of the Army to which the cadets will probably be assigned. The first five men are given subjects selected from military or civil engineering data—batteries planned or in process of construction in the United States and abroad; portions of enceintes; magazines; bridge and canal work, the data for which are being constantly sought in the latest works. The next twenty men, whose probable service is to be in the Ordnance and Artillery Corps, are given subjects of ordnance and artillery construction. Working shop drawings of the principal guns and carriages of the United States Ordnance Bureau are on file in the department, together with a large amount of data from foreign countries of the latest models. The remaining members of the class, whose duties will be in the Line as quartermasters, commanders of working parties, and as commanding officers of posts and in control of Government property, are given working drawings of details of building construction, and a figured drawing of a simple direct-acting high-pressure vertical steam engine to complete to given scale. A large perfect model of a frame house to a scale of one-sixth is used for this work. Students are required to make isometric sections and projections through different parts of the barrack project showing

entire construction of windows, doors, and interior floor and roof construction—figured. A facsimile model of steam engine to one-half scale is used for the figured drawing of steam engine. Detail drawings of all the parts are also available, and the student is required to set up the engine to scale from these and the model. This work completes the course of drawing.

## LECTURES.

All theoretic and explanatory instruction is given by lectures abundantly illustrated by stereopticon, blackboard, and models. Running commentary and viva voce criticism and instruction go on at all times. At any time when special explanation is needed the classes are called into the lecture room or to the models.

The course of lectures beginning with the first year's work covers: Drawing instruments—their character, quality, use, and care; methods and connections in geometrical drawing; topographical signs and conventions; methods of large surveys; triangulation and field work; contouring and hill sketching; traversing; plotting; cartography—historical sketch, styles, and methods; reading of maps; study and character of terrane; scales; the Young-Helmholz theory of color—the prismatic and normal spectrum, color constants; complementary color; nomenclature; subjective color; pigments; harmony, contrast—illustrated by the stereopticon, Maxwell's disks, and color samples; methods of field reconnaissance. Instruments—levels, odometers, pedimeters, compasses, clinometers, etc.—are shown and explained.

Lectures on form, light and shade, proportion, outline, technical and pictorial art, practical and aerial perspective, and landscape drawing are given during free-hand work, and are all illustrated with stereopticon.

During the last term of constructive and mechanical drawing a carefully prepared series of lectures accompany the work, explanatory of the details of building construction from foundations to interior finish; a historical sketch of architecture and explanation of styles; a descriptive analysis of the steam engine and its details, showing character and functions of its working parts, and of the various shop drawings. In addition, lectures giving the character and number of architectural drawings, fees and procedure in architects' offices, specifications, reproductive processes, quality and preparation of paper, tracings, enlargements.

In former years the entire course in drawing consisted in copying pictures in pen, ink, and color from engravings and lithographs. The course was devoid of lectures or theoretical instruction. No original work was undertaken. The work was largely worked over and finished by the instructor to give pictorial effect.

The work of the present course can not well be compared with that of other institutions, for the reason that it is general and comprehensive, whereas in the technical and scientific schools of the country the work is special, and in the special lines is carried further, and in the art schools the object aimed at is fine art, while the students possess special talent and have had considerable training before entering. At the Military Academy the eye and hand must be trained from a condition of entire helplessness, while at the same time a knowledge of the graphics of a wide range of arts is acquired. Notwithstanding the great disparity in the preparation of the students and the character of the aim, as well as limitation of time, I am of the opinion that the result will compare without discredit with similar work, either at home or abroad. The best drawings do not fall below the grade of expert work. This high standard of achievement is due to the methods of work of the Military Academy, the thorough preparation given by my associates, and the conscientious and enthusiastic fidelity of my assistants, without which very little could be achieved. I may also add that the interest of the cadets themselves in their work is an important factor.

I think that the count given to the subject in its present scope and treatment is too small, and is unfair both to the work itself, the range of instruction given, and the amount of knowledge and skill developed in the cadet student. At the least the recommendation of the committee appointed in 1883 to determine upon the relative value of different subjects should prevail, which gave to the course of the third-class year a value of 90, and that of the second-class year a value of 60. At that time the counts of law and ordnance and gunnery were the same as that of drawing. These subjects now count 150, although the number of hours devoted to the subjects is less than that devoted to drawing. I venture to assume that the advance in instruction has not been greater.

I believe that a great gain in practical efficiency would ensue if the course in surveying were to be incorporated with that of drawing, for the reason that the subject is essentially graphical and can not be divorced from graphical methods. It is not properly a part of pure mathematics, as all of its principles are those of geometry and trigonometry, and have already been taught in that course. I advance this suggestion here only because, after consultation with the Professor of Mathematics, I understand his views to coincide with my own.

Should the Professor of Engineering agree with my judgment, I would suggest also the consideration of the advisability of transferring the drawing now done as a class attendance in that department to the department of drawing. It would, I think, be a gain in efficiency to have all drawing done by the class in a body under the direction of one department. The theoretical instruction and the nature of the problem given out would be controlled by the department of engineering. The conditions would be precisely similar to those which obtained when the descriptive geometry drawing was transferred from the department of mathematics to this department.

Very respectfully, your obedient servant,

CHARLES W. LARNED,  
*Professor of Drawing, U. S. M. A.*

The ADJUTANT, UNITED STATES MILITARY ACADEMY,  
*West Point, N. Y.*

*Record of number of cadets found deficient in drawing—1818 to 1896.*

| Year. | January.      |              | June.         |              | Year. | January.      |              | June.         |              |
|-------|---------------|--------------|---------------|--------------|-------|---------------|--------------|---------------|--------------|
|       | Second class. | Third class. | Second class. | Third class. |       | Second class. | Third class. | Second class. | Third class. |
| 1818  |               |              | 1             |              | 1858  |               | 2            |               |              |
| 1819  |               |              | 3             |              | 1859  |               |              |               |              |
| 1820  |               |              |               |              | 1860  |               |              |               |              |
| 1821  |               |              | 2             |              | 1861  |               |              |               |              |
| 1822  |               |              | 2             |              | 1862  |               |              |               |              |
| 1823  |               | 1            | 1             |              | 1863  |               |              | 1             |              |
| 1824  | 6             | 6            | 2             | 2            | 1864  |               |              |               |              |
| 1825  |               |              |               |              | 1865  | 1             | 3            |               |              |
| 1826  | 1             | 10           |               |              | 1866  |               |              |               |              |
| 1827  |               | 3            |               |              | 1867  |               |              |               |              |
| 1828  |               |              |               |              | 1868  | 2             | 2            |               |              |
| 1829  |               | 1            |               |              | 1869  |               |              |               |              |
| 1830  |               |              |               |              | 1870  | 2             | 4            |               |              |
| 1831  |               |              |               |              | 1871  |               |              |               |              |
| 1832  |               |              |               |              | 1872  |               |              |               |              |
| 1833  |               |              |               |              | 1873  |               |              |               |              |
| 1834  |               | 5            |               | 1            | 1874  |               |              |               | 1            |
| 1835  | 1             | 6            |               |              | 1875  |               |              |               |              |
| 1836  | 10            | 6            | 2             |              | 1876  |               |              | 1             |              |
| 1837  |               | 6            |               |              | 1877  |               | 4            |               |              |
| 1838  |               |              |               |              | 1878  | 1             |              |               |              |
| 1839  |               | 8            |               |              | 1879  |               |              |               |              |
| 1840  | 2             | 1            |               |              | 1880  | 1             | 1            |               | 3            |
| 1841  | 2             | 3            |               |              | 1881  |               | 1            |               | 1            |
| 1842  |               | 5            |               |              | 1882  |               |              |               |              |
| 1843  | 4             | 2            | 3             | 2            | 1883  |               |              |               |              |
| 1844  | 3             | 2            |               |              | 1884  |               |              |               |              |
| 1845  |               | 6            |               | 2            | 1885  |               | 3            |               | 1            |
| 1846  | 1             | 1            |               |              | 1886  |               |              |               |              |
| 1847  | 2             | 4            |               |              | 1887  |               |              |               |              |
| 1848  |               | 3            |               |              | 1888  |               |              |               |              |
| 1849  | 3             | 5            |               |              | 1889  |               | 7            |               |              |
| 1850  |               | 2            |               | 1            | 1890  |               |              |               |              |
| 1851  |               | 2            |               |              | 1891  | 1             |              |               |              |
| 1852  |               | 8            |               |              | 1892  |               |              |               | 1            |
| 1853  | 3             |              | 2             |              | 1893  |               | 1            |               |              |
| 1854  |               | 1            |               |              | 1894  |               | 1            |               | 1            |
| 1855  |               | 1            |               |              | 1895  |               | 3            |               |              |
| 1856  |               |              |               |              | 1896  | 1             | 4            |               |              |
| 1857  |               |              |               |              |       |               |              |               |              |

F.

WEST POINT, N. Y., *May 31, 1896.*

SIR: In accordance with the requirements of your communication dated Headquarters United States Military Academy, West Point, N. Y., October 3, 1895, I have the honor to submit the following report of the course of studies and methods of instruction, including practical instruction, employed at the Military Academy in the department of mathematics.

Very respectfully, your obedient servant,

EDGAR W. BASS,  
*Professor of Mathematics, U. S. M. A.*

The ADJUTANT, UNITED STATES MILITARY ACADEMY,  
*West Point, N. Y.*

PART I.

BRIEF HISTORICAL SKETCH OF THE DEPARTMENT, GIVING DATE OF ITS ESTABLISHMENT, ITS SCOPE IN THE BEGINNING, AND IMPORTANT STEPS IN ITS DEVELOPMENT.

The following facts are taken mainly from Cullum's Register, Regulations United States Military Academy, staff records of the academic board, cadet registers, Boynton's History of West Point, American State Papers, and laws relating to the Military Academy:

1802.

The Military Academy was established by an act of Congress approved March 16, 1802.

Previous to this date a few cadets of the corps of artillerists and engineers were sent to West Point for instruction.

1801.

Mr. George Barron was appointed teacher of arts and sciences January 6, 1801, and acted as instructor in mathematics.

He was probably appointed under the act of Congress approved July 16, 1798, which authorized the President to appoint four teachers of the arts and sciences necessary for the instruction of artillerists and engineers.

[Extracts from report of Col. Jonathan Williams, dated March 14, 1803.]

"The institution was established at West Point in the year 1801, under the direction of a private citizen (George Barron), and was nothing more than a mathematical school for the few cadets that were then in the service.

"Instruction in mathematics at this period was given in the form of daily lectures on elementary mathematics."

1802.

Mr. George Barron was dismissed the service February 11, 1802.

Capt. Jared Mansfield, Corps of Engineers, acting professor of mathematics, May 3, 1802, to November 14, 1803.

Capt. W. A. Barron, Corps of Engineers, acting professor of mathematics, July 6, 1802, to February 14, 1807.

"Under Major Williams, as superintendent, the Military Academy, with 10 cadets, was formally opened for instruction July 4, 1802.

"Capts. Jared Mansfield and William A. Barron, of the Corps of Engineers, gave instruction in mathematics, the former in the line of algebraical, the latter in that of geometrical demonstrations."

[Extracts from Cullum's History.]

"Four months after the opening of the Academy the first cadet was admitted upon the following testimonial:

"We certify that we have, agreeably to an academic order \* \* \* examined in the elements of arithmetic (vulgar and decimal) \* \* \* Joseph G. Totten, aged 14, \* \* \* and find him well qualified in the aforesaid branches.

"W. A. BARRON,  
"JARED MANSFIELD,  
"Corps of Engineers."

Major Williams gave instruction in the use of instruments.

From 1802 to 1810 cadets entered the Academy without mental or physical examination, and at any time of the year. They were of all ages, from 12 to 34.

"The term began in April and ended in November. Study hours, including recitations, after 1805, were from 8 a. m. to 1 p. m., 2 p. m. to 4 p. m., and in the evening.

"In mathematics the instruction was limited to the elements of geometry and algebra, with the use of surveying instruments.

"During the summer of 1802 a survey of West Point was made and the elevations of surrounding peaks were determined.

"Early in October the first public examination was held by the Superintendent and Captains Mansfield and Barron. Two cadets were examined in Hutton's Mathematics."

Owing to the poor condition of the quarters and the severity of the winters, instruction ceased on the 1st of December and began on the 15th of March following.

## 1803.

Capt. Jared Mansfield was relieved from duty at West Point on November 14, 1803. He was a graduate of Yale College and had a high reputation for learning. After important service in the surveys of the Northwestern Territory he returned to the Academy as professor of philosophy October 7, 1812.

Colonel Williams resigned June 20, 1803, when the command at West Point devolved upon Capt. W. A. Barron.

## 1804.

In April, 1804, the Academy opened with only Captain Barron, the teacher of French, and about 10 cadets.

## 1805.

Until the reappointment of Colonel Williams, April 19, 1805, as chief engineer and Superintendent of the Military Academy, no progress in instruction is recorded for the Academy.

In 1805 the hours from 8 to 11 a. m. were assigned to the study and recitations of mathematics.

Colonel Williams desired the return of Major Mansfield to West Point, stating: "There is not a man in our country, in my opinion, better calculated for a mathematical instructor, as well on account of his amiable character as his professional knowledge."

## 1806.

"A general examination took place October 10, 1806, lasting four days, in the presence of the Superintendent and the acting professor of mathematics. Seven cadets were examined in arithmetic and the elements of algebra and geometry for advancement; 6 cadets in arithmetic, algebra, and geometry for promotion to the artillery, and 5 cadets in algebra, geometry, including surveying, \* \* \* for promotion to the engineers."

## 1807.

Capt. W. A. Barron served as acting professor of mathematics until February 14, 1807.

He was said to be "a man of social temper, fair abilities, and had a faculty for teaching." He subsequently became attached to the Quartermaster's Department.

Mr. Ferdinand R. Hassler, acting professor of mathematics, February 14, 1807, to December 31, 1809.

In 1807 the Academy closed on the 23d of November, after the annual examination, at which 5 cadets were graduated.

## 1808.

The academic term of 1808 began in April, with about 35 cadets.

Instruction in mathematics was given by Professor Hassler, assisted by Lieut. Alden Partridge.

## 1809.

In 1809 the Academy opened about the 1st of April, with about 30 cadets.

William Eustis had in the meantime been appointed Secretary of War. He began immediately to do all he could to crush the Academy by depriving it of students, teachers, and means of support.

In September, 1809, Lieut. Alden Partridge, who was in command, reported as follows:

"On Monday last there was a very thin mathematical academy. \* \* \* Yesterday there was a still less number in the mathematical academy, and some of those who did attend did not come into the academy until about 10 o'clock."

October 24, 1809, Lieutenant Partridge proposed that "no person be appointed a cadet who is under 14 or over 18 years of age; nor unless he can produce testimony of his knowledge of the first rules of arithmetic." \* \* \*

"Professor Hassler was born in Switzerland and studied mathematics at the University of Göttingen. He was the director of a geodetic survey of Switzerland. Although a profound mathematician, he was not a successful teacher except for those with considerable aptitude for mathematics. His methods of instruction were original and his tendency was toward analytical mathematics. With no idea of discipline, he supplied valuable information to all of his students, but made impressions on very few of them."

He was the author of a work entitled Elements of Analytic Trigonometry.

After leaving the Academy he was appointed Superintendent of the United States Coast Survey.

While not a great teacher, there is no doubt but what the country and Military Academy are much indebted to him for the introduction and practical use of mathematics. It is said that Hassler was the first one to teach analytic trigonometry in this country.

As acting professor of mathematics at the Academy his salary was \$700 per year.

"With the academic term of 1809 ended the active services of all the heads of the several branches of instruction." \* \* \*

1810.

"Professor Hassler, of the department of mathematics, resigned February 14, 1810, leaving the department of mathematics in charge of Capt. Alden Partridge, Corps of Engineers."

"Capt. Alden Partridge, Corps of Engineers, assistant professor of mathematics, November 4, 1806, to June 5, 1811, also from April 29, 1812, to April 13, 1813. Professor of mathematics, April 13, 1813, to September 1, 1813."

"In 1810 the Academy was deprived of nearly all means of instruction \* \* \* Officers and cadets were troubled about getting their pay. The disgraceful condition of the Academy at this period was due to the opposition of William Eustis, Secretary of War, who apparently did all in his power to crush the Academy."

Colonel Williams, after much effort, succeeded in securing the Secretary of War's approval to the following regulations:

[From Regulations United States Military Academy, 1810.]

"1. \* \* \* no cadet shall be admitted into the Military Academy under the age of 15 or above that of 20. \* \* \*

"3. \* \* \* The qualifications for admission into the Academy \* \* \* that the candidate is well versed in \* \* \* and arithmetic." \* \* \*

Vacations were granted annually from December 15 to March 15.

May 25, 1810, Colonel Williams also established the following internal regulations for the Military Academy:

"1. Every cadet attached to the Military Academy previous to his being considered a candidate for a commission shall have completed the following course of studies, viz:

"In mathematics he shall be required to be well versed in arithmetic, logarithms, the elements of algebra, geometry, trigonometry, mensuration, \* \* \* planometry, stereometry, surveying, \* \* \* conic sections."

1811-12.

During 1811 and part of 1812 the Academy practically ceased to exist as such. On March 31, 1812, the Academy was left without a single instructor or cadet.

Up to 1812 the library was very small, the apparatus incomplete, the buildings dilapidated, and the facilities for instruction inadequate. At this time "algebra, to include cubic equations, geometry, plane trigonometry, mensuration of planes and solids, and the use of instruments constituted the mathematical course. All cadets were required to obtain a thorough knowledge of this course, which was contained in the first volume of Hutton's Mathematics. Two years were generally devoted to the course in mathematics, but it varied somewhat, depending upon the previous attainments and capacity of the pupil."

1812.

In 1812 Congress passed a law relating to the Military Academy which in a great measure reorganized the institution.

[Extract from act of Congress approved April 29, 1812.]

"SEC. 2. *And be it further enacted*, That the Military Academy shall consist of the Corps of Engineers and the following professors: \* \* \* one professor of mathematics, with the pay and emoluments of a major, if not an officer of the corps, and if taken from the corps, then so much, in addition to his pay and emoluments, as shall equal those of a major. \* \* \*

"Each of the foregoing professors to have an assistant professor, which assistant professor shall be taken from the most prominent characters of the officers or cadets, and receive the pay and emoluments of captains, and no other pay or emoluments while performing those duties.

"\* \* \* that the candidates for cadets be not under the age of 14, nor above the age of 21 years; that each cadet \* \* \* shall be well versed in reading, writing, and arithmetic." \* \* \*

Secretary Eustis did nothing to carry out the provisions of the above act. On March 31, 1812, the Military Academy was without a single instructor.

In September, 1812, C. S. Merchant was the only cadet at West Point.

During the winter five others reported but were furloughed till April 15, 1813.

Captain Partridge is reported as "being an able, strong-willed, but eccentric man, who wanted to have his own way in everything pertaining to the Military Academy. He was a good mathematical instructor, but had little administrative ability."

The difficulties under which he labored render it impossible to decide whether or not he was responsible for the lack of development in mathematical instruction from 1809 to 1813. It seems to be thoroughly established, however, that during the subsequent four years his peculiar conduct rather retarded than advanced the interests of the Academy.

1813.

Andrew Ellicott, professor of mathematics, September 1, 1813, to August 29, 1820.

While the act of 1812 prescribes definite requirements for admission, no attention seems to have been paid to the law.

1816.

[Extract from report of De Witt Clinton, February 1, 1816.]

"In the Military Academy no previous examination is required for the admission of cadets; they are not divided into classes; a course of studies is not prescribed; nor is a final examination \* \* \* essential." \* \* \*

The first course of study which received the authority of the Secretary of War is given in the regulations of May 22, 1816.

[Extracts.]

\* \* \* \* \*

"A complete course of mathematics will embrace the following branches, namely: The nature and construction of logarithms; the use of tables; algebra, to include the solution of cubic equations, with all preceding rules; geometry, to include plane and solid geometry; also ratios, \* \* \* mensuration, plane trigonometry, with its application to surveying and measurements of heights and distances; spherical trigonometry; \* \* \* conics, with applications to military and other projectiles; fluxions, to be taught and studied at the option of the professor and student."

Due to the opposition of Captain Partridge, the regulations of 1816 were not enforced.

Hutton's Mathematics, used by Professor Ellicott: "It was a sort of compendium of mathematics, embracing arithmetic, logarithms, algebra, geometry, trigonometry, land surveying, conics."

E. D. Mansfield states "that the curriculum for 1816 did not include fluxions, but that calculus was added to the course a year or two later."

During the first year, logarithms, algebra, and plane geometry, to include ratio and proportion, were studied, and during the second year geometry was continued to include that of planes and solids, the construction of geometrical problems, the application of algebra to geometry, the mensuration of planes and solids, plane and spherical trigonometry, and conic sections.

On December 1, 1816, the department of mathematics received much assistance in the appointment of Charles Davies as principal assistant professor of mathematics.

1817.

March 6, 1817, Prof. Claude Crozet, a graduate of the Polytechnic School of Paris, introduced the first instruction in descriptive geometry in the Military Academy, and, so far as I know, the first in this country. This instruction was oral in the beginning, and was given to a few pupils only. No text-book was then used, the demonstrations being made by the professor (using the blackboard) for the purpose of aiding his students in the study of engineering.

Professor Crozet greatly stimulated and advanced the study of geometrical mathematics in the United States. In 1821 he wrote a treatise on descriptive geometry and perspective.

During the period from 1809 to 1817 but little progress was made in the mathematical studies.

On July 28, 1817, Maj. Sylvanus Thayer was made Superintendent of the Academy. His appointment marks a new era in the history of the development of the Academy, including that of mathematical instruction.

"It was through Major Thayer's agency that Prof. Claude Crozet, the parent of descriptive geometry in America, became attached to the Academy."

"Major Thayer classified cadets according to proficiency in studies, divided classes into small sections, required weekly class reports, established more thorough recitations, with freer use of the blackboard, and improved the curriculum of studies."

1818.

The regulations approved July 22, 1818, established semiannual examinations, the first to commence on January 1, and the second on the 1st of June.

Entrance examinations were to be held from June to September 1, but candidates were examined as late as November. At this time, 1818, some candidates were assigned to advanced classes, and the classes were divided into two sections for instruction.

In June, 1818, the following alterations were made in the mathematical course: Analytical, plane, and spherical trigonometry were added to the second year's course, and descriptive geometry was transferred from the fourth to the second year.

Hutton's Conic Sections was substituted for Simpson's.

1819.

In January, 1819, classes were organized into sections according to gradation of merit. The examinations included all courses studied up to the time of the examination. Thus, in June, 1819, the first class was examined upon the entire course of mathematics.

The examinations at this time were quite thorough, for out of 120 examined in algebra January, 1819, 74 were pronounced proficient, 20 doubtful, and 26 deficient. The examinations appear to have been entirely oral, and about one day was devoted to a section of about 25.

1820.

In 1820 algebra and geometry were studied during the first year. Trigonometry, surveying, conics, descriptive geometry, and (provisionally) fluxions were studied during the second year.

Perspective, shades, and shadows were taught in the engineering course.

The following copy of a weekly class report, dated November 18, 1820, exhibits the method at that time. The scale of marking on daily recitations ranged from +3 to -3.

*Class report for week ending November 18, 1820. a*

[Class third.—Department of mathematics, second section.]

| No. | Name. | Monday. | Tues-<br>day. | Wednes-<br>day. | Thurs-<br>day. | Friday. | Satur-<br>day. | Total. |
|-----|-------|---------|---------------|-----------------|----------------|---------|----------------|--------|
| 1   | D     | 3       | 2½            | 2               | 2              | 1       | 1½             | 12     |
| 2   | R     | 3       | 2             | 2               | 1½             | 1       | 1½             | 11     |
| 3   | G     | 3       | 2½            | 2½              | 2              | 1½      | 1½             | 13     |
| 4   | C     | 3       | 3             | 3               | 2½             | 2½      | 3              | 14½    |
| 5   | L     | 2       | 1½            | 1               | 1½             | 1       | 1              | 8      |
| 6   | S     | ½       | 3             | 3               | 2½             | 2½      | 3              | 14½    |
| 7   | B     | 3       | 3             | 3               | 2½             | 2       | 3              | 16½    |
| 8   | M     | ½       | -2            | 0               | 1              | -1      | 0              | -1½    |
| 9   | H     | ½       | 3             | 3               | 2½             | 2       | 3              | 15     |
| 10  | K     | 1½      | 2             | 2               | 1½             | 2       | 1              | 10     |
| 11  | T     | -1      | 1½            | 1½              | 1              | 1½      | 1              | 5½     |

*a* Progress from articles 44 to 75, in Gregory's Mathematics (algebra).

EXPLANATION OF THE FIGURES AND SIGNS USED ABOVE.

Scale of merit used: Best, 3; very good, 2; good, 1; indifferent, 0; bad, -1; worst, -3. The intermediate marks, 2½, 1½, and -2, express intermediate merit.

Andrew Ellicott was born January 24, 1754, in Bucks County, Pa. Early in life he acquired scientific attainments and was employed frequently in the settlement of boundaries of the new States. In 1790 he laid out the city of Washington and determined the boundaries of the District of Columbia. He was the recipient of many honors, including a membership of the National Institute of France. He was one of the recognized leaders of science for a period of forty years.

He held the professorship of mathematics with credit till his death, August 29, 1820.

David B. Douglass, captain, Corps of Engineers, professor of mathematics, August 29, 1820, to May 1, 1823.

1821.

The general regulations for the Army, 1821, established the annual term from September 1 to July 1, with general examinations in June, in the presence of the board of visitors, by the academic board in all the branches of science and instruction through which the cadets had passed.

The superintendent was authorized to detail cadets to act as assistant professors, each to receive \$10 per month for extra services.

The manner of giving instruction is indicated by the following extracts from the regulations of 1821.

\* \* \* \* \*  
 59. For convenience of instruction in mathematics the third and fourth classes shall be divided separately into convenient sections, which sections shall be counted off from the mathematical merit roll of each class, respectively, in such manner that the first section shall consist of the first cadets on that roll, the second of those next in order, and so on. The first sections thus formed shall be under the immediate tuition of the professor, and each of the others of an assistant professor of mathematics, and will attend with them three hours every day in the recitation room of the section.

60. The instruction to be conveyed under each particular head of the specified course of mathematics will be proportioned in extent as well as in the manner of conveying it to the capacity of the different sections, and in conformity with this principle the following branches may be omitted in the instruction of the lower sections at the discretion of the academic board, viz: The summation of infinite series and figurate numbers, construction of logarithms, construction of trigonometrical tables and fluxions; those, together with the more profound and difficult investigations of the course generally, being reserved for the sections of the highest rank.

\* \* \* \* \*  
 64. The professors of mathematics, natural philosophy, and engineering; in order to ascertain the proficiency of the sections intrusted immediately to their assistants and the manner in which they have performed their duty, shall occasionally, and in rotation, when there are more than two sections, instruct the sections intrusted to the assistants, the period for which will be fixed by the academical staff and reported to the War Department, and the assistant professor, when the professor has his section under his instruction, shall take charge of the section usually under the instruction of the latter. Lectures or such portions of the studies as are most suitable to them may, with the assent of the superintendent, be substituted in lieu of the usual mode of instruction.

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 76. Each cadet, previously to his being admitted a member of the Military Academy, must be able to read distinctly and pronounce correctly, to write a fair, legible hand, and to perform with facility and accuracy the various operations of the four ground rules of arithmetic, both simple and compound, also of reduction, of single and compound proportion, and of vulgar and decimal fractions.

The hours allotted to the study of mathematics were from sunrise to 7 a. m., 11 a. m. to 12 m., and one-half hour past sunset to 9.30 p. m. The time from 8 to 11 a. m. was employed in mathematical instruction.

The following is a detailed programme of the course in mathematics:

[Extract from staff records.]

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## VII. DETAIL OF INSTRUCTION, HAVING REFERENCE TO THE DIFFERENT SECTIONS.

### *First mathematics.*

*Algebra.*—Fundamental operations; involutions and evolutions; reduction and conversion of practical and surd quantities; reduction and solution of equations, to include those of the third degree; ratios and proportions; summation of infinite series and figurate numbers; nature and construction of logarithms.

*Geometry.*—Plane and solid geometry, and the construction of geometrical problems; application of algebra to geometry; practical geometry on the ground; mensuration of planes and solids.

*Trigonometry.*—The solution of all the various cases of plane and spherical triangles; spherical projections; the analytical investigation of trigonometrical principles and the construction of tables.

*Surveying.*—The principles of common and trigonometrical surveying; measurement of heights and distances; the actual use in the field of the various instruments employed in surveying; different methods of plotting surveys, and the use of mathematical instruments.

### *Conic sections.*

*Descriptive geometry.*—The solution of geometrical problems, generally by the graphical method, and the application of this method to spherical trigonometry.

*Fluxions.*—The direct and inverse method of fluxions; its application to maxima and minima; the drawing of tangents; rectification of curves; radii of curvatures, quadratures, cubatures, etc.

The instruction under each particular head of the course of mathematics, as thus specified, will be proportioned, in extent and in the manner of conveying it, to the rank and capacity of the different sections, the more profound investigations generally, and the following entire subjects being reserved for the higher sections only, viz: Summation of infinite series and figurate numbers, construction of logarithms, construction of trigonometrical tables, and the whole course of fluxions.

In 1821 Biot's application of algebra to geometry was introduced as a class book.

1823.

In 1823 I find that the following text-books were in use: The Cambridge Trigonometry, Legendre's Geometry (translation), Lacroix's Algebra (translation), Sganzi's Course of Construction, Garnier's Analytic Geometry. The use of Hutton's Mathematics was discontinued.

Professor Douglass was a scientist of a high order, a man of great character, and a good mathematician. His influence was always for better discipline and a high standard in educational methods. On May 1, 1823, he was appointed professor of engineering.

Charles Davies, professor of mathematics, May 1, 1823, to May 31, 1837.

1824.

In 1824 a translation of Lacroix's Trigonometry was used.

To indicate the standard of requirements at this date, we have the fact that out of 100 who entered at that date but 24 graduated.

Descriptive geometry was mainly taught by lectures; notes were taken by the pupils on one day, and drawings made before the next lecture. The work by Crozet was also in use.

In 1824 Biot's Analytical Geometry, in French, was used, and Lacroix's Calculus for the higher sections.

1825.

[From United States Army Regulations, 1825.]

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Par. 1370. For instruction in mathematics the third and fourth classes shall be separately divided into convenient sections, which sections shall be counted off from the mathematical merit roll of each class, respectively, in such manner that the first section shall consist of the first cadets on that roll, the second of those next in order, and so on. The first section thus formed shall be under the immediate tuition of the professor, and each of the others of an assistant professor of mathematics.

Par. 1371. The instruction in each particular branch of the course of mathematics will be proportioned to the capacity of the different sections; the more profound and difficult investigations of the course, generally, being reserved for the higher sections.

\* \* \* \* \*

Par. 1347. The complete course of mathematics will comprehend:

*Algebra.*—Fundamental operations; involutions and evolutions; reduction and conversion of fractional and surd quantities; reduction and solution of equations, to include those of the third degree; ratios and proportions; summation of infinite series and figurate numbers; nature and construction of logarithms.

*Geometry.*—Plane and solid geometry and the formation and construction of determinate geometrical equations.

*Trigonometry.*—The solution of all the various cases in plane and spherical trigonometry; spherical projections; analytical investigation of trigonometrical formulæ and the construction of tables.

*Surveying.*—Mensuration of planes and solids; principles and practice of common land surveying, different methods of platting and calculating such surveys, and the use of mathematical instruments. Also trigonometrical surveying and measurement of heights and distances, together with the use of the instruments usually employed therein.

*Descriptive geometry.*—The graphic illustration and solution of problems in solid geometry generally, and the particular application of this method to spherics and conic sections.

*Perspective.*—The theory and use of linear perspective, shades, and shadows.

*Analytical geometry.*—The construction and analysis of linear and superficial loci, particularly for equations of the first and second order.

*Fluxions.*—The direct and inverse methods of fluxions; its application to maxima and minima; the drawing of tangents; rectification of curves, radii of curvatures, quadratures, cubatures, etc.

The text-books in use at this time were:

*First year.*—Algebra: *Complement des Elemens d'Algebre*, par Lacroix; Lacroix's *Elements of Algebra*. Geometry: Legendre. Trigonometry: Translation from Lacroix, from Lacroix & Bezout, by Professor Farrar.

*Second year.*—Descriptive geometry, conic sections: Crozet's *Treatise on Descriptive Geometry and Conic Sections*. Perspective, shades, and shadows: Crozet's *treatise on same*. Analytical geometry: Biot. Fluxions: *Traité du Calcul*, par Lacroix.

1828.

At the head of the graduating class of July 1, 1828, stood Cadet Albert E. Church, who was destined for a long and successful career in the department of mathematics in this Academy. From August 31, 1828, to August 28, 1831, he served as assistant professor of mathematics.

1831.

In 1831 Lieut. Edward C. Ross, then assistant professor of mathematics, translated M. Bourdon's *Algebra*, which was adopted as the text-book on that subject. This translation became the foundation of the subsequent *Davies's Bourdon*.

About this time Prof. Charles Davies began writing a series of mathematical text-books, which were adopted from time to time as they appeared. By 1839 all of the mathematical text-books in use at the Academy were works of Davies.

The relative weight given to the different subjects in forming the general merit roll of each class is represented by the following numbers:

FIRST CLASS.

|  |   |                        |   |
|--|---|------------------------|---|
| Conduct .....                                  | 3 | Infantry tactics ..... | 2 |
| Engineering .....                              | 3 | Artillery .....        | 1 |
| Mathematics .....                              | 3 | French .....           | 1 |
| Natural philosophy .....                       | 3 | Drawing .....          | 1 |
| Chemistry and mineralogy .....                 | 2 |                        |   |
| Rhetoric and moral and political science ..... | 2 |                        |   |

SECOND CLASS.

|                          |   |               |   |
|--------------------------|---|---------------|---|
| Natural philosophy ..... | 3 | Drawing ..... | 1 |
| Chemistry .....          | 1 |               |   |

THIRD CLASS.

|                   |   |               |               |
|-------------------|---|---------------|---------------|
| Mathematics ..... | 3 | Drawing ..... | $\frac{1}{2}$ |
| French .....      | 1 |               |               |

FOURTH CLASS.

|                   |   |              |   |
|-------------------|---|--------------|---|
| Mathematics ..... | 2 | French ..... | 1 |
|-------------------|---|--------------|---|

MANNER OF GIVING INSTRUCTION.

[Extract from Regulations United States Military Academy, 1831.]

\* \* \* \* \*

44. For instruction in mathematics the third and fourth classes shall be separately divided into convenient sections, which sections shall be counted off from the mathematical merit roll of each class, respectively, in such manner that the first section shall consist of the first cadets on that roll, the second of those next in order, and so on. The first section thus formed shall be under the immediate tuition of the professor, and each of the others of an assistant professor of mathematics. The instruction in each particular branch of the course of mathematics will be proportioned to the capacity of the different sections; the more profound and difficult investigations of the course generally being reserved for the higher sections.

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55. Every assistant instructor or teacher having the immediate charge of one or more sections of a class shall keep daily notes of its or their progress and the relative merit, and at the end of each week shall report thereon to the head of the

department to which he belongs. The reports thus made shall be rendered to the superintendent by the head of each department with such further explanations as may be necessary to show the relative progress of the sections, and he will at the same time recommend all the transfers which are to be made from one section of the class to another.

COURSE IN MATHEMATICS AT THE MILITARY ACADEMY, 1832.

*Second year, third class.*—Fluxions, Lacroix; analytical geometry, Biot; perspective—shades and shadows, Davies; mensuration, Davies.

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*First year, fourth class.*—Trigonometry, Legendre; descriptive geometry, Davies; geometry—plane and solid, Legendre; algebra, Bourdon, translated by Lieutenant Ross.

1833.

On October 28, 1833, Lieut. Albert E. Church, who had been absent from the Academy since August 28, 1831, was again placed on duty in the department of mathematics as principal assistant professor of mathematics.

On July 1, 1833, Col. Sylvanus Thayer was relieved and Maj. R. E. De Russy took command.

“Under Thayer’s management mathematics advanced from Hutton’s Elements to a complete course of algebra, geometry, plane and spherical trigonometry, descriptive geometry (including shades and shadows, and perspective), surveying, use of instruments, analytical geometry, and the calculus.”

[Extract from report on Military Academy by Committee on Military Affairs, May 17, 1834.]

“Mathematics is the study which forms the foundation of the course. This is necessary, both to impart to the mind that combined strength and versatility, that peculiar vigor and rapidity of comparison necessary for military action, and to pave the way for progress in the higher military sciences. All experience shows that the mind, in order that it may act with efficiency, must be accustomed to exertion. It should be taught gradually to develop its own powers, and as it slowly learns their capacity and the manner of employing them, the increasing lights which are thrown upon its course will enable it to go on for an unlimited extent in the path of improvement. Algebra and geometry, and the application of algebra to geometry, form the studies of the first year. The text-books used are generally from the French mathematicians. The French claim the high honor of having introduced a revolution into all the branches of this science, and of having substituted analysis for the Newtonian method of investigation.

“Descriptive geometry is also studied during this year. This is a science peculiarly necessary in civil and military engineering, and which has been nowhere else cultivated with advantage or assiduity, save in France. The foundation for analysis is well laid by the study of that prince of algebraists, Bourdon.

“The course of the second year extends to the higher branches of mathematics, to the theory of curves, and to the differential and integral calculi. In these branches the works of those illustrious authors, Biot and Lacroix, are employed.”

1835.

In 1835 paragraph 55, United States Military Academy Regulation, was changed to read practically the same as paragraph 52 of the present regulations, and I infer that previous to this time transfers from section to section were not made weekly.

1837.

Prof. Charles Davies entered the Military Academy in December, 1813, and graduated in December, 1815. From 1816 to 1821 he was principal assistant professor of mathematics, and from May 1, 1823, to May 31, 1837, he was professor of mathematics.

For a period of twenty-one years Professor Davies was closely identified with the Military Academy, and gave his best years to its advancement. In 1826 he wrote a text-book on descriptive geometry.

He did much to systematize and classify the methods of instruction in the Military Academy. Owing to the fact that no good series of mathematical text-books existed, he began, about 1830, to devote himself to their preparation.

He first wrote his geometry, which was based upon Legendre’s, and followed it with his algebra, taking Bourdon as his standard. These two works, revised and modified from time to time, have been continued to the present as text-books in this Academy.

Professor Davies also wrote text-books on trigonometry, surveying, descriptive geometry, analytic geometry, calculus, and arithmetic. In all, he produced more than 20 different volumes, which were for many years the standard text-books in this country.

He was a great teacher and a pioneer author of elementary mathematics. He, more than any other of his time, influenced the development of mathematical instruction in this country.

According to Professor Church, who was closely associated with him, "Professor Davies was an enthusiastic, energetic, clear, logical demonstrator, and an admirable teacher."

Albert E. Church was professor of mathematics from June 1, 1837, to March 30, 1878.

1839.

The following detailed programme by Professor Church of the mathematical course taught and text-books in use at the Military Academy 1839 and 1840 gives a complete description of the course at that time:

*Programme of the course of mathematics as taught at the United States Military Academy, 1839 and 1840.*

#### ALGEBRA.

[Text-book, Davies' Bourdon.]

1. Preliminary definitions, explanations, and uses of the different algebraic signs, symbols, and terms; mode of reducing similar algebraic expressions.
2. Addition of algebraic quantities, with numerous examples.
3. Subtraction of algebraic quantities; transformations of polynomials, with practical examples.
4. Multiplication of algebraic quantities, both monomial and polynomial, with examples; examination of the product of homogeneous polynomials; greatest and least number of terms in the product of two polynomials; formation of the square of the sum or difference of two quantities and of the product of the sum by the difference; decomposition of quantities into factors, with examples.
5. Division of algebraic quantities, both monomial and polynomial, with applications; mode of indicating the division when not possible and of reducing the result to its simplest form, with examples; value of the expression  $a^0$ ; demonstration of the possibility of dividing the difference of two similar powers of two quantities by the difference of the quantities.
6. Explanation and classification of algebraic fractions; manner of reducing them to simplest form; theory and use of the greatest common divisor; rules for reduction, addition, subtraction, multiplication, and division of fractions, with examples; discussion of the result obtained by adding the same quantity to both terms of a fraction.
7. Definition and classification of equations; explanation of the different transformations of equations of the first degree, with examples; solution of equations of the first degree with one unknown quantity, with examples both literal and numerical; explanation of the manner of forming the equation of a problem from express or implied conditions, with applications to numerous questions; explanation of the three principal modes of elimination, and application to the solution of equations containing two or more unknown quantities; distinction between determinate and indeterminate quantities.
8. Theory of negative quantities discussed and illustrated by several problems; explanation of the symbols  $\frac{A}{O}$ ,  $\frac{O}{A}$ , and  $\frac{O}{O}$ ; discussion of particular examples which reduce to form  $\frac{O}{O}$  without being indeterminate.
9. Of inequalities and of the different transformations which can be performed upon them, with examples.
10. Demonstration of the law of formation of the square, and thence the rule for the extraction of the square root of numbers; rules for approximating to the square roots of imperfect powers, whether entire or fractional, to within less than a given quantity, with applications; explanation of the terms incommensurable, irrational, and surd.
11. Extraction of the square root of algebraic quantities first applied to monomials; demonstration of the principle that the square root of a product is equal to the product of the square roots of the several factors; explanation of imaginary quantities; demonstration of the law of formation for the square of any polynomial, and

thence the rule for the extraction of the square root of polynomials, with applications; radicals and their classification into degrees; similar radicals; rules for adding, subtracting, multiplying, and dividing radicals of the second degree, with applications; explanation of important transformations of radicals of the second degree.

12. Equations of the second degree with one unknown quantity; their classification and mode of solution, with applications; explanation of the roots of an equation of the second degree, their properties; division of first member of an equation into factors, with the general and complete discussion of the four forms of equations of the second degree; application of this discussion to the "problem of the lights."

13. Mode of estimating the degree of equations containing two unknown quantities; solution of some equations of the second degree of this kind; explanation of, and means of solving trinomial equations.

(o) 14. Mode of extracting the square root of trinomials of the form of a  $\pm\sqrt{O}$ , with examples.

15. Application of preceding principles to the solution of many equations, and questions depending upon equations of the second degree, containing one or two unknown quantities. Remark: Some of the equations and questions referred to in this paragraph being difficult, the lower sections of the class are not required to solve them.

16. Definition and theory of arithmetical proportions and progressions. Determination of the formulas expressing any term, the sum of the terms, and the common difference in both increasing and decreasing progression. Mode of inserting any number of arithmetical means between two quantities.

17. The same with reference to geometrical proportions and progressions.

18. Demonstration of the law for the formation of the product of any number of factors of the form  $(x-a)x-b$ , etc. Explanation of the theory of permutations, arrangements, and combinations, with its application to the demonstration of the binomial theorem for the formation of any power of a binomial; consequences of the binomial formula.

19. Demonstration of the law of formation of the cube of a number, and thence the rule for the extraction of the cube root with applications; the same extended to any power and root of a number; mode of simplifying the extraction of roots of the higher degrees; mode of approximating to the roots of imperfect powers whether entire numbers, vulgar or decimal fractions, to within less than a given quantity, with numerical examples.

20. Manner of forming the powers and extracting the roots of any degree of algebraic monomials; demonstration of the law for the formation of the cube of any polynomial and thence the rule for the extraction of the cube root of a polynomial; the same extended to any power of root of a polynomial, with examples.

21. Manner of simplifying and reducing radicals of any degree; of adding, subtracting, multiplying, and dividing them; also the formation of their powers and extraction of their roots; discussion of the different roots of a quantity and particularly of the roots of unity.

22. Theory of exponents, with rules for multiplying, dividing, formation of the powers, and extraction of the roots of quantities affected, with any exponents.

(o) 23. Euler's demonstration of the binomial theorem in the case of any exponent.

24. Explanation of conveying and diverging series, with the means of approximating to the sum of the former kind in certain cases.

25. Theory of indeterminate coefficients and development of functions by means of them.

(o) 26. Explanation and formation of recurring series.

(o) 27. Explanation of continued fractions, with rules for approximating to their value, and determining the degree of approximation; resolution of exponential equations.

28. Complete theory of logarithms; explanation of manner of using them in multiplying, dividing, forming the powers and extracting the roots of numbers; formation of logarithmic series and explanation of mode of calculating tables of logarithms.

(o) 29. General theory of equations; their properties; number and nature of their roots; division into factors of different degrees; their transformations and composition; complete theory of the common divisor and its application, elimination, and the determination of final equations; formation of derived polynomials; mode of determining, and discussion of the equal roots of equations.

(o) 30. Resolution of numerical equations of the higher degrees, determination of the limits of their roots; Newton's method of finding the smallest limit in active numbers; demonstration of Descartes's rule for ascertaining the greatest number of positive and negative roots; properties of and mode of determining the commensurable roots of numerical equations; Newton's method of approximating to the real incommensurable roots when they differ from each other by at least unity.

## GEOMETRY.

[Text-book, Davies' Legendre.]

1. Preliminary definitions; explanation of the different kinds of plane geometrical figures, of the terms and symbols used.
  2. Demonstration of the geometrical properties of the right line; the conditions of equality in angles and triangles and their properties; of the isosceles triangle; of perpendicular and parallel lines; leasure of the sum of the interior and exterior angles and triangles of polygons; properties of parallelograms.
  3. Explanation of ratios and proportions, with their properties.
  4. Definition of the circle and its different parts; their properties and connection; nature of a tangent to a circle; conditions that two circles intersect or be tangent; measurement of and mode of comparing angles, of inscribed angles.
  5. Solution of problems relating to the right line and circle, including method of drawing perpendiculars; geometrical construction of triangles and parallelograms; division of angles; inscribing and circumscribing circles in and about triangles; construction of tangent line to the circle: determination of the numerical ratio of two right lines, arcs or angles, etc.
  6. Definition and nature of similar figures; equivalent and equal figures; conditions that parallelograms contain equal arcs; relation between parallelograms and triangles of same base and altitude; proportions of different rectangles; determination of the measure of the area of the rectangle, parallelogram, triangle, and trapezoid of the square described upon the sum or difference of two lines; of the rectangle upon the sum and difference; relation of the squares described upon the sides of a scalen triangle; same with respect to the right-angled triangle; properties of similar triangles; conditions for similar triangles; general properties of the right-angled triangle; proportions of similar figures in general; properties of chords and secants.
  7. Solution of problem depending upon the preceding principles, including division of right line into proportional parts; construction of mean proportions; third and fourth proportions; construction of squares which shall be equivalent to given figures; construction of similar figures.
  8. Regular polygons and their properties; manner of circumscribing them about and inscribing them in a circle; measure of their angles and area when similar; relation between them when inscribed in the same circle, or circumscribed about it; measure of the area and length of the circumference of a circle; also the area of circular sectors; proportions of circles and their circumferences; calculation of the approximate ratio of the diameter to the circumference of a circle.
  9. Properties of the plane; definition; condition of equality and mode of comparing solid angles; construction of perpendicular to a plane; theories relating to the intersection of planes; of parallel planes; equality of plane angles when not in the same plane; limits of the sum of the plane angles forming a solid angle.
  10. Definitions of polyhedrons, different kinds; consequences of their intersection by planes; regular polyhedrons; measure of the convex surface of a regular pyramid and frustum; measure of the solidity of any prism; relation between prisms and pyramids having same base and altitude; measure of surface of right prisms; proportions of paralleloipedons, when equivalent; measure of their solidity; measure of the solidity of pyramid and of any polyhedron; comparison of similar prisms and pyramids.
  11. Definition of properties and mode of generating the threeround bodies; measure of the convex surface and solidity of a cylinder; same with respect to a cone and frustum; relation between similar cylinders and cones; intersection of spheres by planes; position of tangent plane to sphere; measure of the surface generated by a regular semipolygon revolved about a fixed axis and its application to the determination of the measure of the surface of a sphere and zone; measure of solid generated by a triangle revolving about a fixed axis, and thence of the solid generated by a regular semipolygon and the application to the determination of the measure of the solidity of a sphere; comparison of the surfaces and solidities of sphere and circumscribed cylinder; measure of the solid generated by a circular segment revolving about a fixed axis; measure of a spherical segment.
  12. Definition of spherical triangles and polygons; their properties, conditions for equality; limits of the sum of their angles and the measure of their area; polar triangles and their properties; spherical lune and its measure; spherical pyramid and wedge; construction of regular polyhedrons.
  13. Numerous applications of algebra to the solution of geometrical problems.
- Remark: The lower sections are required to solve but a portion of these problems.

## PLANE TRIGONOMETRY.

[Text-book, Davies's Legendre.]

1. Its object; manner of dividing the circumference; explanation of the different trigonometrical lines employed and discussion of their value and algebraic signs for different values of the arc.

2. Formulas expressing the value between the sine, cosine, and radius; the value of the tangent, cotangent, secant, and cosecant; the relation between the tangent, cotangent, and radius.

3. Formulas expressing the value of the sine and cosine of the sines and difference of two arcs, of the sine and cosine of a double arc, of the sine and cosine of half an arc, of the sum and difference of the sines of two arcs; the same with reference to the cosines of the product of the sine and cosine, sine and sine, etc., of two arcs, of the square of the sine, cosine, tangent, and cotangent of half an arc, of the tangent of the sum and difference of two arcs, of the tangent of a double arc, triple arc, etc.

4. Various other formulas expressing a relation between the sum and difference of the sines and cosines of two arcs, and the sine, cosine, tangent, etc., of one-half the sum or difference of the same.

5. Explanation of the mode of calculating a table of natural sines, cosines, etc.

6. Explanation of the construction and manner of using the common table of logarithms, logarithmic series, tangents, etc.

7. Demonstration of the principles for the solution of all cases of rectilinear triangles, both right-angled and oblique.

8. Explanation of the arithmetical complement of a logarithm and its use, with the calculation of numerous triangles, including examples of every case by the aid of logarithms.

## SPHERICAL TRIGONOMETRY.

[Text-book, Davies's Legendre.]

1. Its object; relation of the sine of the angles to the series of the opposite sides; formulas expressing the value of  $R'$  into the cosine of a side or angle, of the sine and cosine of half an angle in terms of the sides, of the cosine of half a side in terms of the angles, of the cotangent of one side into the sine of another; demonstration and use of Napier's analogies.

2. Napier's circular parts and demonstration of his rules for the solution of right-angled spherical triangles; application of logarithms to the solution of examples of right-angled and quadrantal triangles.

3. Explanation of the mode of solving all cases of oblique-angled triangles, with practical examples in each case.

4. Applications of the principles of geometry and trigonometry to the mensuration of the different geometrical surfaces and solids (a portion of which are not required of the lower sections).

## DESCRIPTIVE GEOMETRY.

[Text-book, Davies.]

1. Its objects and its principles; manner of representing magnitudes on the planes of projection; solution of the principal problems on the right line and plane.

2. Classification of lines; definition and nature of a tangent line.

3. Mode of generation and classification of curved surfaces; of surfaces of revolution; mode of representing surfaces; definition, nature, and properties of tangent planes.

4. Construction of tangent planes to the single curved surfaces of shortest distance between two straight lines.

5. Construction of tangent planes to spheres and surfaces of revolution. Remark: Two of the most complicated methods referred to are not required of the lower sections.

6. Construction of the intersection of curved surfaces and planes applied to the intersection of cylinders and surfaces of revolution by oblique planes; construction of tangent line to the curves of intersection; development of surfaces with application to cylinder and right cone with circular base.

7. Intersection of curved surfaces in general and mode of constructing tangent line to the curve of intersection; applied to intersection of two cylinders and surfaces of revolution, to intersection of oblique cone and sphere with the development of the cone; intersection of two cones.

(o) 8. Application of preceding principles to the construction of several practical problems; also to the construction of spherical triangles.

9. Spherical projections; first principles of orthographic projections; mode of projecting circles; construction of the projection of the sphere on the planes of the equinoctial colure equator and horizon.

10. Principles of stenographic projections; mode of projecting circles, their poles and tangents; construction of the stenographic projection of the sphere on the equator, etc.

11. Nature, modes of generating, classification, and manner of representing warped surfaces; construction of elements; conditions that warped surfaces be tangent to each other along an element.

(o) 12. Properties of the conoid; hyperbolic paraboloid and hyperboloid of one nappe.

13. Construction of tangent planes to warped surfaces.

(o) 14. Construction of tangent plane through a right line to any surface of revolution, and of right line to a curve.

(o) 15. Construction of the intersection of hyperboloid of revolution of one nappe with oblique plane.

#### SHADES, SHADOWS, AND PERSPECTIVE.

[Text-book, Davies.]

1. First principles of shades and shadows.

2. Applications to the mathematical construction of the shades and shadows, of the right line, the abacus and pillar, the house, the cylinder, the rectangular abacus and column; shadow of cylindrical abacus on a vertical wall; shade and shadow of inverted frustrum of a cone, of a sphere, of an ellipsoid, of the niche; shade on the torus.

3. Mode of constructing the brilliant points of surfaces.

(o) 4. The construction of the lines of shade and shadow on a surface of revolution.

(o) 5. Of the properties of the helicoid and its tangent plane.

(o) 6. The construction of the lines of shade and shadow on the screw.

7. Object of perspective; preliminary principles; direct method of constructing the perspective of bodies, applied to a cube.

8. Method of constructing the perspective of point by means of diagonals and perpendiculars; application to the construction of the perspective of four cubes with their shadows, of four pyramids, of a circle, of a cylinder, frustrum of inverted cone; niched sphere and groined arch, with their shadows, etc.

(o) 9. The construction of the perspective of a house, with its shades and shadows.

10. Mode of constructing Mercator's chart; panoramic views, etc.

11. The drawing in right lines of most of the problems above referred to.

#### SURVEYING.

[Text-book, Davies's Surveying.]

1. Description and mode of using the different instruments for drawing and laying off lines and angles; construction of practical problems.

2. Object of surveying; plane surveying; preliminary definitions.

3. Mode of measuring and calculating lines and angles, including the description of the chain, tape, etc.; the manner of adjusting and using the theodolite.

4. Application of principles to the measurement of heights and distances.

5. Methods of determining distances with the tape or chain only.

6. Description and use of the surveying cross.

7. Mode of measuring the area of ground, of laying out and dividing land.

8. Description and use of the surveyor's compass; manner of making notes on the field; different methods of platting the survey; calculation of the area by means of the traverse table, and double meridian distances; use of effects; method of supplying errors in field notes; mode of calculating the area by the use of a table of natural sines.

9. Description of the mode of surveying the public lands.

10. Practical modes of determining the variation of the compass.

11. Description and use of the plane table.

12. Description, manner of adjusting, and use of the level; determination of the difference of level between any two points on the earth's surface.

13. Method of surveying for the purpose of showing the contour of a piece of ground; mode of representing the horizontal curve of intersection by planes.

14. General description of the object and mode of surveying a harbor; method of triangulation.

## ANALYTICAL GEOMETRY.

[Text-book, Davies.]

1. Object and preliminary definitions; mode of representing quantities by algebraic symbols; construction of algebraic expressions; of the roots of the equation of the second degree.

2. Mode of solving determinate problems, applied to several examples.

(o) 3. Division of right line into extreme and mean ratio.

4. Object and nature of indeterminate geometry; nature of equations of lines and points; object and position of coordinate axes; construction of lines by means of their equations; determination and discussion of the equation of the right line; measure of angle between two right lines with conditions that they be perpendicular or parallel; mode of determining the intersection of lines.

5. Object of transformation of coordinates and deduction of the formulas used in all cases for lines in a plane; nature and use of the system of polar coordinates, with the formulas for transformation.

6. Classification of lines; determination and discussion of the equations of a circle; nature and position of its supplementary chords; determination of the equations of its tangent and normal; determination and discussion of its polar equation.

7. Definition of ellipse; determination and discussion of its equations and properties; explanation of the different modes of constructing it; position, properties, and construction of its foci; properties of its supplementary chords; determination and discussion of the equations of its tangent and normal; different modes of constructing its tangents; nature and properties of its conjugate diameters; its equation when referred to them as axes, and manner of constructing them; determination and discussion of its polar equation; measure of its area.

8. Definition of the parabola; determination and discussion of its equation; its properties and modes of construction; position and properties of its focus; the determination of the equation of its tangent and normal; modes of constructing its tangents; determination and discussion of its equation when referred to oblique axes; position, properties, and mode of constructing its diameters; determination and discussion of its polar equation; measure of its area.

9. Nature and properties of the hyperbola; determination and discussion of its equations; mode of constructing it; properties of its supplementary chords; equations of its tangent and normal; modes of constructing its tangents; determination and discussion of its equation when referred to its conjugate diameters; their properties and construction; nature and mode of constructing its asymptotes; their properties; determination and discussion of its equation when referred to them as axes; determination and discussion of its polar equation.

10. Determination and discussion of the particular equation which represents the conic sections when referred to their principal vortex.

(o) 11. Discussion of the general equation of the second degree between two variables; classification of and analytical conditions for the curves represented by it; determination of their limits; modes of construction, points in which they intersect the axes of coordinates; their particular cases; discussion of numerical examples.

12. Nature and properties of centers and diameters; determination of the form of the equation of the second degree when referred to them.

13. Mode of representing points and lines in space; the equations of a point; determination and discussion of the equations of a right line in space; measure of angle between two lines and conditions that they be parallel or perpendicular.

(o) 14. Determination of condition which causes two right lines to intersect; determination of the intersection of two curves.

15. Determination and discussion of the equations of a plane and its traces.

(o) 16. Mode of determining the intersection of planes and surfaces; measure of angle between two planes; conditions that they be parallel; properties of line and plane; numerical examples.

(o) 17. Transformation of coordinates in space; determination of the proper formulas used; nature of polar coordinates in space with formulas for transformation.

(o) 18. Classification of surfaces; determination and discussion of the equation of the sphere and of its tangent plane, of the cylinder and cone; equation of the intersection of the cone and plane determined and discussed; equations of surfaces of revolution.

(o) 19. Discussion of general equation of second degree between three variables; classification of the surfaces represented by it; their centers and center planes; equations of their tangent planes; their modes of generation.

## CALCULUS.

[Text-book, Davies.]

1. Nature and classification of functions; definition of a general rule for obtaining the differential and differential coefficient of a function; demonstration of particular rules for differentiating algebraic functions and obtaining the differential coefficient of an implicit function, with examples.
  2. Mode of obtaining successive differentials; demonstration and application of Taylor's and McLaurin's theorems with examination of their failing cases.
  3. Particular rules for differentiating exponential, logarithmic, and circular functions and applications to examples (the more difficult of which are not required by the lower sections); developments of arcs and their functions with explanation of their use in calculating tables of natural sines, etc., and ratio of diameter to the circumference of a circle.
  4. Nature of partial differentials and differential coefficients of a function of any number of variables; mode of obtaining differential equations.
  - (o) 5. Differentiation of any function of any number of variables; development into a series of any function of two variables; manner of eliminating constants from an equation and its differential equation, being the terms of an equation of exponents.
  6. Demonstration of the rules for determining the value of vanishing fractions, with examples.
  7. Complete discussion of the maxima and minima; states of a fraction of one variable, with rules for determining them, with applications (the more difficult of which are not required of the lower sections).
  8. Application of the differential calculus to the determination of the general equations of a tangent and normal with application to particular curves; determination of the differential of an arc and area; use of the second differential coefficient in determining the position of a curve with reference to the axis of abscissas.
  - (o) 9. Mode of ascertaining and constructing the asymptotes of curves, applied to the conic sections.
  - (o) 10. Characteristics and mode of constructing the singular points of curves.
  11. Conditions and modes of ascertaining when two curves have any contact; determination of the equations of osculatory curves; properties and use of the osculatory circle; measure of the curvature of curves; properties, mode of construction, and determination of the equation of evolutes.
  12. Transcendental curves; discussion of the equation and properties of the logarithmic curve; determination of the equations of the cycloid and its evolute and their properties.
  - (o) 13. Discussion of the equations and properties of spirals.
  - (o) 14. Determination of the equation of a tangent plane to any surface.
  15. The object of the integral calculus; determination of rules for integrating simple monomial differentials; discussion of the arbitrary constant; integration of particular binomials and of the differentials of logarithms and circular functions.
  16. Mode of integrating by series; applied to numerous examples.
  17. Conditions for the integrability of binomial differentials; integration by parts, and determination of formulas for reducing binomial differentials (three of which are not required of the lower sections).
  18. Integration of all cases of rational fractions with examples (the more difficult of which are not required of the lower sections).
  19. Integration of irrational fractions composed of monomials; and of expressions containing  $\sqrt{ax^2 + bx + cx}$  with applications (the most difficult of which are omitted for the lower sections).
  20. Application of the calculus to the rectification of plane curves; to the quadrature of curves; to the determination of the area of surfaces of revolution and the cubature of solids of revolution (a portion of those applications are not required of the lower sections).
  - (o) 21. Nature of double integrals, and their application to the determination of a general expression for the cubature of any solid applied to the sphere.
- General remark.*—The whole course as detailed above is required of the higher sections of the third and fourth classes, while the subjects referred to in the paragraphs marked thus, (o) are not required of the lowest, in accordance with paragraph 45, academic regulations. The intermediate sections are required to learn such portions marked (o) as they can without interfering with the other more important parts.

1843.

The following is the answer of the academic board in regard to certain objections to the course of instruction made by a board of officers, of which Major-General Scott was president, appointed in 1843 to inspect and report upon the United States Military Academy: "The academic board believe that one of the most important

objects of the Academy is to subject each cadet, previous to his promotion to a higher grade in the Army, to a thorough course of mental as well as military discipline, to teach him to reason accurately, and readily to apply right principles to cases of daily occurrence in the life of a soldier. They are satisfied that a strict course of mathematical and philosophical study, with applications to the various branches of military science, is by far the best calculated to bring about this end, and that the present scientific course at the Academy, the result of the experience of many years, is in its main features such a course. They are aware that many of the cadets, as is the case with most of those who pursue a scientific course at other institutions, will have little occasion to make practical applications of the many mathematical formulæ with which they meet, and that they may have passed over particular problems without thoroughly understanding their meaning in all their points; still, if the course has been carefully taught, the reasoning faculties will have been strongly exercised and disciplined and a system and habit of thought acquired which are invaluable in the pursuit of any profession, and as desirable for the infantry or dragoon officer as for any other officer in service. The officer whose mind has thus been disciplined, and who is not forgetful of the duty which he owes to the Government that has furnished him with opportunities so valuable, will acquire facts and information in whatever station the interests of the service may place him. The discipline and system he will acquire at an early age only, and nowhere so well as during his term of service at the Academy."

While it is always possible to improve the curriculum of this or any other institution, the objection to which the above is an answer is one that is constantly raised by those who have had little or no experience in the development of the mental faculties of youth. It would be well to have the above statement printed for the information and instruction of those well-meaning but narrow-minded friends of the Military Academy who always desire a practical equivalent for each mental effort.

These same debit and credit mental protectors read of those who, hundreds of years before Christ, raised exactly the same objections to the geometrical teachings of Pythagoras and Euclid, without realizing that a hand glass would exhibit to them fair likenesses of their ancient prototypes.

The course of instruction and the text-books in mathematics remained practically the same from 1839 till 1843, when Church's Calculus was substituted for Davies's.

## 1852.

In 1852 Church's Analytical Geometry replaced Davies's.

## 1855.

In 1855 the mathematical course was arranged and distributed as follows:

*First year, fifth class.*—Algebra, Davies' Bourdon; geometry, Davies' Legendre; trigonometry, Davies; descriptive geometry, Davies.

*Second year, fourth class.*—Algebra, Davies' Bourdon; geometry, Davies' Legendre; trigonometry, Davies; descriptive geometry, Davies.

*Third year, third class.*—Shades, shadows, and perspective, Davies; spherical projections and warped surfaces, Davies; surveying, Davies; analytical geometry, Church; calculus, Church.

## 1856.

## COURSE OF STUDIES IN MATHEMATICS AT THE UNITED STATES MILITARY ACADEMY.

*First year, fifth class.*—Same as in 1855.

*Second year, fourth class.*—Descriptive geometry, Davies; shade, shadows, and perspective, Davies; spherical projections and warped surfaces, Davies; surveying, Davies; analytical geometry, Church; calculus, Church.

*Third year, third class.*—Descriptive geometry, Davies; shades, shadows, and perspective, Davies; spherical projections and warped surfaces, Davies; surveying, Davies; analytical geometry, Church; calculus, Church.

## 1857.

## COURSE OF STUDIES IN MATHEMATICS AT THE UNITED STATES MILITARY ACADEMY.

*First year, fifth class.*—Algebra, Davies' Bourdon; geometry, Davies' Legendre; Trigonometry, Davies' Legendre; descriptive geometry, Davies.

*Second year, fourth class.*—Descriptive geometry, Davies; shades, shadows, and perspective, Davies; spherical projections and warped surfaces, Davies; surveying, Davies; analytical geometry, Church; calculus, Church.

1860.

The following report made by Prof. Albert E. Church, in 1860, to a commission appointed to examine into the organization \* \* \* course of instruction of the United States Military Academy at West Point, of which Hon. Jefferson Davis was president, contains a thorough description of the course in mathematics at that period and the methods employed:

UNITED STATES MILITARY ACADEMY, *July 31, 1860.*

SIR: In accordance with the request contained in your note of July 13, I have the honor to submit the following replies to the questions proposed by the commission instituted by the act of Congress of June 21, 1860:

1. The subjects taught in my department are algebra, geometry, trigonometry, mensuration; descriptive geometry, with its applications to spherical projections; shades, shadows, and perspective; analytical geometry, differential and integral calculus, and surveying.

*Algebra.*—The course of algebra comprehends all of the fundamental operations, involution and evolution; transformation and reduction of fractions and radical quantities; theory and solution of equations, including those of the higher degrees; ratios and proportions; summation of series; nature, computation, and use of logarithms.

This course is studied by the fifth class, and occupies the time from the 1st of September to the 1st of January.

The first section of the class is, in general, required to study all contained in the text-book now in use—Davies' Bourdon's Algebra. The lowest section omits many of the more difficult discussions and examples, the amount studied being less than two-thirds of that required of the first section.

The intermediate sections in this, as in other subjects, omit more or less, according to their capacity and progress, in accordance with paragraph 43 of academic regulations.

*Geometry.*—The course of geometry comprehends plane geometry, geometry of volumes, and spherical geometry—nine books, as in the text-book, Davies' Legendre. The entire course is required of every section of the fifth class, commencing after the close of the January examination, about the 10th of January.

The first section finished it about the 1st of March; the lowest about the 25th of the same month; the other sections at intermediate dates.

*Trigonometry.*—The course of trigonometry comprehends the deduction and analytical investigation of all the important trigonometrical formulas; the nature, construction, and use of the various trigonometrical tables; and the solution of all cases in plane and spherical triangles.

The entire course is required of every section of the fifth class. The first section commences it immediately after finishing geometry, and completes it about the 25th of March.

The lowest section commences after finishing geometry, and completes it about the 25th of April.

*Mensuration.*—The course of mensuration comprehends the mensuration of the various plane geometrical figures and volumes; and, with the exception of two or three problems omitted by the lower sections, is required by the entire fifth class. It is studied immediately after trigonometry, and is acquired in two or three lessons.

*Descriptive geometry.*—The course of descriptive geometry comprehends the representation of lines and surfaces on planes; the classification and mode of generation of lines and surfaces; the construction of their tangent lines and planes; the intersection and development of surfaces; the construction of spherical triangles, of spherical projections, of the shades and shadows of various objects and their perspectives. Each section of the fifth class commences the course immediately after finishing mensuration, and studies as much as can be well acquired by the 8th or 10th of May, when the class reviews the entire course previously studied, with the exception of algebra, which is usually reviewed by the first and second sections only, preparatory to the June examination.

The first section of the fourth class resumes this subject about the 5th of November, after completing the course of analytical geometry (see below), the lowest about the 25th of October, and both pursue it until about the 5th of December, when the whole course of the term is reviewed, preparatory to the January examination. From the close of the examination in January—about the 15th—until the 5th of February the whole class is occupied, three hours each morning, in the mathematical drawing academy, in drawing problems in shades, shadows, and perspective.

In this course, as in the algebra, many of the more difficult problems are omitted by the lowest and other sections, the lowest section studying not much more than half of that required by the first.

*Analytical geometry.*—The course of analytical geometry comprehends the construction of algebraic equations; solution of determinate problems; determination and

discussion of the equations of the right line, plane, and conic sections; discussion of the general equation of the second degree, involving two or three variables; determination of loci, etc.

This course is commenced by the fourth class on the 1st of September, and finished by the first section about the 5th of November and by the lowest about the 25th of October. The first section studies all the text (Church's Analytical Geometry) with the exception of ten or twelve pages; the lowest not much more than one-half.

*Calculus.*—The course of differential and integral calculus comprehends the elementary principles and rules, with their application to maxima and minima; the drawing of tangents, curvation of curves, their rectification, quadratures, cubatures, construction, and discussion of the properties of curves and surfaces.

The fourth class commences this course about the 5th of February, and completes it about the 15th of April, the first section learning most of the text (Church's Differential and Integral Calculus); the lowest not more than one-half.

*Surveying.*—The course of surveying comprehends the principles and practice of common land surveying, different methods of platting and calculating the surveys, trigonometrical surveying, measurement of heights and distances, use of instruments in platting, surveying, etc.

The entire course is required as in the text (Davies's Surveying), with the exception of a small portion relating to geodetic surveying, omitted for one or two of the lower sections. The fourth class commences this course immediately after completing the differential and integral calculus, and finishes it about the 7th of May, when the mathematical course for the year is received, preparatory to the June examination.

II. The detailed programme of the course of studies in each of the branches of the mathematical course has been arranged, after long experience and with various modifications from time to time, with special regard to the objects for which the Military Academy is established. In my opinion it is not necessary to extend the teaching in any direction; neither ought there to be any curtailment.

I consider the course of mathematics as now taught to all who pass their final examination sufficient to enable the cadet to acquire a thorough knowledge of all the courses which follow it, and not more than sufficient to enable him to study with advantage the course of natural and experimental philosophy, engineering, and ordnance and gunnery. Moreover, I regard the mental training of the pupil as one of the great objects of the study of mathematics—a training particularly required by the officer of every corps of the Army, and to which many of them owe their distinguished success; and I believe that the scientific reputation of the Academy—all that distinguishes it from other institutions of learning—depends in a great degree upon the thoroughness and extent to which the mathematics and its applications to other sciences are taught, and to diminish them would seriously affect this reputation and the success of the institution.

III. For the purpose of instruction and recitation in the mathematical department, each class is divided into convenient sections of from ten to fifteen members each. Two of these sections are instructed daily by one of the assistant professors under the general supervision of the professor. Every member of each section is, if possible, required to daily explain, at the blackboard or wall slate, one or more propositions of the lesson given out on the previous day, and is thoroughly examined by questions on a portion or all of it.

Points not well understood are carefully explained by the instructor or professor. Each pupil is also expected to make known all difficulties with which he may meet, to the end that they may be at once removed, and a thorough understanding of each lesson in order thus obtained. For the purpose of testing this understanding various practical examples illustrating the principles of the course are required to be worked by the pupil at the blackboard or slate.

The head of the department is also required to pass the hours of recitation in visiting two or more of the sections, and is constantly occupied in explanations of the principles of the course and their applications, either to the entire section by a familiar conversational lecture, or in particular explanations of the more difficult points to individuals.

A uniformity of method of instruction is thus secured to all the sections, while the relative merits of each pupil are thus in detail made known to the professor, and transfers from section to section of those making the most or least progress can be made without inconvenience or injustice.

In descriptive geometry most of the elementary problems are illustrated and explained by the professor from models in the section room and also from a set of models in the mathematical room.

In surveying, the pupils, in addition to the explanations of the construction and use of the instruments, are required afterwards to use them practically on the field.

I know of no modifications in the method of instruction calculated to improve it. The method in the branches of descriptive geometry and surveying may be made more effective by the further addition of models and instruments.

IV. The only practical instruction given in my department, except the exercises in the practical solution of examples and problems before referred to, is the instruction in the drawing of problems in shades, shadows, and perspective, and the instruction on the field in surveying. In this latter branch each section of the fourth class is sent into the field, in charge of its proper instructor, during the hours of morning recitations, in the months of April and May, whenever the time can be spared and the weather will permit.

As much time is allowed as will enable every attentive pupil to become familiar with the use of each of the common surveying instruments, though it is impossible in this limited time to make anyone a practical surveyor. It is desirable that more time should be given to this practice, as well as to the instruction in drawing.

V. From three and a half to four hours should be given daily by the cadet to render him thoroughly proficient in the prescribed lessons of the mathematical course. No modifications are proposed which would affect this time.

VI. Each cadet of the fourth and fifth classes is occupied an hour and a half daily in the mathematical recitation or section room, or in the field, except during the practical instruction in drawing, when three hours in the drawing academy are required.

VII. I do not consider the amount of study required in the fifth class such as to overtax the pupil.

I was satisfied at the time of the adoption of the programme for a five years' course that more was required of the fourth class than its members could learn with that thoroughness which is absolutely necessary to make accomplished and well-trained scholars.

I am confirmed by experience in this opinion, and although the course of this class has been since somewhat modified by the omission of a portion of the course of English, I still think that more is required than it can accomplish with advantage. The difficulty is not so much in the amount of time requisite for the study and recitation of the lessons as in the mental confusion which must arise from the multiplicity of subjects.

No student should be required to prepare himself by previous study for recitation in more than two distinct subjects a day, particularly when one of them is scientific; and each lesson, as far as possible, should be recited before it is necessary to begin the study of the other.

VIII. In my own department I seldom see any indication of overwork or weariness of study. I see much more of an inclination to get along with as little study as possible. In fact, my frequent inquiries of the members of the two classes under my charge have shown me that the instances are many in which the cadet does not industriously occupy all the time which should be devoted to the study of his lessons, and which I think can and will be devoted by an ambitious student without overwork or weariness.

I have little opportunity of observing in other departments except at examinations, where I see no such indication.

IX. In my opinion the programme of the present course of studies is imperfect and has failed to answer the purposes contemplated at the time of its adoption. I think we have fallen into an error in attempting to combine too much of a thorough literary with a thorough scientific and military course of instruction. By the introduction of a multiplicity of subjects without a corresponding increase of time we have endangered the accomplishment of the latter course, to which the Military Academy owes its reputation and success, and from which its graduates have derived the systematic and thoughtful habits which have made them distinguished as effective officers or citizens.

The interests of the Academy require that the programme should be carefully revised and so modified as to make it more in accordance with what the experience of the last six years has clearly indicated. One of the greatest obstacles to a successful prosecution of the course of studies at the Academy is the want of previous proper study on the part of many of the cadets of the simple elementary branches prescribed by law as required for their admission. I do not think it proper to increase the number of these branches, instruction in which is now within the reach of every American youth (unless, perhaps, that of geography might be included), but I do think it essential that a more thorough knowledge should be required.

A hurried and by no means strict examination here results annually in the rejection of many of the candidates for admission, who have come from a long distance and been subjected to great expense. Could several candidates to fill each vacancy be carefully examined in the simple branches required in the district or State from which they are to be appointed, and the best one selected, the Academy would receive a far better material and be able to give better results.

Very respectfully,

Lieut. J. C. IVES,  
*Secretary of Committee, etc.*

A. E. CHURCH,  
*Professor of Mathematics, U. S. M. A.*

1862.

In 1862 the mathematical course was the same as in 1857, except that the first year's was the fourth class and the second year's was the third class.

1863.

In 1863 a pamphlet on trigonometry was substituted for Davies' Trigonometry.

1864.

In 1864 Church's Descriptive Geometry was introduced and studied by the fourth class.

1865.

In 1865 Church's Descriptive Geometry and Spherical Projections replaced Davies' in the third-class course.

1866.

In 1866 Church's Shades, Shadows, and Perspective was substituted for Davies' in the third-class course.

In 1866 the following law, approved June 16, was passed, increasing slightly the requirements for admission:

[Extract.]

SEC. 2. \* \* \* "And in addition to the requirements necessary for admission as provided by the third section of the 'Act making further provisions for the Corps of Engineers,' approved April 29, 1812, candidates shall be required to have a knowledge of the elements of English grammar, of descriptive geography, particularly of our own country, and of the history of the United States."

From 1866 to 1878 no change of importance was made in the mathematical course.

1878.

On March 30, 1878, the long and valuable career of Professor Church was brought suddenly to an end by his death. For nearly forty-one years he had served as professor of mathematics. For forty-eight years he had taught mathematics at the Academy. From the time of his entrance to the Academy in 1824 until his death in 1878, a period of nearly fifty-four years, he was away from the Academy about two years.

[Extracts from Cullum's Register.]

\* \* \* \* \*  
 "Punctual to the minute, the professor was always in his seat to hear the recitations of his pupils.

\* \* \* \* \*  
 "With the utmost amiability and patient painstaking he would eliminate every knotty point by a few sagacious suggestions, and, even for the dullest, simplified them by some familiar illustration, so that none except the utterly deficient failed to be taught. Besides the mathematical instruction thus implanted, he required great precision of language in the demonstrations of the subject under discussion, thereby making the mental drill in the recitation room as exact as the parade drill in the field.

\* \* \* \* \*  
 "Church, as a member of the academic board, was invaluable, not only because of his sagacious opinions, but on any doubtful question his accurate memory could always furnish a precedent in point.

\* \* \* \* \*  
 "With strict fidelity and conscientious impartiality he merged all personal interests in the welfare of the Academy.

\* \* \* \* \*  
 "He has left a strong impress upon the Military Academy, which will not soon be effaced.

He was the author of four text-books, which, at the time they were written, were, without exception, the best of their kind in this country.

In 1842 he wrote his Calculus; in 1851 the Analytical Geometry; in 1857 the Trigonometry, and in 1865 he published his Descriptive Geometry, including the subjects of spherical projections, shades and shadows, and perspective.

In all of these he exhibited a clearness of language which has served as a model for most modern writers of mathematical text-books.

Church was more of a geometrician than algebraist. His Descriptive Geometry was relatively his best production. His Calculus was distinguished for its clear statements of methods and rules. As a teacher and demonstrator he was distinguished to a high degree.

The philosophy of mathematics did not impress him as very important for students. Even in his preferred subject, descriptive geometry, he rather urged his pupils to follow the established rules of construction instead of trying to see the magnitudes in space. In the Calculus he ignored any attempt to define or put a differential or its coefficient in a tangible form.

Demonstrations were more to his taste than applications. He was inclined to the student who, in beautiful, clear, and concise language, could show how to obtain a result, rather than to one who merely produced the answer.

Under Church the mathematical demonstrations were more perfect and complete than at any other time in the history of the Academy.

The following extracts from a paper entitled "Personal reminiscences of the United States Military Academy," which was written and read by Professor Church at a meeting of the United States Service Institute two days before his death, will ever form a portion of the reliable history of the institution:

\* \* \* \* \*

"The requirements for admission in 1824 were simply arithmetic, reading, and writing. In arithmetic we received daily and very thorough instruction, our instructors being generally those cadets who during the term had acted as assistant professors, receiving therefor \$10 per month and many extra privileges, including the important one of keeping a waiter. In this subject these instructors were able to form an approximate opinion in regard to those who were duly qualified, and as a consequence the examination of most of us in it was hurried and slight. To many not more than one or two questions were asked, while to those who were deemed doubtful much more time was given and their proficiency fully tested. We were required to read and write in the presence of the academic board. Very few comparatively were rejected. Over 100 of my class were admitted. At the January examination 93 were examined and about 20 found deficient and discharged. June left us with only 54 and graduation with only 33, 9 of these having been turned back from the preceding class. From my recollection of my classmates and from my experience and close observation since, I am satisfied that our candidates at that time and for a number of years after were in the three branches required better prepared than those of later years. Why, I do not pretend to say, but I have strong opinions on the subject. Particularly do I think young men were better readers and spellers than now.

"I would say, moreover, that this opinion is in no way founded upon the fact that more are rejected now than then.

\* \* \* \* \*

"The course of studies at this time was theoretically nearly the same as now. The Superintendent, Colonel Thayer, after the labor of years had succeeded in organizing a course which he deemed best fitted to an American military education—a course calculated to cultivate the powers of thought rather than store the memory. This was a problem of no little difficulty. His experience in the French military schools and his extended acquirements made it one of deep interest to him and had prepared him for its solution. His guiding principle was thoroughness in everything—thorough teaching, thorough learning—and though these could only be attained after long experience, he laid a firm foundation for them, and to him, more than any other man, does the Military Academy owe that which is now the source of its great reputation, viz, its thorough teaching of a few rather than a smattering of many things. He rightly believed that a military education must be founded on a mathematical training and knowledge, hence he gave in the course that prominence, which they have ever since retained, to mathematics, natural and experimental philosophy, and engineering.

"Limited to four years in time he could not, with his ideas of thoroughness in these important branches, and in such special military knowledge as he deemed particularly necessary to the educated soldier, do that which has been often and vainly attempted since, crowd into this time a greater part of the literary course of our colleges.

"The modes of instruction, too, were entirely new and the text-books very imperfect. The professors and teachers had themselves to learn the true use of the blackboard and the strict and detailed manner of demonstration, and in the first year or two of my time, had, with perhaps a single exception, failed to imbibe the spirit which the Superintendent was, by personal exertion, striving to instil into all. The assistants were at this time mostly cadets of the higher classes, with their own lessons to study and entirely without experience.

"In algebra, the best text-book that could be obtained in the English language was a poor translation of Lacroix. In geometry, though various editions of Euclid

were in vogue, we had a translation of Legendre, really the foundation of our present text, but filled with inaccuracies and imperfections not all of which have to this day been eliminated. In trigonometry, a translation of a work by Lacroix. In descriptive, a small work by Crozet, a French officer, graduate of the polytechnic school, and who had been professor of engineering here. This contained only the elements, without application to the intersection of surfaces or to warped surfaces. These, with the whole of shades, shadows, and perspective, stone cutting, and problems in engineering, both civil and military, were given by lectures to the whole class by the respective professors. Notes were taken by the cadets, the drawings made in our rooms before the next morning, then presented for examination, and at once recited upon, previous to the following lecture. You will understand how this could all be done when I tell you that in the departments of mathematics, philosophy, and engineering, the sections, of over 20 cadets each, were kept in three hours daily. Of course, the real teachers in these subjects were those cadets who made careful notes, finished their drawings early in the day, made the demonstrations to their classmates, and lent their drawings for copying. Great skill was acquired in making these copies. A clear and large pane of glass was placed on the top of the washstand, a lighted candle underneath the finished drawing on the glass, and the paper for the copy on top, and every point quickly marked with a pencil. Several copies of the same drawing were thus made. Of course, the number of drawings made by each cadet was much greater than now. I think I had over 50 full sheets.

"In the third class we had, in the higher sections of analytical geometry, Biot's work on this subject in French (a work scarcely surpassed since); in the lower a small English work the name of which I have forgotten. In the calculus the higher sections had, also in French, the work of Lacroix, which all my pupils know I still regard as the best model on the subject; and the lower, an inferior work by Boucharlat, also in French."

Edgar W. Bass was appointed professor of mathematics, United States Military Academy, April 17, 1878.

1879.

After careful consideration it was deemed best (1879) to change the order of certain branches, to transfer the accurate constructions of problems in descriptive geometry to the department of drawing, and to introduce a few lessons in the subject of least squares.

The change as made is indicated in the following resolution:

"The professor of mathematics submitted the following resolution, affecting the course of studies in his department and the department of drawing, and upon motion it was adopted:

"Resolved, That the following changes in the order of instruction of the several branches of the mathematical course be adopted by the academic board.

"1. That the instruction in surveying be transferred from the third-class to the fourth-class course, and to follow immediately after trigonometry.

"2. That the instruction in analytical geometry shall follow immediately after surveying in the fourth-class course, and be continued in the third-class course until finished.

"3. That the subject of descriptive geometry shall follow immediately after analytical geometry.

"4. That the accurate construction, with a right-line pen, of the various problems in shades and shadows, linear perspective and isometric projections, now under the direction of the mathematical department, be discontinued, and that the same shall hereafter form a part of the course in the department of drawing. The time for making such drawings to follow, as nearly as possible, the termination of the study of the principles relating thereto in the department of mathematics."

\* \* \* \* \*

The academic board of the United States Military Academy respectfully recommend to the honorable Secretary of War that Chauvenet's Treatise on the Method of Least Squares be authorized as a text-book to be used in the mathematical course. The grounds for this recommendation are, that knowledge of this branch of mathematics is required in the subsequent course of philosophy in this academy, and in the reduction of observations, in general, which officers of the army are frequently required to make, especially in geodetic and astronomic measurements.

The proposed text-book is believed to be the best separate publication on the subject.

1880.

In April, 1880, a pamphlet entitled "Notes on determinants," by Lieut. J. G. D. Knight, was introduced as an essential part of algebra for the upper part of the classes, and was taught in five lessons to the first section of the third class.

The following is a detailed programme of the course in mathematics as then established.

1881.

## DETAILED PROGRAMME OF THE COURSE OF MATHEMATICS.

*Fourth-class course in mathematics.*

[September to January.]

## ALGEBRA (DAVIES' NEW BOURDON, EDITION OF 1877).

|   | Number of lessons. | Average number of pages. |
|---|--------------------|--------------------------|
| First section:  |                    |                          |
| Advance to page 396.....  | 55                 | 7                        |
| First review to page 396.....   | 30                 | 12½                      |
| General review to page 396.....   | 17                 | 22½                      |
| Last section:   |                    |                          |
| Advance to article 264, page 341 (omit articles 133, 199, 200, 208, 253, and 254, and exercises on page 193)..... | 49                 | 6                        |
| First review. Same.....   | 28                 | 11                       |
| General review. Same.....   | 21                 | 15                       |

[January 10 to June.]

## PLANE GEOMETRY (DAVIES' LEGENDRE, EDITION OF 1875).

|  |    |     |
|--|----|-----|
| First section:   |    |     |
| Advance to page 272 and introduction to trigonometry (12 pages)..... | 29 | 9½  |
| First review (omit appendix and introduction to trigonometry).....   | 15 | 17½ |
| General review (omit appendix and introduction to trigonometry)..... | 10 | 25½ |
| Last section:  |    |     |
| Advance to page 259 and introduction to trigonometry.....            | 29 | 9   |
| First review (omit introduction to trigonometry).....                | 15 | 16½ |
| General review (omit introduction to trigonometry).....              | 11 | 22½ |

## TRIGONOMETRY, PLANE AND SPHERICAL (CHURCH).

|                                      |    |    |
|--------------------------------------|----|----|
| First section:                       |    |    |
| Omit article 41; advance.....        | 13 | 5  |
| Omit article 41, first review.....   | 7  | 9½ |
| Omit article 41, general review..... | 5  | 13 |
| Last section:                        |    |    |
| Omit article 41; advance.....        | 13 | 5  |
| Omit article 41, first review.....   | 7  | 9½ |
| Omit article 41, general review..... | 6  | 11 |

## SURVEYING (DAVIES).

|   |    |     |
|---|----|-----|
| First section—From page 23 to 219 (omit 33, 34, 35, 36, 37, 38, 39, and from 40 to Book II, 137, 138, 139): |    |     |
| Advance.....  | 14 | 12  |
| First review.....   | 6  | 28  |
| General review.....   | 4  | 42  |
| Last section—Omit same as first section:  |    |     |
| Advance.....  | 16 | 10½ |
| First review.....   | 8  | 21  |
| General review.....   | 4  | 42  |

## ANALYTICAL GEOMETRY (CHURCH).

|                                |    |     |
|--------------------------------|----|-----|
| First section:                 |    |     |
| Advance to page 106.....       | 14 | 7½  |
| First review to page 91.....   | 6  | 15  |
| General review to page 91..... | 4  | 23  |
| Last section:                  |    |     |
| Advance to page 78.....        | 12 | 6½  |
| First review.....              | 7  | 11  |
| General review.....            | 4  | 19½ |

*Third-class course in mathematics.*

[September to January.]

ANALYTICAL GEOMETRY (CHURCH).

|  | Number of lessons. | Average number of pages. |
|--|--------------------|--------------------------|
| First section—From article 66 through (omit 184, 185, and from 211 to 231):                      |                    |                          |
| Advance.....   | 21                 | 8 $\frac{1}{2}$          |
| First review.....  | 11                 | 16 $\frac{1}{3}$         |
| General review.....  | 10                 | 18                       |
| Last section—From 66, through (omit 122, 184, 185, examples page 238, 201, and from 211 to 231): |                    |                          |
| Advance.....   | 25                 | 7                        |
| First review.....  | 16                 | 11                       |
| General review.....  | 13                 | 13 $\frac{1}{2}$         |

DESCRIPTIVE GEOMETRY (CHURCH).

|  |    |                  |
|--|----|------------------|
| First section—To Part III (omit 134):  |    |                  |
| Advance.....   | 30 | 4 $\frac{1}{2}$  |
| First review.....  | 16 | 8 $\frac{1}{2}$  |
| General review.....  | 11 | 12 $\frac{1}{2}$ |
| Last section—To Part II (omit 56, 103, 104, 133, 134, 139, 140, 141, 150, 151, 152, 175, and 179): |    |                  |
| Advance.....   | 27 | 3 $\frac{2}{3}$  |
| First review.....  | 15 | 6 $\frac{2}{3}$  |
| General review.....  | 9  | 11               |

[January to June.]

|  |    |                 |
|--|----|-----------------|
| First section—From Part III, through:                                  |    |                 |
| Advance.....   | 10 | 5 $\frac{1}{2}$ |
| First review.....  | 6  | 8 $\frac{1}{2}$ |
| General review.....  | 4  | 13              |
| Last section—From Part II, through (omit 220-221, 229, 258, 259, 288): |    |                 |
| Advance.....   | 15 | 4 $\frac{1}{2}$ |
| First review.....  | 9  | 8               |
| General review.....  | 7  | 10              |

CALCULUS (CHURCH).

|  |    |                  |
|--|----|------------------|
| First section—Entire book:   |    |                  |
| Omit from page 202 to Part II (204-212, inclusive, 224-230, inclusive, and 232); advance.....  | 44 | 8                |
| Omit 166, 167, from 186 to 193, 200, from 204 to 216, from 218 to 222, 224 to 231, 232, and 207, and after 271; first review.....                          | 23 | 13               |
| Omit 59 in addition to above; general review.....  | 17 | 18               |
| Last section:  |    |                  |
| Advance to article 261, page 351 (omit 59, 113 to 117, 128 to 131, 152 to 154, 166-167, 186-187, 192, 199, 200, 203 to 216, 218 to 231, 232); advance..... | 45 | 6 $\frac{1}{2}$  |
| First review (in addition to above omit 188 to 192)—   |    |                  |
| First review.....  | 24 | 14 $\frac{1}{2}$ |
| General review.....  | 17 | 16 $\frac{1}{2}$ |

DETERMINANTS (PAMPHLET BY LIEUT. J. G. D. KNIGHT).

|                |   |       |
|----------------|---|-------|
| First section: |   |       |
| Advance.....   | 3 | ..... |
| Review.....    | 2 | ..... |

LEAST SQUARES (CHAUVENET).

|                |    |       |
|----------------|----|-------|
| First section: |    |       |
| Advance.....   | 10 | ..... |

1885.

Previous to 1885 the weekly maximum marks for the different sections of a class were generally different. This necessitated a reduction before marks given in different sections could be compared. It was then determined to make the weekly maximum the same for all sections of a class in any one subject. The maximum was determined by the greatest number of recitations made by any individual of the class, multiplied by 3.

1887.

In 1887 an elementary treatise on determinants by Prof. W. G. Peck was substituted for the pamphlet then in use.

In 1887 a pamphlet entitled, Introduction to the Calculus, by Prof. E. W. Bass, was introduced to replace the first part of Church's Calculus.

1888.

In 1888 Elements of Trigonometry, by Lieut. H. H. Ludlow, was substituted for Church's Trigonometry.

1889.

In 1889 a pamphlet entitled, Part I, Differential Calculus, by Prof. E. W. Bass, was substituted for the corresponding part of Church's Calculus.

1891.

In 1891 The Theory of Errors and Method of Least Squares, by William W. Johnson, professor of mathematics in the United States Naval Academy, was introduced to replace Chauvenet's.

1893.

In 1893 a third pamphlet entitled, Part II, Differential Calculus, was substituted for the last portion of Church's Differential.

The chair of associate professor of mathematics was established, and First Lieut. Wright P. Edgerton, Second Artillery, was appointed.

1896.

In 1896 Bass's Differential Calculus replaced the pamphlets on the same subject previously in use.

## PART II.

STATEMENT OF THE PRESENT COURSE, GIVING TITLES OF TEXT-BOOKS, FULL LIST OF SUBJECTS, NUMBER OF LESSONS IN EACH SUBJECT—ADVANCE AND REVIEW, LENGTH OF LESSONS, HOURS OF STUDY, LENGTH OF RECITATIONS, TOTAL NUMBER OF HOURS DEVOTED TO EACH SUBJECT DURING THE TERM, INSIDE AND OUTSIDE THE SECTION ROOM, NUMBER OF LECTURES AND SUBJECTS OF LECTURES, DIFFERENCES IN COURSE FOR HIGHER AND LOWER SECTIONS, ETC.

For the study of each lesson in mathematics three and a half hours is arranged for.

The recitations are daily (Sundays excepted) between the hours of 8 and 11 a. m. One-half of a class recites from 8 to 9.30, and the other from 9.30 to 11.

To the subject of algebra four months is allotted, giving in general 102 recitations, arranged as follows:

|                      | Upper sections. | Lower sections. |
|----------------------|-----------------|-----------------|
| Advance lessons..... | 53              | 50              |
| First review.....    | 28              | 28              |
| General review.....  | 19              | 22              |
| Extra.....           | 1 or 2          | 1 or 2          |
| Total.....           | 102             | 102             |

On advance the upper sections average about  $7\frac{1}{2}$  pages, and the lower about  $6\frac{1}{2}$ . The first-review lessons are about double the advance, and the general-review are equivalent to about three advance lessons.

The following is a list of the daily lessons in algebra. It will be observed that the principal difference between subjects taken by the upper and lower sections is that of the theory of equations:

*Fourth-class course, September 1, 1895, to January 1, 1896.*

[Corrections and omissions marked in text-book.]

ALGEBRA (DAVIES' BOURDON), 1877 EDITION.

| No. of lesson. | All sections.                 | No. of lesson. | All sections.                       |
|----------------|-------------------------------|----------------|-------------------------------------|
| 1.....         | Advance to Chapter II, p. 23. | 21.....        | Advance to 100, p. 121.             |
| 2.....         | Advance to 23, p. 31.         | 22.....        | Advance to Chapter V, p. 128.       |
| 3.....         | Advance to 31, p. 39.         | 23.....        | Advance to approximate, p. 133.     |
| 4.....         | Advance to 41, p. 46.         | 24.....        | Advance to 109, p. 138.             |
| 5.....         | Review to 25, p. 33.          | 25.....        | Advance to 113, p. 144.             |
| 6.....         | Review to 41, p. 46.          | 26.....        | Advance to 119, p. 152.             |
| 7.....         | Advance to 43, p. 52.         | 27.....        | Advance to II problems, p. 160.     |
| 8.....         | Advance to 55, p. 59.         | 28.....        | Advance to 125, p. 166.             |
| 9.....         | Advance to 61, p. 66.         | 29.....        | Advance to 2 <sup>o</sup> , p. 172. |
| 10.....        | Advance to 76, p. 74.         | 30.....        | Advance to 133, p. 178.             |
| 11.....        | Advance to 80, p. 82.         | 31.....        | Advance to example 13, p. 186.      |
| 12.....        | Advance to 90, p. 89.         | 32.....        | Advance to problem 7, p. 191.       |
| 13.....        | Advance to problem 10, p. 97. | 33.....        | Advance to 141, p. 196.             |
| 14.....        | Advance to 92, p. 101.        | 34.....        | Review to 98, p. 116.               |
| 15.....        | Review to 55, p. 59.          | 35.....        | Review to Chapter V, p. 128.        |
| 16.....        | Review to 76, p. 74.          | 36.....        | Review to 110, p. 141.              |
| 17.....        | Review to 90, p. 89.          | 37.....        | Review to 123, p. 155.              |
| 18.....        | Review to 92, p. 101.         | 38.....        | Review to 127, p. 169.              |
| 19.....        | Advance to problem 1, p. 109. | 39.....        | Review to 134, p. 182.              |
| 20.....        | Advance to 22, p. 114.        | 40.....        | Review to 141, p. 196.              |

| No. of lesson. | Upper sections.                         | Intermediate sections.                  | Lower sections.                            |
|----------------|---|---|--|
| 41.....        | Advance to 143, p. 203.....             | Advance to 143, p. 203.....             | Advance to 142, p. 201.                    |
| 42.....        | Advance to 147, p. 211.....             | Advance to 146, p. 210.....             | Advance to 144, p. 208.                    |
| 43.....        | Advance to 152, p. 220.....             | Advance to 151, p. 218.....             | Advance to 150, p. 215.                    |
| 44.....        | Advance to 159, p. 229.....             | Advance to 157, p. 226.....             | Advance to 154, p. 222.                    |
| 45.....        | Advance to 165, p. 237.....             | Advance to 162, p. 233.....             | Advance to 159, p. 229.                    |
| 46.....        | Advance to 178, p. 246.....             | Advance to 168, p. 241.....             | Advance to 164, p. 234.                    |
| 47.....        | Advance to 191, p. 257.....             | Advance to 180, p. 249.....             | Advance to 168, p. 241.                    |
| 48.....        | Advance to 199, p. 265.....             | Advance to 191, p. 257.....             | Advance to 178, p. 246.                    |
| 49.....        | Advance to 204, p. 274.....             | Advance to 199, p. 265.....             | Advance to 187, p. 252.                    |
| 50.....        | Advance to 210, p. 282.....             | Advance to 204, p. 274.....             | Advance to 192, p. 259.                    |
| 51.....        | Advance to 219, p. 290.....             | Advance to 210, p. 282.....             | Advance to 201, p. 268.                    |
| 52.....        | Advance to 227, p. 297.....             | Advance to 219, p. 290.....             | Advance to 203, p. 272.                    |
| 53.....        | Advance to Table II, p. 7a.....         | Advance to 227, p. 297.....             | Advance to 209, p. 281.                    |
| 54.....        | Advance to 233, p. 304.....             | Advance to Table II, p. 7a.....         | Advance to 215, p. 288.                    |
| 55.....        | Advance to 245, p. 315.....             | Advance to 233, p. 304.....             | Review to 145, p. 208.                     |
| 56.....        | Advance to 251, p. 322.....             | Advance to 242, p. 312.....             | Review to 151, p. 218.                     |
| 57.....        | Advance to 2 <sup>o</sup> , p. 331..... | Advance to 249, p. 320.....             | Review to 158, p. 227.                     |
| 58.....        | Review to 146, p. 210.....              | Advance to 255, p. 328.....             | Review to 165, p. 237.                     |
| 59.....        | Review to 155, p. 223.....              | Review to 145, p. 208.....              | Review to 178, p. 246.                     |
| 60.....        | Review to 165, p. 237.....              | Review to 153, p. 221.....              | Review to 191, p. 257.                     |
| 61.....        | Review to 185, p. 251.....              | Review to 162, p. 233.....              | Review to 201, p. 268.                     |
| 62.....        | Review to 179, p. 265.....              | Review to 176, p. 246.....              | Review to 206, p. 276.                     |
| 63.....        | Review to 208, p. 277.....              | Review to 192, p. 259.....              | Review to 215, p. 288.                     |
| 64.....        | Review to 219, p. 290.....              | Review to 202, p. 269.....              | Advance to 222, p. 293.                    |
| 65.....        | Review to 233, p. 304.....              | Review to 209, p. 281.....              | Advance to 227, p. 297.                    |
| 66.....        | Review to 247, p. 317.....              | Review to 220, p. 291.....              | Advance to Table II, p. 7a.....            |
| 67.....        | Review to 255, p. 328.....              | Review to 233, p. 304.....              | Advance to 232, p. 303.                    |
| 68.....        | Advance to 261, p. 337.....             | Review to 247, p. 317.....              | Advance to 238, p. 308.                    |
| 69.....        | Advance to 265, p. 344.....             | Review to 255, p. 328.....              | Advance to 245, p. 315.                    |
| 70.....        | Advance to 268, p. 352.....             | Advance to 259, p. 334.....             | Advance to 249, p. 320.                    |
| 71.....        | Advance to 272, p. 360.....             | Advance to 263, p. 340.....             | Advance to 1 <sup>o</sup> , p. 329.        |
| 72.....        | Advance to 2 <sup>o</sup> , p. 367..... | Advance to 277, p. 365.....             | Advance to 259, p. 334.                    |
| 73.....        | Advance to 281, p. 373.....             | Advance to 4 <sup>o</sup> , p. 369..... | Advance to 262, p. 339.                    |
| 74.....        | Advance to 284, p. 379.....             | Advance to 282, p. 375.....             | Review to 226, p. 296.                     |
| 75.....        | Advance to 289, p. 386.....             | Advance to 284, p. 379.....             | Review to 233, p. 304.                     |
| 76.....        | Advance to 294, p. 393.....             | Review to 263, p. 340.....              | Review to 242, p. 312.                     |
| 77.....        | Advance to 296, p. 396.....             | Review to 4 <sup>o</sup> , p. 369.....  | Review to 249, p. 320.                     |
| 78.....        | Review to 265, p. 344.....              | Review to 284, p. 379.....              | Review to 3 <sup>o</sup> , p. 331.         |
| 79.....        | Review to 272, p. 360.....              | Advance to 286, p. 384.....             | Review to 262, p. 339.                     |
| 80.....        | Review to 281, p. 373.....              | .....do.....                            | General review to 31, p. 39.               |
| 81.....        | Review to 286, p. 384.....              | .....do.....                            | General review to second principle, p. 54. |
| 82.....        | Review to 296, p. 396.....              | .....do.....                            | General review to 70, p. 68.               |
| 83.....        | General review to 42, p. 51.....        | .....do.....                            | General review to 90, p. 89.               |
| 84.....        | General review to 73, p. 71.....        | .....do.....                            | General review to 92, p. 101.              |

*Fourth-class course, September 1, 1895, to January 1, 1896—Continued.*

ALGEBRA (DAVIES' BOURDON), 1877 EDITION—Continued.

| No. of lesson. | Upper sections.                      | Intermediate sections.      | Lower sections.                       |
|----------------|--------------------------------------|-----------------------------|---------------------------------------|
| 85.....        | General review to problem 10, p. 97. | Advance to 286, p. 384..... | General review to example 25, p. 114. |
| 86.....        | General review to 25, p. 114.....    | do.....                     | General review to 104, p. 128.        |
| 87.....        | General review to 105, p. 132.....   | do.....                     | General review to 113, p. 144.        |
| 88.....        | General review to 119, p. 152.....   | do.....                     | General review to problems, p. 160.   |
| 89.....        | General review to 128, p. 170.....   | do.....                     | General review to 128, p. 170.        |
| 90.....        | General review to problem 9, p. 191. | do.....                     | General review to 137, p. 184.        |
| 91.....        | General review to 147, p. 211.....   | do.....                     | General review to 141, p. 196.        |
| 92.....        | General review to 162, p. 233.....   | do.....                     | General review to 146, p. 210.        |
| 93.....        | General review to 189, p. 255.....   | do.....                     | General review to 158, p. 227.        |
| 94.....        | General review to 204, p. 274.....   | do.....                     | General review to 168, p. 241.        |
| 95.....        | General review to 220, p. 291.....   | do.....                     | General review to 192, p. 259.        |
| 96.....        | General review to 240, p. 310.....   | do.....                     | General review to 206, p. 276.        |
| 97.....        | General review to 255, p. 328.....   | do.....                     | General review to 220, p. 291.        |
| 98.....        | General review to 266, p. 348.....   | do.....                     | General review to 233, p. 304.        |
| 99.....        | General review to 277, p. 365.....   | do.....                     | General review to 245, p. 315.        |
| 100.....       | General review to 285, p. 380.....   | do.....                     | General review to 255, p. 328.        |
| 101.....       | General review to 296, p. 396.....   | do.....                     | General review to 269, p. 339.        |
| 102.....       | Extra for instruction.....           | do.....                     | Do.                                   |

*a* Mathematical tables.

From which it appears that about three hundred and six hours are devoted to the study of algebra, and one hundred and fifty-three hours to recitations and instruction in the section rooms.

To the subject of elementary geometry, eight and one-half weeks, 51 lessons, is devoted as follows:

|                      | Number of lessons. | Average number pages. |
|----------------------|--------------------|-----------------------|
| Advance lessons..... | 27                 | 10½                   |
| First review.....    | 14                 | 20                    |
| General review.....  | 10                 | 28½                   |
| <b>Total.....</b>    | <b>51</b>          | <b>.....</b>          |

The difference in this course between the upper and lower parts of a class consists in giving the upper part a great many more extra problems and new propositions to prove.

The following is a list of the daily lessons in geometry, from which it will be seen about one hundred and fifty-three hours are devoted to the study and seventy-six and one-half hours to recitations and instruction in the section rooms:

*Fourth class.—Plane geometry (Davies' Van Amringe), 1885 edition.—Advance and first review and general review.*

| January. | All sections.   | February. | All sections.  |
|----------|---|-----------|--|
|          | Advance to P. 2, p. 21.<br>Advance to 9, p. 28.<br>Advance to 18, p. 37.<br>Advance to 26, p. 45.<br>Advance to 5, p. 56.<br>Advance to 5, p. 65.<br>Advance to 15, p. 75.<br>Advance to 1, p. 84.<br>Advance to 16, p. 93.<br>Advance to 6, p. 104.<br>Advance to 15, p. 114.<br>Advance to 23, p. 123.<br>Advance to 1, p. 133.<br>Advance to 3, p. 145.<br>Advance to 11, p. 155, paper and limits.<br>Advance to 2, p. 167.<br>Review to P. 15, p. 34.<br>Review to 3, p. 55.<br>Review to 14, p. 74.<br>Review to 16, p. 93. |           | Advance to 13, p. 177.<br>Advance to Book VII, p. 189.<br>Advance to P. 7, p. 199.<br>Advance to 15, p. 209.<br>Advance to regular polyhedrons, p. 219.<br>Advance to P. 5, p. 232.<br>Advance to 13, p. 242.<br>Advance to 2, p. 252.<br>Advance to 9, p. 261.<br>Advance to 17, p. 271.<br>Advance to appendix, p. 279 (wedge and prismoid).<br>Review from 2, p. 167, to Book VII, p. 189.<br>Review to P. 15, p. 209.<br>Review to 3, p. 230.<br>Review to Book IX, 250.<br>Review to P. 15, p. 268.<br>Review to appendix, p. 279 (wedge and prismoid). |

*Fourth class.—Plane geometry (Davies' Van Amringe), 1885 editions.—Advance and first review and general review—Continued.*

| January. | All sections.  | February. | All sections.  |
|----------|--|-----------|--|
|          | Review to 12, p. 111.<br>Review to 26, p. 128.<br>Review to 7, p. 149.<br>Review to 2, p. 167. |           | General review to 26, p. 45.<br>General review to 15, p. 75.<br>General review to 6, p. 104.<br>General review to 28, p. 130.<br>General review to 11, p. 155.<br>General review to 18, p. 181.<br>General review to 14, p. 208.<br>General review to 7, p. 234.<br>General review to 6, p. 257.<br>General review to appendix, p. 279 (wedge and prismoid). |

*Remarks.*—270 pages; 27 advance lessons, average 10 pages; 14 first review lessons, average 19 $\frac{2}{3}$  pages; 10 general review lessons, average 27 pages; total, 51 lessons; 8 $\frac{1}{2}$  weeks for plane geometry. Extra exercises with each lesson graded according to section.

In trigonometry thirty lessons are taken, requiring five weeks, as follows:

|                      | Number of lessons. | Average pages.   |
|----------------------|--------------------|------------------|
| Advance lessons..... | 16                 | 9 $\frac{2}{3}$  |
| First review.....    | 7                  | 21 $\frac{2}{3}$ |
| General review.....  | 7                  | 21 $\frac{2}{3}$ |
| Total.....           | 30                 | .....            |

The upper sections, on advance, take a chapter on trigonometric developments and a chapter on solution of trigonometric equations, which are omitted by the lower part of the class.

About ninety hours are devoted to the study of this subject and forty-five hours to recitations and instruction in the section rooms.

The daily lessons are as follows:

*Fourth class.—Trigonometry (Ludlow), third edition.*

| Upper sections.  | March. | Lower sections.  |
|--|--------|--|
| Advance to 17, p. 18.<br>Advance to 40, p. 31.<br>Advance to 54, p. 43.<br>Review to 54, p. 43, from 10, p. 13.<br>Advance to 62, p. 54.<br>Advance to 69, p. 65.<br>Advance to 73, p. 73.<br>Mathematical tables and use (10, p. 8 to 21, p. 24).<br>Advance to 81, p. 89.<br>Advance to 92, p. 99.<br>Advance to 105, p. 111; read 100.<br>Advance to Part II, p. 123.<br>Review to 69, p. 65; from 81, p. 89.<br>Review to 101, p. 106 (omit 99-100).<br>Review to Part II, p. 123 (omit 104).<br>Advance to 117, p. 131; read 114.<br>Advance to 126, p. 141; read 119, 123, 125.<br>Advance to 133, p. 149.<br>Advance to VII, p. 157.<br>Advance to 143, p. 165.<br>Advance to end, p. 174.<br>From Part II, p. 123—<br>Review to 124, p. 140 (omit 114, 119, 123).<br>Review to VII, p. 159 (omit 125 and 136).<br>Review to end, p. 174.<br>General review to 51, p. 37.<br>General review to 62, p. 54.<br>General review to 92, p. 99 (omit Chapters V and VI).<br>General review to Part II, p. 123 (omit 99, 100, 104, 108).<br>General review to 124, p. 140 (omit 114, 119, 123).<br>General review to VII, p. 157 (omit 125 and 136).<br>General review to end, p. 174. |        | Advance to 14, p. 16.<br>Advance to 31, p. 26.<br>Advance to 51, p. 37.<br>Review to 51, p. 37; from 10, p. 13.<br>Advance to 56, p. 45.<br>Advance to 62, p. 54.<br>Advance to 69, p. 65; Note, p. 61, standard.<br>Mathematical tables and use (10 p., 8 to 21, p. 24); read 16, 17, 20.<br>Advance to 92, p. 99 (omit Chapters V and VI).<br>Advance to 105, p. 111 (omit 99, 100, and 104).<br>Advance to Part II, p. 123 (omit examples, pp. 121, 122).<br>Review to 62, p. 54. } From 51, p. 37<br>Review to 92, p. 99. } (omit as on<br>Review to Part II, p. 123. } advance).<br>Advance to 117, p. 131 (omit 114).<br>Advance to 124, p. 140 (omit 119 and 123).<br>Advance to 129, p. 146 (omit 125).<br>Advance to 136, p. 153.<br>Advance to 140, p. 159.<br>Advance to 144, p. 167.<br>Advance to end, p. 174.<br>From Part II, p. 123—<br>Review to 124, p. 140 (omit 114, 119, and 123).<br>Review to VII, p. 157 (omit 125 and 136).<br>Review to end, p. 174.<br>General review same as upper sections. |

From twenty-five to twenty-eight lessons are assigned to surveying, as follows:

|                             | Upper sections. | Lower sections. |
|-----------------------------|-----------------|-----------------|
| Advance lessons.....        | 14              | 16              |
| First review lessons.....   | 7               | 8               |
| General review lessons..... | 4               | 4               |
| Total .....                 | 25              | 28              |

Nearly half of the recitation hours in this subject are devoted to the use of the ordinary surveying instruments in the field.

In the general review quite a number of subjects relating to tables and adjustment of instruments are omitted.

The upper sections devote about seventy-five hours to the study of this subject and the lower sections about eighty-four. From thirty-seven and a half to forty-two hours are devoted to recitations and instruction, about half of which is outside the section room and in the field with instruments.

The advance lessons average from 16+ to 14+ pages, the first review from 32 to 28, and the general review 70.

The daily lessons are as follows:

*Surveying (Davies' Van Amringe).—Omissions marked in text-book.*

UPPER SECTIONS.

Advance to 79, p. 53.  
 Advance to 108, p. 74.  
 Advance to 125, p. 90.  
 Advance to 9, p. 108.  
 Advance to 165, p. 145.  
 Advance to 180, p. 157.  
 Advance to 193, p. 168.  
 Advance to 210, p. 190.  
 Advance to 233, p. 205.  
 Advance to 254, p. 221.  
 Advance to 268, p. 234.  
 Advance to 285, p. 249.  
 Advance to 298, p. 263.

Advance to 349, p. 217.  
 Review to 108, p. 74.  
 Review to 9, p. 108.  
 Review to 180, p. 157.  
 Review to 210, p. 190.  
 Review to 254, p. 221.  
 Review to 285, p. 249.  
 Review to 349, p. 317.  
 General review to 125, p. 90.  
 General review to 204, p. 184.  
 General review to 267, p. 233.  
 General review to 349, p. 317.

LOWER SECTIONS.

Advance to 76, p. 51.  
 Advance to 97, p. 71.  
 Advance to 123, p. 84.  
 Advance to 134, p. 97.  
 Advance to 149, p. 131.  
 Advance to 165, p. 145.  
 Advance to 179, p. 156.  
 Advance to 190, p. 166.  
 Advance to 210, p. 190.  
 Advance to 225, p. 203.  
 Advance to 250, p. 217.  
 Advance to 267, p. 233.  
 Advance to 280, p. 246.  
 Advance to 291, p. 256.

Advance to 335, p. 301.  
 Advance to 349, p. 317.  
 Review to 97, p. 71.  
 Review to 134, p. 97.  
 Review to 165, p. 145.  
 Review to 190, p. 166.  
 Review to 225, p. 203.  
 Review to 267, p. 233.  
 Review to 291, p. 256.  
 Review to 349, p. 317.  
 General review to 125, p. 90.  
 General review to 204, p. 184.  
 General review to 267, p. 233.  
 General review to 349, p. 317.

Sixty-six recitations, requiring eleven weeks, are allotted to the study of analytic geometry.

All sections take very nearly the same course, the upper sections gaining about three recitations.

|                             | Upper sections. | Lower sections. |
|-----------------------------|-----------------|-----------------|
| Advance lessons.....        | 34              | 37              |
| First review lessons.....   | 17              | 17              |
| General review lessons..... | 12              | 12              |
| Total .....                 | 63              | 66              |

The fourth class begins this subject in April and takes 12 lessons.

In September the third class takes it up with a review lesson of the part already studied and continues the subject until finished about the 1st of November.

From one hundred and eighty-nine to one hundred and ninety-eight hours are devoted to the study of this subject and from ninety-four and one-half to ninety-nine are taken up in the section room with recitations and instruction. The first review lessons average 15 pages and the general review average 20 pages.

The lessons are as follows:

*Analytic Geometry (Church).*

| Upper sections.  | April.     | Lower sections.   |
|--|------------|---|
| <p>Advance to "the second," top p. 9.<br/>                     Advance to 9, p. 16.<br/>                     Advance to 14, p. 24, Part II.<br/>                     Advance to 26, p. 34.<br/>                     Advance to 31, p. 40; paper.<br/>                     Advance to 41, p. 48.<br/>                     Advance to 48, p. 56; paper.<br/>                     Advance to 54, p. 64.<br/>                     Advance to 62, p. 72; papers.<br/>                     Advance to 66, p. 78.<br/>                     From 14, p. 24—<br/>                         Review to 31, p. 40.<br/>                         Review to 48, p. 56.</p>  |            | <p>Advance to "the second," top p. 9.<br/>                     Advance to 9, p. 16.<br/>                     Advance to 14, p. 24, Part II.<br/>                     Advance to 23, p. 31.<br/>                     Advance to 27, p. 36, and paper.<br/>                     Advance to 32, p. 41.<br/>                     Advance to 39, p. 46.<br/>                     From 14, p. 24, Part II—<br/>                         Review to 27, p. 36, with paper.<br/>                         Review to 39, p. 46.<br/>                     Review to 39, p. 46 (give out corrections for future).<br/>                     Advance to 46, p. 54; paper.<br/>                     Advance to 50, p. 60.</p>   |
| Upper sections.  | September. | Lower sections.   |
| <p>Review to 48, p. 56 (give out corrections).<br/>                     Review to 58, p. 68.<br/>                     Review to 66, p. 78.<br/>                     Advance to 71, p. 87.<br/>                     Advance to 77, p. 93.<br/>                     Advance to 83, p. 102.<br/>                     Advance to 91, p. 110.<br/>                     From 48, p. 56—<br/>                         Review to 66, p. 78.<br/>                         Review to 77, p. 93.<br/>                         Review to 91, p. 110.<br/>                     Advance to 96, p. 116.<br/>                     Advance to 103, p. 124.<br/>                     Advance to 106, p. 131.<br/>                     Advance to 118, p. 139.<br/>                     Advance to 126, p. 147 (omit 122).<br/>                     Advance to "first," p. 154.<br/>                     Advance to 138, p. 162.<br/>                     Advance to equation <math>e</math>, p. 170.<br/>                     Advance to 154, p. 177.<br/>                     Advance to 161, p. 184.<br/>                     Advance to 166, p. 192.<br/>                     Advance to 167, p. 199.<br/>                     From 90, p. 108—<br/>                         Review to 103, p. 124.<br/>                         Review to 118, p. 139.<br/>                         Review to 134, p. 156 (omit 122).<br/>                         Review to equation <math>e'</math>, p. 170.<br/>                         Review to 161, p. 184.<br/>                         Review to 167, p. 199.</p> |            | <p>Advance to 57, p. 67.<br/>                     Advance to 63, p. 74 (take formula, § 62½; omit deduction of same).<br/>                     Advance to 68, p. 82.<br/>                     Advance to 74, p. 91 (omit as marked in standard).<br/>                     From 39, p. 46—<br/>                         Review to 50, p. 60.<br/>                         Review to 63, p. 74.<br/>                         Review to 74, p. 91.<br/>                     Advance to 81, p. 97.<br/>                     Advance to 84, p. 103.<br/>                     Advance to 91, p. 110.<br/>                     Advance to 96, p. 116.<br/>                     Advance to 103, p. 124.<br/>                     Advance to 106, p. 131.<br/>                     Advance to 117, p. 139.<br/>                     Advance to 126, p. 147 (omit 122).<br/>                     Advance to "first," p. 154.<br/>                     Advance to 137, p. 161.<br/>                     From 74, p. 91—<br/>                         Review to 84, p. 103.<br/>                         Review to 96, p. 116.<br/>                         Review to 106, p. 131.<br/>                         Review to 126, p. 147 (omit 122).<br/>                         Review to 137, p. 161.<br/>                     Advance to equation <math>e'</math>, p. 170 (omit 139 and 140).<br/>                     Advance to 153, p. 177.<br/>                     Advance to 159, p. 183.<br/>                     Advance to 164, p. 189.<br/>                     Advance to "third," p. 196.<br/>                     Advance to 169, p. 201.</p> |
| Upper sections.  | October.   | Lower sections.   |
| <p>Advance to 171, p. 207.<br/>                     Advance to 175, p. 213.<br/>                     Advance to 179, p. 220.<br/>                     Advance to 192, p. 235 (omit 184-186).<br/>                     Advance to 3, p. 243.<br/>                     Advance to 204, p. 250.<br/>                     Advance to 220, p. 268 (omit 211-219).<br/>                     Advance to 237, p. 285 (omit 220-231 except 225-226).<br/>                     From 167, p. 199—<br/>                         Review to 175, p. 213.<br/>                         Review to 192, p. 235 (omit 184-186).<br/>                         Review to 208, p. 252.<br/>                         Review to 237, p. 285 (omit as before).<br/>                     Descriptive geometry:<br/>                         Advance to 20, p. 10.<br/>                         Advance to 29, p. 15.</p>  |            | <p>Advance to 172, p. 209.<br/>                     Advance to 177, p. 217.<br/>                     Advance to 182, p. 223.<br/>                     Advance to 193, p. 236 (omit 184-186).<br/>                     Advance to 4, p. 243 (omit problems 12 and 13, p. 238).<br/>                     Advance to 206, p. 251 (omit 201 except italics).<br/>                     Advance to 220, p. 268 (omit 211-219).<br/>                     Advance to 237, p. 285 (omit 220-231 except 225-226).<br/>                     From 137, p. 161—<br/>                         Review to 153, p. 177 (omit 139-140).<br/>                         Review to 164, p. 189.<br/>                         Review to 169, p. 201.<br/>                         Review to 177, p. 217.<br/>                         Review to 193, p. 236 (omit 184-186).</p>  |

*Analytic Geometry (Church)*—Continued.

| Upper sections.   | October. | Lower sections.  |
|---|----------|--|
| Descriptive geometry—Continued.<br>Advance to 36, p. 19.<br>Advance to 40, p. 21.<br>Advance to 44, p. 24.<br>Advance to 48, p. 26.<br>General review same as lower sections. |          | From 137, p. 161—Continued.<br>Review to 208, p. 252 (omit as before).<br>Review to 237, p. 285 (omit as before).<br>From 39, p. 46—<br>General review to 57, p. 67.<br>General review to 74, p. 91.<br>General review to 91, p. 110.<br>General review to 106, p. 131.<br>General review to "first," bottom of p. 154 (omit 122).<br>General review to 153, p. 177 (omit 139 and 140).<br>General review to "third," p. 196.<br>General review to 177, p. 217.<br>General review to 4, p. 243 (omit 184-186 and problems 12 and 13, p. 238).<br>General review to 237, p. 285 (omit as before). |

Descriptive geometry is taken up by the third class immediately after the conclusion of analytic geometry. Forty-five lessons are taken before the examination in January and 28 after, making in all 73.

|                      | Number of lessons. | Average number of pages daily. |
|----------------------|--------------------|--------------------------------|
| Advance lessons..... | 40                 | 4 to 5                         |
| First review.....    | 20                 | 8 to 10                        |
| General review.....  | 13                 | 14 to 15                       |
| Total.....           | 73                 | .....                          |

The lower sections omit several subjects relating to warped surfaces which the upper sections take, and the upper sections only take five lessons in determinants.

About two hundred and nineteen hours are devoted to the study of this subject, and one hundred and nine and one-half hours are taken up with recitations and instruction in the section rooms.

The lessons are as follows:

*Third class.—Descriptive Geometry.*

| Upper and second sections.   | November. | Lower sections.   |
|--|-----------|---|
| Review to 29, p. 15.<br>Review to 40, p. 21.<br>Review to 48, p. 26.<br>Advance to 52, p. 29.<br>Advance to 55, p. 31; papers.<br>Advance to 60, p. 36.<br>Advance to 70, p. 40.<br>Advance to 82, p. 47.<br>Advance to 90, p. 51.<br>Advance to 99, p. 56.<br>Advance to 108, p. 61.<br>From 48, p. 26—<br>Review to 55, p. 31.<br>Review to 70, p. 40.<br>Review to 90, p. 51.<br>Review to 108, p. 61.<br>Advance to 122, p. 66.<br>Advance to 131, p. 71.<br>Advance to 140, p. 76 (omit 134).<br>Advance to 150, p. 81.<br>Advance to 160, p. 88.<br>Advance to 166, p. 94.<br>Advance to 172, p. 99.<br>Advance to 177, p. 103.<br>Advance to 184, p. 109.<br>Advance to 191, p. 113.<br>From 108, p. 61—<br>Review to 131, p. 71.<br>Review to 150, p. 81.<br>Review to 166, p. 94. |           | Advance to 18, p. 8.<br>Advance to 28, p. 15.<br>Advance to 34, p. 18.<br>Advance to 39, p. 21; paper.<br>Advance to 43, p. 23.<br>Advance to 46, p. 25.<br>Review to 28, p. 15.<br>Review to 39, p. 21.<br>Review to 46, p. 25.<br>Advance to 49, p. 27.<br>Advance to 52, p. 29.<br>Advance to 55, p. 31.<br>Advance to 60, p. 36 (omit 56; paper).<br>Advance to 70, p. 40.<br>Advance to 80, p. 46.<br>Advance to 89, p. 50.<br>Advance to 98, p. 55.<br>From 46, p. 23—<br>Review to 52, p. 29.<br>Review to 60, p. 36 (omit 56).<br>Review to 80, p. 46.<br>Review to 98, p. 55.<br>Advance to 105, p. 59.<br>Advance to 121, p. 65 (omit 118, 119).<br>Advance to 130, p. 71.<br>Advance to 142, p. 77 (omit 132, 133, 134, 137, 140, 141).<br>Advance to 154, p. 55 (omit 149, 150, 152).<br>Advance to 162, p. 91.<br>Advance to 169, p. 96. |

*Third class.—Descriptive Geometry—Continued.*

| Upper sections.  | December. | Lower sections.  |
|--|-----------|--|
| <p>Review to 177, p. 103.<br/>                     Review to Part II, p. 113.<br/>                     Advance to 12, p. 11 (determinants).<br/>                     Advance to 15, p. 20.<br/>                     Advance to 19, p. 28.<br/>                     Advance to 23, p. 37.<br/>                     Advance to 27, p. 45.<br/>                     Review to 27, p. 45.<br/>                     General review same as lower sections.</p>  | <p>31</p> | <p>Advance to 176, p. 102 (omit 175 and top p. 98).<br/>                     Advance to 184, p. 109 (omit 179).<br/>                     Part II, p. 113 (omit 187).<br/>                     From 93, p. 55—<br/>                     Review to 121, p. 65 (omit 118, 119).<br/>                     Review to 147, p. 77 (omit 132, 133, 134, 139, 140, 141).<br/>                     Review to 162, p. 91 (omit 149, 150, 152).<br/>                     Review to 176, p. 102 (omit 175 and top p. 98).<br/>                     Part II, p. 113.<br/>                     General review to 37, p. 19.<br/>                     General review to 46, p. 25.<br/>                     General review to 55, p. 31.<br/>                     General review to 80, p. 46 (omit 56).<br/>                     General review to 105, p. 59.<br/>                     General review to 142, p. 77 (omit 118, 119, 132, 133, 134, 139, 140, 141).<br/>                     General review to 169, p. 96 (omit 149, 150, 152).<br/>                     Part II, p. 113 (omit 175, 179, and top p. 98).</p>  |
| <p>Advance to equinoxial colure, p. 118.<br/>                     Advance to 204, p. 121.<br/>                     From Part II, p. 113—<br/>                     Review to 204, p. 121.<br/>                     Advance to 215, p. 127.<br/>                     Advance to 222, p. 132.<br/>                     Advance to Part III, p. 140.<br/>                     From 204, p. 121—<br/>                     Review to 222, p. 132.<br/>                     Review to Part III, p. 140.<br/>                     Advance to 248, p. 146.<br/>                     Advance to 252, p. 149.<br/>                     Advance to 258, p. 153.<br/>                     Advance to Part IV, p. 157.<br/>                     From Part III, p. 140—<br/>                     Review to 252, p. 149.<br/>                     Review to Part IV, p. 157.<br/>                     Advance to 276, p. 164.<br/>                     Advance to 284, p. 169.<br/>                     From Part IV, p. 157—<br/>                     Review to 284, p. 169.<br/>                     Advance to 287, p. 174.<br/>                     Advance to curve of shadow, p. 178.<br/>                     Advance to Part V, p. 186.<br/>                     Advance to end, p. 192.</p> | <p>10</p> | <p>Advance to equinoxial colure, p. 118.<br/>                     Advance to 204, p. 121.<br/>                     From Part II, p. 113—<br/>                     Review to 204, p. 121.<br/>                     Advance to 215, p. 127.<br/>                     Advance to 220, p. 130.<br/>                     Part III, p. 140 (omit 220, 221, 227, 229).<br/>                     From 204, p. 121—<br/>                     Review to 220, p. 130.<br/>                     Review to Part III, p. 140 (omit 220, 221, 227, 229).<br/>                     Advance to 247, p. 145.<br/>                     Advance to 251, p. 148.<br/>                     Advance to 254, p. 150.<br/>                     Advance to Part IV, p. 157 (omit 258-259).<br/>                     From Part III, p. 140—<br/>                     Review to 251, p. 148.<br/>                     Review to Part IV, p. 157 (omit 258, 259).<br/>                     Advance to 274, p. 163.<br/>                     Advance to 283, p. 168.<br/>                     From Part IV, p. 157—<br/>                     Review to 283, p. 168.<br/>                     Advance to 286, p. 172.<br/>                     Advance to 289, p. 180 (omit 288).<br/>                     Advance to 293, p. 188.<br/>                     Advance to end, p. 192.</p> |
| <p>From 284, p. 169—<br/>                     Review to curve of shadow, p. 178.<br/>                     Review to end, p. 192.<br/>                     From Part II, p. 113—<br/>                     General review to 215, p. 127.<br/>                     General review to 248, p. 146.<br/>                     General review to Part IV, p. 157.<br/>                     General review to 287, p. 174.<br/>                     General review to end, p. 192.<br/>                     Intermediate examination.</p>   | <p>11</p> | <p>From 284, p. 169—<br/>                     Review to 289, p. 180 (omit 288).<br/>                     Review to end, p. 192.<br/>                     From Part II, p. 113—<br/>                     General review to 215, p. 127.<br/>                     General review to 247, p. 145 (as before).<br/>                     General review to Part IV, p. 157 (as before).<br/>                     General review to 286, p. 172.<br/>                     General review to end, p. 192.<br/>                     Descriptive Geometry, Part II, p. 113 to end.</p>  |

The third class begins the Calculus about the middle of February and finishes it at the end of May.

The lower sections take 93 lessons and the upper 83, as follows:

|                              | Upper sections. | Lower sections. |
|------------------------------|-----------------|-----------------|
| Advance lessons .....        | 46              | 49              |
| First review lessons .....   | 22              | 25              |
| General review lessons ..... | 15              | 19              |
| Total .....                  | 83              | 93              |

The daily lessons are as follows, including 10 lessons which the upper sections take in least squares: The upper sections take in all 467 pages, and the lower take 413 pages. On advance the upper sections average 10 pages and the lower sections about 8½ pages.

On the first review the advance sections omit several subjects, and the average is 20 pages. The lower sections average on the first review about 17 pages. On the general review the upper sections take about 28 pages daily and the lower about 22.

The upper sections devote two hundred and forty-nine hours to the study of this subject and one hundred and twenty-four and one-half hours to recitations and instruction in the section room. The lower sections devote two hundred and seventy-nine hours to study and one hundred and thirty-nine and one-half hours to recitations.

*Third class.—Calculus.*

| Upper sections.   | February. | Lower sections.  |
|---|-----------|--|
| Advance to 17, p. 15.<br>Advance to 33, p. 27.<br>Advance to 50, p. 35.<br>Advance to 62, p. 49.<br>Advance to 69, p. 62.<br>Advance to 78, p. 72.<br>Review to 33, p. 27.<br>Review to 62, p. 49.<br>Review to 78, p. 72.<br>Advance to "In order," middle p. 82.<br>Advance to 85, p. 92.<br>Advance to 92, p. 102.<br>Advance to 13, p. 113.<br>Advance to 103, p. 121.<br>Advance to 106, p. 131.<br>Advance to 110, p. 141.<br>Advance to 115, p. 154.<br>Advance to 118, p. 162.<br>Advance to 123, p. 170.<br>From 78, p. 72—<br>Review to 85, p. 92.<br>Review to 13, p. 113.<br>Review to 106, p. 131.<br>Review to 115, p. 154.<br>Review to 123, p. 170.<br>Advance to example 6, p. 177.<br>Advance to 16, p. 187.<br>Advance to 129, p. 196 (read example 60, p. 192).<br>Advance to 131, p. 206 (read 130).<br>Advance to 137, p. 217.<br>Advance to 139, p. 230.<br>Advance to bottom, p. 242.<br>From 123, p. 170—<br>Review to example 16, p. 187.<br>Review to 137, p. 217 (omission in standard).<br>Review to bottom, p. 242 (in red).<br>Advance to 163, p. 234 (old pamphlet).<br>Advance to 167, p. 245.<br>Advance to 173, p. 253.<br>Advance to top, p. 268 (omit 177).<br>Advance to 193, p. 278 (omit 187).<br>Advance to 204, p. 289.<br>Advance to example 5, p. 299.<br>Advance to example 8, p. 309.<br>Advance to end, p. 319.<br>Review to 169, p. 247 (omit 162, 165, and 166).<br>Review to 187, p. 271 (omit 173, 176, and 177).<br>Review to examples, p. 297 (omit 187, 188 to 193, 198, 200 to 204).<br>Review to end, p. 319. |           | Advance to 17, p. 15 (omit 12 and 13).<br>Advance to 32, p. 25.<br>Advance to 47, p. 35.<br>Advance to 57, p. 44.<br>Advance to 63, p. 52.<br>Advance to 67, p. 59.<br>Review to 32, p. 25.<br>Review to 57, p. 44.<br>Review to 67, p. 59.<br>Advance to 75, p. 68.<br>Advance to 80, p. 76.<br>Advance to example 36, p. 85.<br>Advance to 87, p. 95 (omit 85 and 86).<br>Advance to 93, p. 104 (omission, p. 104).<br>Advance to 13, p. 113.<br>Advance to 103, p. 121.<br>Advance to 106, p. 131 (omit 104).<br>Advance to 110, p. 141.<br>Advance to 115, p. 154 (omit 111).<br>Review to 80, p. 76 (from 67, p. 59).<br>Review to 87, p. 95 (omit 85, 86).<br>Review to 13, p. 113 (omission, p. 104).<br>Review to 106, p. 131 (omit 104).<br>Review to 115, p. 154 (omit 111).<br>Advance to 118, p. 162.<br>Advance to 123, p. 170 (omit as in Standard; on advance omit pp. 163, 169).<br>Advance to 126, p. 179 (omit as in Standard).<br>Advance to example 25, p. 190 (omit as in Standard).<br>Advance to 131, p. 206.<br>Advance to 136, p. 213.<br>Advance to problems, p. 221.<br>Advance to 139, p. 230.<br>From 115 to p. 154—<br>Review to 123, p. 170 (omit as in Standard).<br>Review to example 25, p. 190.<br>Review to 136, p. 213.<br>Review to 139, p. 230.<br>Advance to bottom, p. 242 (omit as in Standard, old text).<br>Advance to 161, p. 229.<br>Advance to 167, p. 245 (omit 162, 165, 166).<br>Advance to example 3, p. 254.<br>Advance to 185, p. 267 (omit 173, 176, 177).<br>Advance to 193, p. 278 (omit 187; read 192).<br>Advance to 204, p. 289 (omit 198, 200 to 204).<br>Advance to 211, p. 304 (omit Chapter XVIII, except read 208, 209).<br>Advance to example 4, p. 312.<br>Advance to end, p. 319. |

## Third class.—Calculus—Continued.

| Upper sections.   | March. | Lower sections.   |
|---|--------|---|
| Advance to 160, p. 217 (Church, integral calculus).<br>Advance to 165, p. 227.<br>Advance to 169, p. 234.<br>Advance to 174, p. 242.<br>Advance to 178, p. 250.<br>Advance to 186, p. 258 (omit 184).<br>Advance to examples, p. 266; paper.<br>Advance to 197, p. 273.<br>Advance to 203, p. 282 (omit 199, 200).<br>Advance to 231, p. 314 (omit 204 to 213, 214-215, 220-221, and 224 to 311).<br>Advance to 239, p. 326 (omit 232).<br>Advance to bottom, p. 335.<br>Advance to 253, p. 342.<br>Advance to 259, p. 349.<br>Review to 166, p. 229 (integral).<br>Review to 175, p. 245 (omit 166, 167).<br>Review to 188, p. 260 (omit 184, 186, 187).<br>Review to 197, p. 273.<br>Review to 233, p. 320 (omit as on advance).<br>Review to 246, p. 333.<br>Review to 259, p. 349.<br>Advance to 23, p. 14 (least squares, Johnson).<br>Advance to 38, p. 25 (omit 27, 28, and 30).<br>Advance to 51, p. 34.<br>Advance to 61, p. 44.<br>Advance to 69, p. 53.<br>Advance to 84, p. 68 (omit 76, 79, 81-83).<br>Advance to 113, p. 91 (omit 96 to 113).<br>Advance to 128, p. 100 (omit 122).<br>Advance to 138, p. 108.<br>Advance to end (omit 139, 142-145). |        | From 139, p. 230 (new)—<br>Review to 161, p. 229 (new) (omit as on advance).<br>Review to example 3, p. 254 (omit as on advance; also 181 to 193).<br>Review to 193, p. 278 (omit as on advance).<br>Review to 211, p. 304 (omit as on advance).<br>Review to end, p. 319.<br>Advance to 159, p. 216 (integral, Church).<br>Advance to 163, p. 223.<br>Advance to 166, p. 229.<br>Advance to example 2, p. 240 (read 166, 167).<br>Advance to 177, p. 248.<br>Advance to 185, p. 254 (omit 184).<br>Advance to 189, p. 263 (omit 186-187; paper).<br>Advance to 194, p. 271 (omit 189-192).<br>Advance to 201, p. 279 (omit 199 and 200).<br>Advance to 233, p. 320 (omit 203 to 216, 218 to 231, and 232).<br>Advance to 239, p. 326.<br>Advance to 244, p. 331.<br>Advance to 247, p. 337.<br>Advance to 255, p. 343.<br>Advance to 259, p. 349.<br>Review to 164, p. 224 (integral).<br>Review to 172, p. 238 (omit 166, 167).<br>Review to 178, p. 250.<br>Review to 191, p. 266 (omit 184, 186-189).<br>Review to 201, p. 279 (omit 192, 199, and 200).<br>Review to 239, p. 326 (omit 203 to 216, 218 to 231).<br>Review to 247, p. 337.<br>Review to 259, p. 349.<br>General review to 44, p. 33 (omit as on advance and first review; differential calculus).<br>General review to 57, p. 44.<br>General review to 67, p. 59.<br>General review to 83, p. 81. |

[Extract from Regulations U. S. M. A., 1894.]

## MATHEMATICS.

32. This course shall comprise—

*Algebra.*—Fundamental operations; algebraic fractions; involution and evolution; imaginary quantities; series and principles of limits; logarithms; interest; combinations; probabilities; elements of determinants and general theory of equations.

*Geometry.*—Geometry of lines, planes, and volumes, and spherical geometry; and the formation and construction of determinate geometrical equations.

*Trigonometry.*—The solution of all the cases in plain and spherical trigonometry; analytical investigation of trigonometrical formulas, and the construction of trigonometrical tables.

*Mensuration and surveying.*—Mensuration of lines, angles, surfaces, and volumes; principles and practice of common land and maritime surveying; methods of platting and computing surveys; trigonometrical surveys; leveling; description and use of all the instruments used in ordinary surveying and platting.

*Analytical geometry.*—Construction of algebraic expressions; solution of determinate problems; systems of coordinates; determination and discussion of the equations of lines, planes, surfaces, and volumes; deduction of the properties, relations, and principles of curves, surfaces, and volumes, especially of the conic sections; methods of constructing curves and determination of loci.

*Descriptive geometry.*—The graphic illustration and solution of geometrical problems in space, and the particular application of this method to spherical projections; construction of maps, shades, and shadows; perspective and isometric projections.

*Differential and integral calculus.*—Differentiation of functions; determination of the rates of change of functions; development of functions into series; evolution of indeterminate forms; maxima and minima of functions; determination of tangents,

normals, asymptotes, order of contact of lines, curvature, involutes, evolutes, envelopes; curve tracing; spirals, formulas, and rules for integration; discussion and use of the arbitrary constant; integration between limits; rectification of curves; quadrature of curves, and cubature of volumes.

*Method of least squares.*—Errors to which observations are liable; correction of observations; probability curve and its equation; measure of precision; deduction and application of the various formulas for probable and mean error; weights of observations; formation of equations of condition and normal equations.

#### COURSE OF STUDY, TEXT-BOOKS, AND BOOKS OF REFERENCE.

The course of study and books used at the Military Academy 1895-96 are as follows:

##### DEPARTMENT OF MATHEMATICS.

*First year, fourth class.*—Davies' Elements of Algebra; Davies' Legendre's Geometry; Ludlow's Elements of Trigonometry; Davies' Surveying; Church's Analytical Geometry; Ludlow's Logarithmic Tables.

*Second year, third class.*—Church's Analytical Geometry; Church's Descriptive Geometry, Spherical Projections, Shades and Shadows, and Perspective; Peck's Determinants; Bass's Differential Calculus; Church's Integral Calculus; Johnson's Least Squares.

So far comparatively few lectures are given in mathematics. One is given early in September to the fourth class, explaining to them the course of study, the requirements of the Academy in mathematical studies, and the necessary methods of study essential for success.

Toward the end of the first year's course a lecture on the history and early development of geometry and algebra is given to the fourth class.

At the conclusion of the subject of descriptive geometry a lecture is given to the third class describing its origin and progress, together with a comparison of algebraic and geometric mathematics, including an outline of modern projective geometry which is not taught at the Academy.

After a few lessons in the calculus a lecture is given to the third class with a view of explaining the difficulties to be encountered and overcome at the beginning of the study of calculus.

At the conclusion of the calculus an account is given of its origin and early development, including the controversy between its discoverers, Newton and Leibnitz.

From time to time, especially on the advance, instruction is given to the sections or portions of a class having the same lesson, which may occupy the entire or a large portion of the recitation hour, but these explanations of lessons are not considered as lectures.

### PART III.

#### ORGANIZATION OF THE DEPARTMENT.

[Description by Associate Prof. Wright P. Edgerton.]

The following is the present staff of the department of mathematics, and is a fair example of its usual organization:

Professor: Edgar W. Bass, head of the department. Associate professor: Wright P. Edgerton. Assistant professor: Daniel B. Devore, first lieutenant Twenty-third Infantry. Instructors: John D. Barrette, first lieutenant Third Artillery; Charles D. Palmer, first lieutenant Third Artillery; John S. Winn, first lieutenant First Cavalry; Charles P. Echols, first lieutenant Corps of Engineers; William O. Johnson, second lieutenant Nineteenth Infantry; William M. Cruikshank, second lieutenant First Artillery; John H. Rice, second lieutenant Third Cavalry.

The organization of the classes under instruction is as shown in Appendixes F<sub>1</sub> and F<sub>2</sub>.

#### DIVISION OF DUTIES.

The head of the department, as the title implies, has control of the entire department, apportions its work among the instructors, exercises a general supervision of both classes under instruction, prepares and conducts the examinations of these classes, is responsible for all property belonging to the department, and is the channel through which must pass all reports and official communications relating to departmental affairs.

The associate and assistant professors perform such duties as are assigned to them by the head of the department. During the present academic year the former has supervised the work of the third class, especially that pertaining to written recitations. He usually teaches the first section of that class and is available as a substitute for any absent instructor. During the same period the assistant professor has supervised in a similar way the work of the fourth class. From September 1 to December 31 he taught two sections of that class; since then he has had but one section, and, like the associate professor, has been available as a substitute for an absent instructor.

Each instructor teaches two sections of the class to which he is assigned.

#### PART IV.

The following is a full description of a recitation, including a description of the section room, number of cadets in a section, assignment of seats, questions and explanatory answers, assignment of subjects for recitations, use of the blackboard, apparatus, merit marks, visits of head of department, etc.:<sup>1</sup>

##### DESCRIPTION OF SECTION ROOM.

The section rooms occupied by the department of mathematics are on the second and third floors of the curtain of the academy building. All are practically of the same dimensions, 22 by 23 feet, height of ceiling 11 feet, and each is lighted by two large windows. Upon the walls in oak frames, their surfaces flush with the face of the frames, are twelve or fourteen slates, usually 4 feet by 3 feet 6 inches. When the wall spaces are long and unbroken four or five of these slates are in a single frame; elsewhere they are framed singly or in pairs. They are all known by the generic name of blackboards. From the lower part of each frame projects a shallow chalk tray, having at its bottom still shallower drawers, and above each drawer a galvanized wire grating. The chalk crayons and erasers, when not in use, are kept on the grating in the tray, while the dust which these implements always generate falls into the drawers below and is removed periodically. Still below the chalk trays are brass racks to support rulers and pointers. On the side of each room next the hall large ventilators are placed above and below the blackboards and above the door. In other parts of the walls are found still more ventilators and the register of the hot-air flue through which, in winter, air is forced, ranging in temperature from hot to cold at the option of the occupants of the room. Consequently the rooms may be said to have almost perfect ventilation, a matter of extreme importance where the air is for the common use of from 10 to 14 persons.

On a platform, usually between the windows, is the instructor's flat-topped desk, with a blackboard for his use behind it. Each member of a section is provided with a separate desk and chair, the latter of oak, the former having a sloping oak top, with a shallow receptacle beneath for books, resting on iron supports similar to those of a sewing machine. In section rooms occupied by the fourth class these desks are placed side by side in two rows, facing each other, parallel to, and equally distant from, the central line of the room through the instructor's desk. In the section rooms of the third class the desks face the blackboard on the side next the hall, and are arranged in four rows of three desks each, the desks of each row having intervals between them of about 3 feet. This permits the cadets to work at their seats, as is the constant custom in the third-class course, with slight danger of mutual assistance or interference.

##### ASSIGNMENT OF SEATS.

Seats are assigned by the instructor to members of a section in the order of their rank in the section, and usually in such manner that the section marcher shall be placed nearest the door.

##### NUMBER OF CADETS IN A SECTION.

Sections belonging to the upper parts of a class generally comprise 11 or 12 members, while the lower sections have but 8 or 10. This difference in size between the upper and lower sections is to enable the instructor having the latter to devote to each member a larger share of his personal attention.

In each section room is posted a copy of the regulations given below, and these are strictly observed:

"The following revised regulations for recitation rooms are published for the information and guidance of all concerned:

"1. The instructor shall be present when the section enters the room.

<sup>1</sup>I am indebted to Associate Prof. Wright P. Edgerton for description.

"2. On entering the recitation room, each cadet shall proceed to the seat assigned to him, and stand 'attention' until the section marcher makes his report.

"3. The section marcher shall enter the recitation room after the section, closing the door if the instructor be present; but in case he be absent, the section shall be seated, the section marcher shall keep the door open, preserve order in the section, and at the end of two minutes report to the senior officer of the department present for instructions.

"4. As soon as the report is made each member shall be seated, and immediately record the next lesson, which shall be written on a blackboard, or otherwise indicated, by the instructor.

"5. Each cadet shall bring to the recitation room a lead pencil, and only such books as may be indicated by the head of the department. Before anyone is called up for recitation the members of the section should ask for any information concerning points in the lesson which they have not been able to comprehend after diligent application, or should make any pertinent statement respecting lack of preparation.

"6. The members of the section called up shall take boards in order as directed, and write their names on the right-hand upper corner.

"7. When prepared to recite, each cadet shall provide himself with a pointer (in case one be needed), face the instructor, and stand 'attention' on that side of his board farthest away from the central line of the room, unless otherwise directed. The pointer shall be held in the hand nearest the board, and with the point down, except when used to indicate work on the board.

"8. Instructors shall require each cadet to keep an upright soldierly position of attention, and to recite with deliberation, clearness, and correct language. Each cadet while reciting, shall, as far as practicable, face his instructor.

"9. Instructors shall see that cadets do not use their hands or pointers improperly, and shall endeavor to prevent them from acquiring any peculiar or nervous habits while reciting; they shall report any want of neatness in dress or appearance.

"10. At the proper signal for dismissal the instructor shall cause all recitations to cease, and immediately dismiss the section. For recitations terminating at 10.55 a. m., 12.53 p. m., and 3.59 p. m., the signal for dismissal is the recall sounded in the hall of the academy building. For recitations terminating at 9.30 a. m., 12 m., and 3 p. m. the signal for dismissal is the assembly sounded in the area of barracks.

"11. Upon the dismissal of the section the section marcher shall leave the room first and supervise the formation of the section outside.

"12. Instructors shall report daily to the adjutant of the Academy, through the head of the department, all cadets who have reported themselves as excused from recitation and any violations of regulations which may have come to their notice in the academy building. Absences will be noted on the weekly class reports.

"13. When an officer enters the section room, the section shall rise and remain at 'attention' until the officer be seated or otherwise indicate his pleasure. The instructor shall rise when the officer is senior to himself. At the discretion of a head of a department, the compliment may be omitted when the officer leaves the room, or reenters during the same recitation hour.

"14. Instructors should bear in mind that the proper discipline of their sections is largely determined by their own example and military bearing. Also, that the success of their instruction will depend in a great measure upon their patience, forbearance, and judicious assistance.

"By order of Colonel Ernst:

"W. E. WILDER,  
"Captain Fourth Cavalry, Adjutant."

#### DESCRIPTION OF A RECITATION.

The 8 o'clock assembly having been sounded in the area of the barracks by the trumpeter, and the sections duly formed, each is marched by its section marcher to the proper room in the academy building, where ranks are broken, caps hung on the hooks in the hall outside the door, and the members enter the section room. The last to enter is the section marcher, who stands in the open door until the members of his section have passed to their desks, where each stands "attention." He then closes the door, faces his instructor, salutes, and reports "All are present, sir," or "Cadet Blank is absent, sir," as the case may be. Occasionally this will be followed by a salute from some member of the section accompanied by the report "I am excused from recitation, sir." The instructor returns the salute and the cadets take their seats while he notes in his section book, a sheet of which is appended, marked F<sub>3</sub>, the absence of Cadet Blank, or the fact that Cadet Dash is excused from recitation. In the latter event he prepares later a report, "Cadet Dash, reporting himself excused from recitation in mathematics," signs his name as reporting officer and submits it to the head of the department, who in turn forwards it to the adjutant, in

whose office the fact involved is verified by inspection of the morning report of the post surgeon. The members of the section open their text-books, glance at the board behind the instructor, where the limits of the next lesson are recorded, make a note of its extent, and of such corrections of, and additions to, the text as the instructor may now give them. The instructor then asks, "Are there any questions on the day's lesson?" At this time any member of the section is at liberty to ask for an explanation of such part of the lesson as he has been unable to comprehend, for the method of solving problems that may involve its principles, or to inquire into any development or extension of these principles.

For the purpose of making clear to the section the points thus brought up for explanation the instructor uses his judgment as to the time he should consume. When going over the text for the first time great latitude is permitted the section. Its members are encouraged to bring before the instructor the difficulties they encounter in the text of whatever nature they may be, and, moreover, the instructor voluntarily elucidates such important features of the lesson as to his mind may prove stumbling-blocks to his pupils. In this way it is customary to consume at least half an hour each morning, and frequently the whole recitation period of one and one-half hours is occupied for purposes of instruction only. On the other hand, when reviewing the text the time given to explanation is reduced to a minimum. Only such questions are answered as pertain to subjects overlooked or neglected when passing over the text before. The cadets at this period are expected to recite upon the subjects in the lesson, or to show their knowledge of its principles by applying them in the solution of examples and problems. Having cleared up all doubtful points of the lesson the instructor calls upon Mr. Asterisk, who takes his place at attention in front of the instructor's desk. The instructor then formally enunciates for him a subject in the lesson, as, for example, if in algebra, "Deduce a rule for extracting the  $n^{\text{th}}$  root of polynomials," or "Discuss the four forms of the quadratic equation." If in the calculus, "Define a point of inflexion; explain how to obtain critical values of the variables and how to test these values." Having heard the enunciation of his subject Mr. Asterisk goes to the board, known as the first front board, generally the one on the left hand opposite the instructor, writes his name on the upper right-hand corner of it, and proceeds to place upon it the formulas, equations, and intermediate mathematical work necessary for a clear and complete demonstration or deduction of the subject assigned to him. No writing is permitted upon the board. No erasure is allowed except by permission of the instructor. Tables of logarithms must be used for all computations.

In the meantime three other members of the section are called upon in turn and in a similar manner sent to the next three boards, in order, on the right of the one already occupied, each to discuss a subject in the lesson of the day. Following these, other members are called, each is given a card or slip of paper containing the data of certain problems or examples involving applications of the principles of the lesson, and each takes his place at one of the boards still remaining vacant, known as side boards, and proceeds to the solution of the problem given. Having sent to the boards as many members of the section as desirable, and this is usually all but one, the instructor then calls upon one of the remaining members whom he questions upon topics of the lesson of the day. As soon as any cadet at the board has completed his work, he takes a pointer in his hand, faces his instructor, and stands attention until called upon to recite. The instructor finishes questioning the cadet on the floor, permits him to take his seat, and marks opposite his name in the proper column of the section book (see Appendix F<sub>3</sub>) his estimate, computed to a scale of 3, of the value of the recitation just completed. He then calls upon Mr. Asterisk, who, in response, enunciates the subject given him as follows: "I am required to deduce a rule for extracting the  $n^{\text{th}}$  root of polynomials," or "I am required to discuss the four forms of the quadratic equation," etc., and after giving any necessary preliminary definitions and explaining the significance of the quantities entering assumed formulæ or equations, passes step by step from this assumed data to the required conclusion. Ordinarily the work is placed upon the board in the same order it has in the text and the recitation follows quite closely the lines of the text, yet this is not required; but any correct demonstration is accepted, provided it is made in clear and logical form. The recitation ended, the instructor usually asks Mr. Asterisk a few questions relating to the salient points of his subject, in order to test the thoroughness of his knowledge of it, or he leads the cadet, by questions, to contemplate some development or application of the subject not indicated in the text. A similar process is followed with each of the other cadets at the front boards and then the instructor turns to those having problems at the side boards. When the instructor is satisfied that the problem or example given is one of which the answer is unknown to the pupil, it is customary to require merely a statement of the problem and the result; although, when time permits, the solution is explained from beginning to end. If errors are committed, they are traced to their source. As each cadet finishes his recitation the instructor marks its value in the section book, as has been described.

When the trumpet sounds recall in the academy building, the instructor dismisses the section as the last note ceases. It is then formed in the hall by the section marcher and marched by him to the area of barracks, where it is finally dismissed.

The foregoing description applies to a recitation in algebra, trigonometry, analytical geometry, or the calculus, and, in its main features, to a recitation in any other branch of the mathematical curriculum.

When teaching plane and solid geometry, each cadet is sent to the board to establish one or more propositions in the day's lesson and, in addition, is given a so-called extra—a problem or application depending upon the principles included in the lesson. This extra usually occupies about one-half hour of the cadet's time, and a failure to solve it is not allowed to affect his mark more than 0.5. In the event of failure, the instructor is required to explain its solution. A book of exercises, containing 422 of these extras, covering the ground embraced by the first four books of Davies's Legendre, has been compiled for the use of the instructors. Each morning the same set of extras is used in each section throughout the class, with the object of testing all parts of the class uniformly. Figures illustrative of principles or used for purposes of deduction must be drawn free hand—that is, without aid of ruler or string—but when a construction is required from given data, the ruler and string must be used and the figure must be as accurately drawn as is admissible with the implements at hand.

In the course of descriptive geometry the data for constructions at the side boards are given out in the form shown in Appendix F<sub>4</sub> and the problems are drawn to the scale marked upon the rulers and on the upper edges of the chalk trays. Colored crayons are largely used, but always in accordance with the scheme appended, marked F<sub>5</sub>. Frequently the instructor allows all or the greater portion of his section to remain seated, gives them the data of certain problems, and requires their construction upon sheets similar to that of Appendix F<sub>4</sub>. With this contingency in view each cadet is required to appear in the section room provided with a properly sharpened drawing pencil and a pair of dividers. Each desk is supplied with a ruler and triangle for the use of the cadet occupying it. Cadets at the front boards who are employed in the deduction of the principles, or in the explanation of the problems embraced in the lesson, are not permitted to place letters or figures upon their constructions; but must make them clear to the instructor by the proper use of the pointer. Occasionally in the course of descriptive geometry proper, and much more frequently in its application to shades and shadows and to perspective, the data for the construction of problems at the desks are hectographed upon a sheet (see appended samples marked F<sub>6</sub>, F<sub>7</sub>, and F<sub>8</sub>), thus saving the time that would otherwise be lost in assuming the given magnitudes and enabling the cadet to concentrate his attention upon the portions of the construction requiring the application of the principles of the lesson.

#### VISIT OF HEAD OF DEPARTMENT.

At intervals the head of the department visits each section, the frequency of these visits depending largely upon the class under instruction and the subject being taught. For example, the fourth class, when studying algebra, receives his constant attention, not only for the purpose of watching the progress of its members, but to see that they acquire the proper methods of recitation. This same class when studying plane geometry or surveying, is visited less frequently, while the third class, which is then devoting its efforts to the calculus, demands a large share of supervision. As a rule a portion of each morning is consumed by visits to the section rooms, where the professor listens to recitations, questions the pupils, and gives such instruction as he deems proper.

#### APPARATUS.

Of apparatus, the department of mathematics has, for use in the course of surveying, 5 transits, 5 compasses, and 4 levels, with the necessary accompaniments of chains, pins, rods, etc.; and the cadets of the fourth class are given as much practical work with these instruments as time will permit. The department possesses also 26 models of geometrical surfaces, some of which are of marked value to the members of the third class when studying descriptive geometry. Those showing the forms and methods of generation of certain warped surfaces seem to be of especial assistance to them.

## PART V.

## WEEKLY CLASS REPORTS, TRANSFERS, EXHIBITION OF MARKS.

The following description is by Associate Prof. Wright P. Edgerton:

## WEEKLY CLASS REPORTS.

Saturday morning, after the recitation hour, each instructor submits to the head of the department a weekly class report (samples appended marked F<sub>9</sub> and F<sub>10</sub>) on which is recorded the daily mark of each member of his sections, the total weekly mark, what portion of the text has been studied during the week, and what recitations have been written instead of oral. The initials at the foot of each daily column indicate the name of the instructor, while a B placed below implies a visit from the head of the department. The instructor also enters the weekly mark of each cadet upon the form appended, marked F<sub>11</sub>, and computes the total mark to date.

## TRANSFERS.

The head of the department, by comparing the total marks of cadets standing respectively at the bottom and top of adjacent sections, determines whether they shall retain their positions in these sections or be interchanged. In the latter case he recommends the transfers on the weekly class report. (See Appendices F<sub>10</sub> and F<sub>12</sub>).

## EXHIBITION OF MARKS.

These weekly reports are submitted by the head of the department to the superintendent, who causes them to be posted in the lower halls of the academy building for the information of the cadets.

## PART VI.

## EXAMINATIONS, WRITTEN, ORAL, WEIGHT OF, DEFICIENCY OR PROFICIENCY OF CADETS, STANDARD REQUIRED.

From the organization of the Academy in 1802, until 1875, the arithmetical examinations were oral so far as I can learn. Since 1875 these examinations have been written.

The following is a detailed description of the requirements in arithmetic for admission in 1875 with the exception of paragraph 7, which was added in 1879. In 1884 the samples of examples and questions were added.

## ARITHMETIC.

In arithmetic, they must be able—

1. To explain accurately and clearly its objects and the manner of writing and reading numbers, entire, fractional, compound, or denominate.
2. To perform with facility and accuracy the various operations of addition, subtraction, multiplication, and division of whole numbers, abstract and compound or denominate, giving the rule for each operation, with its reasons, and also for the different methods of proving the accuracy of the work.
3. To explain the meaning of reduction, its different kinds, its application to denominate numbers in reducing them from a higher to a lower denomination and the reverse, and to equivalent decimals; to give the rule for each case, with its reasons, and to apply readily these rules to practical examples of each kind.
4. To explain the nature of prime numbers and factors of a number, of a common divisor of two or more numbers, particularly of their greatest common divisor, with its use, and to give the rule, with its reasons, for obtaining it; also the meaning of a common multiple of several numbers, particularly of their least common multiple and its use, and to give the rule, with its reasons, for obtaining it, and to apply each of these rules to examples.
5. To explain the nature of fractions, common or vulgar and decimal; to define the various kinds of fractions, with the distinguishing properties of each; to give all the rules for their reduction, particularly from mixed to improper and the reverse, from compound or complex to simple, to their lowest terms, to a common denominator, from common to decimal and the reverse; for their addition, subtraction, multiplication, and division, with the reason for each change of rule, and to apply each rule to examples.

6. To define the terms ratio and proportion, to give the properties of proportion and the rules and their reasons, for stating and solving questions in both simple and compound proportion, or single and double rule of three, and to apply these rules to examples.

7. The candidates must not only know the principles and rules referred to above, but they are required to possess such a thorough understanding of all the fundamental operations of arithmetic as will enable them to combine the various principles in the solution of any complex problem which can be solved by the methods of arithmetic. In other words, they must possess such a complete knowledge of arithmetic as will enable them to take up at once the higher branches of mathematics without further study of arithmetic.

8. It is to be understood that the examination in these branches may be either written or oral, or partly written and partly oral; that the definitions and rules must be given fully and accurately, and that the work of all examples, whether upon the blackboard, slate, or paper, must be written plainly and in full, and in such manner as to show clearly the mode of solution.

The following examples and questions in arithmetic are a few of those which have been used at past examinations. They are given in order to indicate more clearly what is required, but it should be distinctly understood that entirely different ones are used each year.

Multiply 4.32 by .00012.

Explain the reason for placing the decimal point in the answer. (The rule for so doing is not the reason.)

$$5\frac{1}{2} + \frac{7\frac{1}{2}}{05} - 0.725$$

Reduce  $\frac{4 + 3.45}{2\frac{1}{2}}$  to an equivalent decimal.

Divide 3,380,321 by MDCCXCIX, and express the quotient by the Roman system of notation.

Change .013 to an equivalent fraction whose denominator is 135.

Find the greatest common divisor of  $26\frac{1}{2}$ ,  $28\frac{3}{8}$ ,  $29\frac{1}{16}$ .

How many men would be required to cultivate a field of  $2\frac{3}{8}$  acres in  $5\frac{1}{2}$  days of 10 hours each if each man completed 77 square yards in 9 hours?

Separate  $772\frac{3}{8}$  into three numbers which shall be in the same proportion as  $2\frac{1}{2}$ ,  $\frac{7}{16}$ ,  $\frac{6}{10}$ .

If 5 cubic feet of gold weigh 98.20 times as much as a cubic foot of water, and 2 cubic feet of copper weigh 18 times as much as a cubic foot of water, how many cubic inches of copper will weigh as much as  $\frac{1}{8}$  of a cubic inch of gold?

Find the least common multiple for the numbers  $\frac{3}{4}$ , 2.1, 5.25,  $\frac{7}{8}$ .

A wins 9 games out of 15 when playing against B, and 16 out of 25 when playing against C. How many games out of 118 should C win when playing against B?

A and B run a race, their rates of running being as 17 to 18. A runs  $2\frac{1}{2}$  miles in 16 minutes and 48 seconds and B runs the entire distance in 34 minutes. What was the entire distance?

A and B can do a piece of work in 4 hours, A and C in  $3\frac{3}{8}$  hours, B and C in  $5\frac{1}{2}$  hours. In what time can A do it alone?

English shillings are coined from a metal which contains 37 parts of silver to 3 parts of alloy; 1 pound of their metal is coined into 66 shillings. The United States silver dollar weighs 412.5 grains, and consists of 9 parts silver to 1 part alloy. What fraction of the United States dollar will contain the same amount of silver as 1 English shilling?

Give the rules for reducing a decimal of a given denomination to integers of lower denominations.

What is the effect of dividing the denominator of a fraction by a whole number, and why?

Explain the difference between a common fraction and a decimal.

What is the effect of annexing a cipher to a decimal, and why?

If the same number be subtracted from both terms of an improper fraction, what will be the effect? Why?

Give the rule for reducing a common fraction to an equivalent decimal, and explain why the resulting decimal will be equal to the common fraction from which it is obtained.

Give the rule for dividing one decimal by another, and explain why the decimal point in the quotient is placed where the rule directs.

Define reduction, and state the different kinds.

No change has been made in the above requirements since 1884. The following is the paper, with weight, used in March, 1896. A copy of the arithmetic paper used in August, 1878, is submitted for comparison.

PAPER USED IN MARCH, 1896.

[Write your number and the place and date in the spaces provided.]

No. \_\_\_\_\_.

Place, \_\_\_\_\_, March \_\_\_\_\_, 1896.

EXAMINATION IN ARITHMETIC.

[Time allotted, three and one-half hours.]

DIRECTIONS.

Arithmetical solutions are required, but due credit will be given for any correct solution. Sufficient arithmetical work to indicate clearly the method and operations is required in all examples. Answers to examples without the solution will not receive credit. Work to include four decimal places, when necessary, is sufficiently accurate. Reduce all fractional results to simplest form. A rule is not received as a reason for a principle or in place of a solution. Do not attempt to solve examples upon extra paper with a view of copying. In case a question or example is ambiguous, answer or solve it as you understand it. Be careful to put your work in each case in the proper space. There is ample room, but if necessary use the extra sheet, indicating clearly in each case the number of the example.

Draw a line with your pen through erroneous work, and begin again. Do not erase with a knife or eraser. You are advised to take the examples in order as given. Should any one delay you too long, pass on to the others. After trying all you can, return to the unsolved ones, in case there is time. You will receive credit for all correct work done; therefore do what you can in each case, even though you may not be able to complete the solution or obtain a correct result. Numerical errors do not count as much against you as errors in methods. Indicate your answer in each example by writing "Ans." near it.

ASSUME THE FOLLOWING DATA.

1 pound avoirdupois = 7,000 grains troy.  
The weight of 27.7015 cubic inches of distilled water is 1 pound avoirdupois.  
1 gallon beer measure contains 282.0 cubic inches.  
1 bushel contains 2,150.42 cubic inches.  
1 United States gallon wine measure contains 231 cubic inches.  
25 pounds avoirdupois = one quarter.

1 fathom = 6 feet.  
1 hand = 4 inches.  
40 square rods = 1 rood. *R.*  
The ratio of *a* to *b* is  $\frac{a}{b}$ .  
1 ounce troy = 31.1 grammes.  
1 English Imperial gallon contains 277.24 cubic inches.

No. 1.—How many sixteenths are there in  $2\frac{3}{8}$ ?  
[Wt. 5.]

No. 2.—What is the difference in grains between  $42\frac{3}{8}$  lbs. Av. and 42.375 lbs. T.?  
[Wt. 8.]

No. 3.—A bought 10 pears and 20 apples for 11 cents; at another time, when the prices were the same, he bought 20 pears and 10 apples for 13 cents. What did he pay for each apple and pear?

No. 4.—A is 49 years old at the time his three sons are 25, 20, and 16 years old, respectively. Find A's age at the time it is equal to the sum of the ages of his three sons.

No. 5.—472 is the greatest common divisor of two numbers, and  $\frac{3}{7}$  is their ratio in its simplest form. What are the numbers?

No. 6.—A wheel with 35 cogs works into a smaller wheel with 26 cogs; in how many revolutions of the larger wheel will the smaller one gain 10 revolutions?

No. 7.—A gun is fired 36 times before a second gun begins, after which the first is fired 8 times while the second is fired 7 times; but the second requires the same amount of powder for 3 shots that the first requires for 4. When both guns have used up the same amount of powder, how many shots have been fired from each?

No. 8.—A, B, C, and D, working one at a time, do a certain work in 130 days. A gets 42 cents, B gets 45 cents, C gets 48 cents, and D gets 50 cents for each day's work. Each received the same amount. How many days did each work?

No. 9.—Having 300 barrels of flour worth \$7.50 per barrel, and 800 barrels worth [Wt. 15.] \$7.80 per barrel, and 400 barrels worth \$7.65 per barrel, how many more barrels of flour at \$8.00 and \$8.50 per barrel will make 2,000 barrels worth \$7.85 a barrel?

State the arithmetics you have studied.

PAPER USED IN AUGUST, 1896.

No. ———.

AUGUST —, 1878.

EXAMINATION IN ARITHMETIC.

[Time allotted, four hours.]

DIVISION I.

- Express 1666 by the Roman system of notation.
- Multiply four million twenty-five thousand and one by one hundred thousand and twenty.
- What are the prime factors of 2772?
- Find the least common multiple for the numbers 270, 189, 297, 243.

$$5. \text{ Divide } 3\frac{1}{4} - \frac{0.45}{\frac{7}{9} + \frac{11}{8}} \text{ by } \frac{1.05 \times 2\frac{1}{2}}{\frac{5}{6} \div 0.3}$$

- Change 0.4 to an equivalent fraction whose denominator is 28.
- Reduce 3 mi., 8 fur., 15 rds., 4 yds., 2 ft., 7 in., to rods.
- A railroad has three tracks, of the following lengths: 3013, 2231, and 2047 feet; what is the length of the longest rail that will exactly lay each track?
- If  $37\frac{3}{4}$  yards of cloth 4 feet wide cost \$4.25, what will  $104\frac{1}{2}$  feet  $1\frac{1}{2}$  yards wide cost at  $\frac{2}{3}$  the price?
- A and B together can do a piece of work in  $15\frac{1}{2}$  days; A can do  $\frac{2}{3}$  as much as B. In how many days can each do it alone?

DIVISION II.

- Give the rule for reducing two or more fractions to their least common denominator.
- What is the effect of dividing the denominator of a fraction by a whole number, and why?
- Give the rule for changing a decimal to an equivalent common fraction.
- Give the rule for dividing one decimal by another.
- Give the rule for reducing a decimal of a given denominator to integers of lower denominations.

The candidate will state the text-books in this subject that he has studied, and write his number in a legible hand.

Sixty-six per cent was required on the above paper for 1896, except in certain cases where candidates were excellent in all other branches required for admission. The standard was lowered to include some with 64 per cent, 62 per cent, and one with only 60 per cent. This is the general practice of the academic board at present. One hundred and eighty-nine were examined; 129 passed and 60 failed.

Previous to the year 1892 candidates were examined at West Point. In March, 1892, examinations were held at various convenient places, army officers being detailed to supervise them.

The papers were prepared by the academic board, and after the candidates had finished their work all papers were returned to the academic board for correction and decision. A subsequent examination was held in June at the Academy. This method has continued up to the present time, and promises to be better than the old, provided army officers will prevent candidates from communicating with each other at such examinations.

Up to and including the June examination, 1881, the examinations of cadets were in general oral. In December, 1881, a new method was established, which included written as well as oral examinations. The following rules, which were adopted at that time, explain fully the methods subsequently used:

\* \* \* \* \*

"1. For examination in all branches of study of cadets of all classes, both in January and in June, the academic board shall be divided into two committees, as nearly equal in numbers as may be convenient. These committees shall be arranged and the order and method of examination shall be determined by the academic board.

"Examinations at any other time shall be conducted as the academic board may in the case direct.

"2. Each committee shall examine the cadets in the branches of study assigned to it according to the method prescribed, and after examination shall arrange in a proposed order of merit in each branch of study a roll of the cadets of each class pursuing that branch, indicating upon the roll the proficiency, doubtful proficiency, or deficiency of each cadet. No cadet shall be reported by the committee as proficient or deficient except by unanimous vote; in all other other cases the cadet shall be reported as of doubtful proficiency.

"3. After completing its allotted part of the examination, each committee shall submit to the academic board a report of its proceedings, including the several rolls of cadets in order of merit, all written examination papers forming any part of the examination, and such notes and remarks as may be necessary to give the board satisfactory information upon which to base its decision.

"4. Upon receiving the reports of the committees, the academic board shall carefully consider the same, including rolls, marks, notes, remarks, and written examination papers, with especial attention to cases of doubtful proficiency, and shall then arrange each class in order of merit in each branch of study and decide upon the proficiency or deficiency of each cadet.

"The board may also order such further examination as it may think proper.

"General merit rolls shall be arranged by committees appointed by the academic board.

"5. \* \* \* \* \* In all branches of study except drawing the examination shall be oral, written, or partly oral and partly written, as the board shall direct; but after an oral examination in any branch of study every cadet who is not, in the unanimous opinion of the committee, proficient shall be subjected to a written examination upon a paper prepared by the head of the department of study under consideration and approved by the committee, such examination to be conducted by the head of the department and his instructors.

"6. At any oral examination the subject of examination shall be so limited for each cadet as to make not exceeding one hour a reasonable allowance of time to prepare to recite, and after the expiration of the allotted time the cadet may be called upon in his proper turn to recite.

"7. In cases of examination wholly or partly written for the whole class the heads of departments shall prepare, at least one week before the examination, examination papers, to be submitted to a committee of two other members of the board, the committee to be appointed by the board and to be as permanent as practicable.

"8. All written examination papers shall, as soon as possible after the cadet's work upon them is completed, be carefully examined, the errors indicated, and proper marks given, both by the head of the department of instruction and by the instructor of the section. These papers and marks shall be submitted to the committee in case of a written or partly written examination for the whole class, but to the academic board in all other cases."

\* \* \* \* \*

In the autumn of 1895, after careful consideration, the academic board recommended that the following paragraph be added to the regulations for the United States Military Academy:

"72 $\frac{1}{2}$ . Upon the completion by any class of any branch of a course of study before the end of an academic term, the class may, by a vote of the academic board, be examined immediately, and the names of all cadets who are declared deficient shall be submitted to the War Department in the manner prescribed by paragraph 82."

This change was approved by the honorable Secretary of War, and upon the completion of analytical geometry the third class was examined upon that subject. Those who failed to pass were conditioned to make up their deficiency by January 1, 1896.

Upon completing the subject of descriptive geometry in February, 1896, the third class was immediately examined, and those who failed were granted until June to make up their deficiency.

At the annual examination in June only one member of the third class failed to pass.

On March 10, 1896, the fourth class was examined upon plane geometry, and those who failed were permitted to go on until June, 1896. All but three made up their deficiency in that subject, and five only failed upon the course from January to June.

These results, as compared with those of previous years, are remarkable, and while they are almost too good to continue always, they show beyond a doubt the advantage of the method of intermediate examinations.

I submit herewith copies of examination papers which have been used at the times indicated, with a complete set of those used from September 1, 1895, to June 2, 1896, for the entire classes. The weights are indicated thereon. Each paper, with its weights, is examined and approved by a standing committee of the academic board, appointed for that purpose.

Oral examinations in mathematics, being less extended, usually have a weight of five advance recitations, i. e., a maximum of 15.

The standard of proficiency is generally about two-thirds of the maximum mark after examination, due weights having been assigned to the advance, first review, and general review recitations.

[Written for doubtful cases after oral.—Weight, 18.]

#### EXAMINATION IN ALGEBRA.

##### PART I.

[Time allotted, two hours.—January, 1885.]

- Factor the expression  $bx^3 - 7ax^2 - 20a^2x$ .
- Simplify  $\frac{\left[ \left( a^m \right)^{\frac{1}{r}} \left( a^q \right)^1 \right]^{nr}}{\left[ \sqrt[p]{\frac{b^q}{b^u} \left( \frac{p}{b} \right)^r} \right]^{mq}} \div \left[ \left( \frac{a}{b} \right)^q \right]^r$ .
- Find the value of  $-0.0357^{-5}$  by means of logarithms.
- In the expression  $a^{-\frac{2}{3}} \left[ \left( a - a^2x \right)^{\frac{1.42}{1.89}} \right]^{\frac{2m}{6}}$  introduce  $a^{-\frac{2}{3}}$  into the brackets and parentheses and simplify.

##### PART II.

[Time, two and one-half hours.]

5. A cask contains  $a$  gallons of water and  $b$  gallons of alcohol. Another cask contains  $m$  gallons of water and  $n$  of alcohol. If  $h$  gallons be drawn from each cask and mixed, how many gallons of each fluid will the mixture contain?

6. The base of a system of logarithms is 82,134. Find the modulus of the system.

7. Find three numbers such that their sum shall be 14, the sum of their squares 84, and the product of the first and third equal to the square of the second.

#### WRITTEN EXAMINATION, ALGEBRA (FOR DOUBTFUL CASES).

[January, 1895. Total weight, 18.]

##### PART I.

[Time allotted, two hours.]

No. 1. Show that the form  $\left[ \frac{x^m - y^m}{x - y} \right]_{x=y} = \left( mx^{m-1} \right)$  holds true when  $m$  is fractional and equal to  $\frac{r}{s}$ ; also when  $m$  is equal to  $-p$ .

No. 2. Find the number expressed by three digits such that the sum of the squares of the digits shall be 104, the square of the middle digit to exceed twice the product of the other two by 4, and if 594 be subtracted from the number the remainder will be expressed by the same digits reversed.



2. *Analytical geometry*.—Find the equation of a straight line which passes through the point  $\left\{ \begin{matrix} x' = 5 \\ y' = 3 \end{matrix} \right\}$  and is parallel to the straight line which passes through the points  $\left\{ \begin{matrix} x'' = -2 \\ y'' = 7 \end{matrix} \right\}$  and  $\left\{ \begin{matrix} x''' = -4 \\ y''' = -5 \end{matrix} \right\}$ . [Weight, 3.]

3. *Analytical geometry*.—Find the equation of a straight line which passes through the center of the circle  $x^2 + y^2 - 6x - 8y = -21$  and makes an angle of  $60^\circ$  with the straight line  $x - 2y = -1$ . [Weight, 5.]

1. *Trigonometry*.—Find log. sec. — ( $430^\circ 22'$ ). [Weight, 2.]

2. *Trigonometry*.—Having log. cosec  $Q = 0.02610$ , find all positive value of  $Q < 360^\circ$ . [Weight, 2.]

3. *Trigonometry*.—Assume formula for  $\sin(x + b)$  and deduce formulas for following:  $\sin(x - b)$ ,  $\cos(x + b)$  ( $\cos x - b$ ),  $\tan(x + b)$ ,  $\cot(x - b)$ . [Weight, 5.]

4. *Trigonometry*.—Having  $a = 109.4321$  mi.,  $A = 50^\circ 12'$ ,  $C = 58^\circ 08'$ , radius = 100 mi., solve the oblique spherical triangle (log.  $\frac{\pi}{180} = 2.24188$ ). [Weight, 11.]

[Written for the entire class. Weight, 60.]

EXAMINATION FOURTH-CLASS MATHEMATICS, JUNE 1, 1895.

PART I.—8 to 10.30 a. m.

1. *Geometry*.—Show that triangles which have corresponding sides proportional are similar. Scholium. [Weight, 5.]

2. *Geometry*.—Show that any side of a spherical triangle is less than the sum of and greater than the difference between the other two sides. (1) Any side of a spherical polygon —. (2) The arc of a small circle on the surface of a sphere —. (3) The shortest distance from one point to another on the surface of a sphere —. [Weight, 6.]

3. *Geometry*.—Find the volume of the frustrum of a right triangular pyramid, with each side of the lower base = 6 feet and each side of the upper base = 4 feet. The altitude = 5 feet. [Weight, 4.]

4. *Geometry*.—Find the volume generated by a regular semihexagon revolving about its axis which is 12 feet in length. [Weight, 4.]

5. *Geometry*.—Through two given points draw a circle tangent to a given right line, take points and line as indicated C—D. [Weight, 4.]

6. *Geometry*.—Show that the rectangle of the two sides of a triangle is equal to the rectangle of its altitude and the diameter of the circumscribed circle. [Weight, 4.]

PART II.—10.45 a. m. to 1 p. m.

7. *Trigonometry*.—Assume the formulas for  $\sin(x \pm b)$  and  $\cos(x \pm b)$  and deduce formulas for  $\sin \frac{Q}{2}$ ,  $\cos \frac{Q}{2}$ ,  $\tan \frac{Q}{2}$ ,  $\cot \frac{Q}{2}$ , in terms of  $\cos Q$ . [Weight, 3.]

8. *Trigonometry*.—In an oblique plane triangle  $a = 273.960$ ,  $b = 198.632$ ,  $c = 236.914$ . Compute  $A$ ,  $B$ , and  $C$ . [Weight, 4.]

9. *Trigonometry*.—In a right trihedral  $\alpha = 69^\circ 13' 40''$ ,  $B = 99^\circ 40' 30''$ ,  $A = 90$ . Solve the trihedral. [Weight, 4.]

10. *Trigonometry*.—In an oblique trihedral  $\alpha = 68^\circ 46' 2''$ ,  $\beta = 37^\circ 10'$ ,  $C = 39^\circ 23'$ . Solve the trihedral. [Weight, 7.]

PART III.—2 to 4 p. m.

11. *Trigonometry*.—Express  $\sin Q$  in terms of each of the other trigonometric functions of  $Q$ . (Assume formulas in Table B.) [Weight, 3.]

12. *Analytical geometry*.—Find the shortest distance between the right lines whose equations are  $9x - 3y = 7.7$  and  $y = -3x + 9$ . [Weight, 2.]

13. *Analytical geometry*.—Find the equation of a right line which passes through the point  $(x' y')$  and makes with the line  $Ax + By + C = 0$  an angle =  $Q$ . [Weight, 3.5.]

14. *Analytical geometry*.—Find the equation of a right line which passes through the point  $x' = 5y' = -3$  and is perpendicular to the right line which passes through

the two points  $\left\{ \begin{matrix} x'' = -2 \\ y'' = 7 \end{matrix} \right\}$ ,  $\left\{ \begin{matrix} x''' = -4 \\ y''' = -5 \end{matrix} \right\}$ . [Weight, 3.5.]

15. *Analytical geometry*.—Deduce the general equation of a circle referred to rectangular axes in its own plane, and determine formulas for finding the center and radius from the general equation. [Weight, 3.]

[Written for the entire class. Total weight, 45.]

EXAMINATION THIRD CLASS MATHEMATICS, JANUARY, 1895.

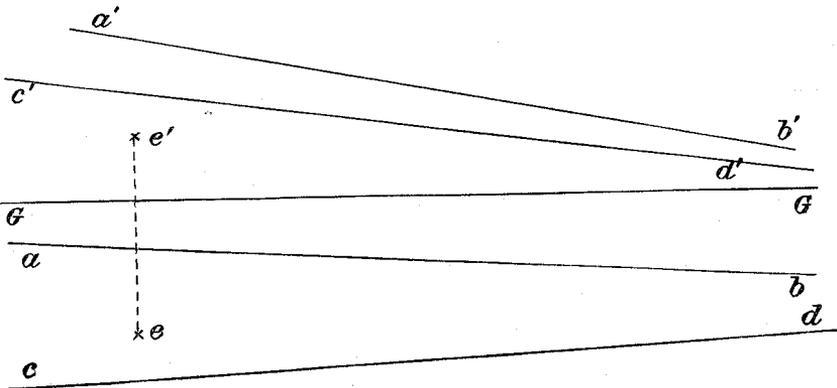
PART I.

ANALYTICAL GEOMETRY, TWO AND ONE-HALF HOURS.

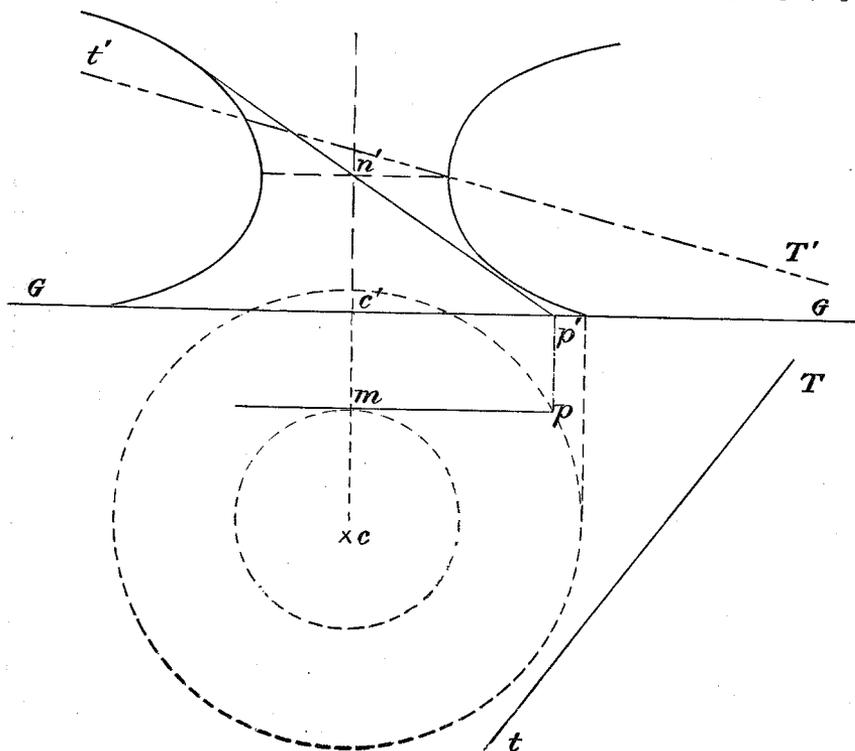
1. Find the equation of a plane which contains the point  $(-2, 3, 4)$ , is parallel to the right line  $\begin{cases} x = 3z + 2 \\ y = -6z - 3 \end{cases}$ , and makes an angle of  $60^\circ$  with plane  $z = -2/3x - \frac{y}{2} + 2$ . [Weight, 4.]
2. Show what the area of a portion of a parabola is equal to, in terms of the rectangle described on the ordinate and abscissa of the extreme point. [Weight, 6.]
3. If a circle be described on the conjugate axis of an ellipse, show the relation existing between any abscissa of the circle and the corresponding abscissa of the ellipse. Show the construction that depends upon the relation. [Weight, 5.]
4.  $r = \frac{-b^2}{a + e \cos v}$  and  $r = \frac{b^2}{a - e \cos v}$ , in which  $c = \sqrt{a^2 + b^2}$  are the polar equations of the hyperbola pole at the right-hand focus. Discuss them with respect to  $v$ , show which points of curve are determined by each, and the corresponding values of  $\cos v$ . Determine values of  $r$  for the vertices of curve. [Weight, 6.]
5. Construct with accuracy the curve  $144y^2 - 120xy + 25x^2 - 2x - 29y - 1 = 0$ . [Weight, 6.]

DESCRIPTIVE GEOMETRY.

1. Prove that if lines are tangent in space their projections on the same plane will be tangent to each other. Show when the converse is true and why. [Weight, 1.]
2. Show that any meridian plane of a surface of revolution bisects at right angles a system of chords of the surface. [Weight, 1.]
3. Prove that in general a plane which contains a rect element of a warped surface is tangent to the surface at some point of this element, but not all along the element. Mention any exception to the last clause. [Weight, 2.]
4. Find the length of the perpendicular from the point E to the plane of the two right lines AB and CD. [Weight, 5.]



5. To find the intersection of any surface of revolution by a plane. [Weight, 9.]



Let the surface be a hyperboloid of revolution of one nappe given below, and  $tTt'$  be the cutting plane. Construct the curve of intersection and an axis of it. Points of tangency of projections of curve to corresponding projection of important limiting lines of surface required, with reasons for the tangency.

[Written for the entire class. Total weight, 3.]

INTERMEDIATE EXAMINATION, THIRD CLASS, ANALYTICAL GEOMETRY, NOVEMBER 6, 1896.

PART I.—8 to 9.25 a. m.

- Given  $\begin{cases} 3z - 2x = 17 \\ 5z + 4y = 9 \end{cases} \dots (1)$  and  $\begin{cases} \frac{3}{2}z + \frac{x}{4} = 3 \\ 7 - z6y = -2 \end{cases} \dots (2)$ . Find the angle they make with each other. Find the angle that (1) makes with axis of X. Find the angle that (2) makes with the plane YZ. [Weight, 6.]
- Find the axes, eccentricity, and parameter of the curve  $3y^2 + 4x^2 = 18$ . [Weight, 4.]
- Deduce a general polar equation of the ellipse. Determine form of same when pole is at center of ellipse;  $1^\circ$  in terms of  $a$  and  $b$ ,  $2^\circ$  in terms of  $b$  and  $e$ ,  $3^\circ$  in terms of  $a$  and  $e$ . [Weight, 5.]

PART II.—9.30 to 10.55 a. m.

- Having ellipse referred to its center and axes, deduce an expression for the subtangent corresponding to  $(x', y')$  and explain the consequent construction. Will a similar construction apply when ellipse is referred to its center and a set of conjugate diameters? Why? [Weight, 4.5.]
- Deduce the formulas for coordinates of the center of conics, and show which have centers and which have not. [Weight, 4.5.]
- Find the equation of the surface generated by revolving the curve  $y^2 = 8x - 16$ ,

about the axis of Y; its meridian curve, and its intersection by a plane perpendicular to Y. [Weight, 4.]

7. (a') Give the equation of an ellipsoid referred to center and axes. (b') Give equation of tangent plane to same at  $(x'' y'' z'')$ . (c') What kind of curves may be cut out of an ellipsoid by planes? (d') When  $a > b > c$  describe the position of planes that cut out circles. (e') What kind of a conic is the line of contact of a cone tangent to an ellipsoid? Why? [Weight, 2.]

[For the entire class. Weight, 21. Time, one and one-half hours.]

EXAMINATION PAPER, DESCRIPTIVE GEOMETRY, JANUARY, 1896, FIRST PERIOD.

1. Give the analysis of the problem: "To find the shortest line which can be drawn, terminating in two right lines, not in the same plane." [Weight, 1.5.]

2. If a right line is perpendicular to a plane, prove that its projections will be respectively perpendicular to the traces of the plane. [Weight, 1.5.]

3. Surfaces..  $\left\{ \begin{array}{l} \text{First..} \\ \text{Weight, 3.} \end{array} \right. \left\{ \begin{array}{l} \text{First...} \\ \text{Second..} \\ \text{Third...} \end{array} \right. \left\{ \begin{array}{l} \text{First.} \\ \text{Second.} \end{array} \right.$

Complete the above diagram so that it shall exhibit the classification of surfaces, and define each class and subclass.

Find the angle  $x$  made by the right line AB (5a, 3, 4) (8, 1.5, 4.5) with the plane of the two right lines CD (6.5, 4, 2) (2, 2, 4) and CE (6, 5, 4, 2) (4, 1, 0). No traces of planes to be found or used. [Weight, 5.]

Total weight for first period, 11.

THIRD CLASS, JANUARY, 1896, SECOND PERIOD.

[Time, one and one-half hours.]

52. Construct the cylinder whose base, in H, is a circle having for its radius 1.5 and for its center the point C (8.0, 3.0, 0.0), the rectilinear elements of the cylinder being parallel to the right line CB (8, 3, 0) (6, 0, 1.5). [Weight, 1.]

Intersect the cylinder by the plane, perpendicular to CB, passing through the point of that line one unit above H, find the curve of intersection by this plane and develop the portion of the cylinder lying between the intersecting plane and H.

NOTE.—Place the development on the left of the drawing, the rectified right section coincident with the left edge of the paper and the center of this rectified arc on GG.

[For the entire class. Weight, 15.]

INTERMEDIATE EXAMINATION, THIRD CLASS, DESCRIPTIVE GEOMETRY, FEBRUARY 12, 1896.

FIRST PERIOD.—8 to 9.20 a. m.

1. Show what the stereographic projection of any circle on the surface of a sphere is and where the extremities of a diameter of the projection of any such circle are to be found. [Weight, 2.5.]

2. Describe the conic projection. State (1) when the exaggeration is the greatest; (2) how it may be lessened; (3) the manner of using it to advantage when a small portion of the surface between two given parallels is to be represented. [Weight, 1.5.]

3. Construct the shade and shadow of a sphere. (Model given.) [Weight, 3.5.] Total weight for first period, 7.5.

SECOND PERIOD.—9.30 to 10.55 a. m.

4. (1) The perspectives of what sets of parallel lines are parallel? Why?

(2) Rule for constructing the vanishing line of any plane.

(3) Rule for constructing a set of conjugate diameters of an ellipse which is the perspective of any given circle.

(4) Rule for constructing the vanishing point of the projections of rays on any plane. [Weight, 3.3.]

(5) Perspective of shade and shadow of a cylindrical column with square pedestal and abacus. (Model with perspective of pedestal, abacus, and one circle of column given.) [Weight, 4.2.]

[Written for the entire class. Total weight, 25.]

## INTERMEDIATE EXAMINATION, FOURTH CLASS, IN GEOMETRY, MARCH 10, 1896.

PART I.—8 to 9.30 a. m. [Weight, 13.]

1. If two angles of a triangle are equal, the sides opposite to them are also equal. [Weight, 2.]
2. If from a point without a circle a tangent and a secant are drawn, the secant terminating in the concave arc, the tangent is a mean proportional between the secant and its external segment. [Weight, 2.]
3. If a straight line is perpendicular to two straight lines at their point of intersection it is perpendicular to the plane of those lines. [Weight, 4.]
4. Given an equilateral triangle inscribed in a circle, and a similar circumscribed triangle; determine the ratio of the two triangles to each other. [Weight, 3.]
5. Find a point within a triangle such that the angles formed by drawing lines from it to the three vertices of the triangle shall be equal to each other. [Weight, 2.]

PART II.—9.30 to 11 a. m. [Weight, 12.]

6. Show what the volume of the frustrum of any cone is equal to. [Weight, 3.]
7. The area of a spherical triangle = ? [Weight, 3.]
8. The area of a lune = 33.55 sq. ft.; the angle of the lune =  $60^\circ$ . Surface of sphere = ? Volume of sphere = ? [Weight, 2.]
9. What is the surface of a zone on a hemisphere whose radius is 5 feet, the radii of the bases being 4 and 3; and what is the volume of the corresponding segment? [Weight, 3.]
10. Given A—B = base of a triangle  $\triangle A$ , "a" angle at base, and C—D = side opposite angle "a" minus unknown side adjacent to "a," construct the triangle. [Weight, 1.]

## WRITTEN EXAMINATION PAPER FOR THE FOURTH CLASS, JUNE 2, 1896. TRIGONOMETRY, SURVEYING, AND PART OF ANALYTICAL GEOMETRY.

[Time, four and one-half hours.]

1. *Trigonometry*.—Paper with constructions, etc., functions to be determined. [Weight, 2.]
2. *Trigonometry*.—From a point 108 feet above a horizontal plane the angles of depression of the top and bottom of a tower standing on the plane are  $30^\circ$  and  $60^\circ$ , respectively. Find the height of the tower. [Weight, 3.]
3. *Trigonometry*.—Assume the square of any side of a triangle in terms of the other two sides and their included angle, and deduce values for  $\sin \frac{1}{2} A$ ,  $\cos \frac{1}{2} A$ , and  $\tan \frac{1}{2} A$  in terms of the sides. [Weight, 4.]
4. *Trigonometry*.—The distance between two points on a horizontal plane is 940 feet. From a balloon in the same vertical plane the angles of depression to these points are  $22^\circ 15'$  and  $30^\circ 46'$ , respectively. Find the height of the balloon above the plane. [Weight, 4.]
5. *Trigonometry*.—In a right trihedral prove =  $1^\circ$ —each oblique dihedral is of the same species as its opposite face angle, and if one is  $90^\circ$  the other is  $90^\circ$ ;  $2^\circ$ —An oblique dihedral if not equal to its opposite face angle is nearer to it than  $90^\circ$ . [Weight, 3.]
6. *Trigonometry*.—Given  $B=82^\circ 58' 10''$ ,  $C=43^\circ 27' 36''$ ;  $y=29^\circ 32' 29''$ . Solve the oblique trihedral. [Weight, 8.]
7. *Analytical geometry*.—Find the equation of a right line through the point  $(-4, 3)$ , such that the portion between the axes is divided by the given point in the ratio of 5:3. (One line only required.) [Weight, 2.]
8. *Analytical geometry*.—Find the distance from the point of intersection of the lines  $y=3x-4$  and  $5x-y+2=0$  to the line  $7x-y=0$ . [Weight, 1.5.]
9. *Analytical geometry*.—Find the angle between the lines  $x+y\sqrt{3}=3$  and  $x-y\sqrt{3}=2$ . Also the coordinates of the point of intersection. [Weight, 2.]
10. *Analytical geometry*.—Find the equation of the lines bisecting the angles between  $4y=3x+7$  and  $3y=4x+17$ . [Weight, 2.]
11. *Analytical geometry*.—Determine the coordinates of the center and the radius of the circle  $2x+2y^2-14x+6y-3=0$ . [Weight, 1.5.]
12. *Surveying*.—Deduce the rule for determining the double meridian distance of any course. [Weight, 2.]

## PART VII.

## CRITICAL REVIEW OF PRESENT COURSE AND METHOD OF INSTRUCTION, COMPARISON WITH FORMER YEARS AND WITH OTHER INSTITUTIONS, ADVANTAGES, DEFECTS, ETC.

Previous to 1881 the recitations and examinations in mathematics were almost entirely oral. Demonstrations predominated largely over applications. Believing that both were essential, I introduced more examples and exercises into the course with improved results.

About the same time I became convinced that oral examinations alone, in which each student had as a rule a single subject, were very unsatisfactory. The academic board received insufficient data from the examination, and the student regarded it largely as a matter of luck. Furthermore, there was no record of the examination work, for after consideration in cases where questions as to facts and fairness subsequently arose.

The present method of requiring in all cases of doubtful proficiency, after an oral examination, a written one, embracing subjects and applications throughout the course, was then adopted, obviating to a great extent the defects of the former method. Written examinations, however, soon developed the fact that the method of exclusive oral recitations was faulty. Written recitations were then introduced, especially during reviews, so that the necessary instruction upon advance should not be interrupted. The result has been extremely satisfactory, and I believe that the present system of combining written recitations and examinations with the oral compares favorably with that employed in any other similar institution. I am convinced that the successful students acquire a better understanding of the principles than formerly, and the percentage of failures has of late years diminished.

I have endeavored to sustain the high standard established by my distinguished predecessor, Prof. A. E. Church, and to introduce such improvements as time and experience naturally suggest. For the future, I have several important plans and propositions to submit.

In the first place, I believe that for a four year's course too much time is employed in learning the course in pure mathematics. The course for the lower sections has not been increased during the last fourteen years, and is considered the minimum necessary for the proper study of philosophy, engineering, ordnance and gunnery, and drawing. The greater portion of the first two years is now employed in the study of mathematics. In order to diminish the time required daily for lessons in mathematics, I purpose recommending that the present method of going three times over such subjects as trigonometry and integral calculus, which consists mainly of formulas, be reduced to two—that is, an advance and one review only. The daily lessons could thus be shortened, and ample time secured for such applications as would instruct the student in the use of formulas not important for training the mind, and which, as a rule, are soon forgotten.

I recommend that the instruction in surveying be made almost entirely practical. The principles employed are those of geometry and trigonometry. The data should be taken by the pupil in the field and plotted by him. The latter requires drawing instruments and facilities only to be found in the department of drawing, and the best methods of delineation are more readily and thoroughly taught in that department. I would, therefore, go once over some good treatise, as Johnson's or Gillespie's, using it more as a book of reference than a text-book. Afterwards I would turn the subject over to the department of drawing for the practical work. With no mathematical lesson to study, two or three hours in the morning could be devoted to field work, and the data could be plotted in the drawing academy in the afternoon. The instructors of the class in mathematics would, of course, be available for the field work. The graduate would then obtain a better knowledge of surveying instruments and methods, and the student would have to devote less time daily to the study of the subject.

With the increased facilities which the new academy building affords for lectures and explanations to large portions of a class together, I am able to give more students the benefit of my knowledge and experience upon the more important points, especially during the advance. These changes, with a little knowledge of algebra at admission to the Academy, which I am convinced must soon be required, will enable me to shorten the lessons throughout the two years, thus affording more time daily for other purposes.

The advantages of the methods of instruction employed here are numerous. The classes are divided into small sections of 10 or 12 each, so that each cadet is generally called upon daily to recite or receive instruction. Generally two or three subjects only are studied at the same time.

The student is cut off from those pleasures and outside attractions which divert his mind and prevent concentration of thought. Regular hours of study and recreation, combined with wholesome food, promote good health and enable the pupil to acquire the best mental results from his efforts. He is also surrounded by studious associates and has little or no temptation to idleness.

Correct habits of study are continuously impressed upon him.

Instruction is always freely given when necessary, but the importance of self-reliance in acquiring knowledge is inculcated from the day of admission to the day of graduation.

Among the advantages must be mentioned the stimulus for study which is due to the desire to graduate and enter the Army, combined with the fear of disgrace which is usually attached to a failure. This may also be considered a defect in another way, for it leads in some cases to a habit of studying for a mark, with a hope of obtaining the reward of a commission at the end, instead of studying for knowledge.

The most serious and only defect in the present organization of the Academy which is important to mention is the low standard of admission. Through it many enter who are not qualified to master the subsequent course. Many therefore fail, thus diminishing the number of graduates.

Sympathy for the weak, and a desire to assist them, naturally impels a professor to give much of his time and instruction to pupils who are really doomed from the first to disappointment and failure.

At least half of my instruction is devoted to pupils who do not graduate. If valuable, it seems as though the graduate should have the benefit of more of a professor's experience.

For many years this Academy has been the model for other scientific institutions. Astronomy in this country was nurtured here. Trigonometrical and topographical surveying, methods of triangulation, magnetic declination, and the systems of locating, surveying, and dividing the public lands of the United States, are some of the branches which emanated from this Academy. Methods of field astronomy and some of the most valuable instruments of precision have been developed and invented by graduates of West Point.

The object of this Academy is to furnish to the country a number of young men qualified in the fundamental principles of the science of war and fortification. While this science has advanced materially during the past quarter of a century, and the mathematical instruction has of necessity been extended to keep pace with the times, yet the necessary mathematics has a limit. The time available for its study is also fixed. Hence the mathematical instruction at West Point has assumed a conservative and moderate form of development.

The object of the mathematical instruction in this Academy is primarily to prepare the pupil for the study of mechanics, wave motion, astronomy, electricity, ordnance and gunnery, and engineering. In addition the study of mathematics develops the reasoning faculties and establishes a mental foundation upon which any branch of knowledge may safely and rapidly be constructed.

For many years this Academy was one of the leading scientific institutions in this country. It was among the first to import high mathematical talent from Europe. Several mathematical branches were first introduced into this country through this Academy, and were originally studied from text-books in French.

The first complete course of elementary mathematical text books published in this country was written by Prof. Charles Davies, and for forty years his works were the standard through the United States. Even to-day they are extensively used and serve as the basis for other books.

Other scientific institutions have arisen unlimited by corresponding considerations, and, in fact, by anything except knowledge itself. Higher and more advanced subjects in mathematics have been introduced elsewhere for the benefit of the specialist preparing for some particular branch of science. Therefore, to-day, the United States Military Academy does not occupy the preeminent position among scientific institutions that it enjoyed for so long a period in the early development and growth of this country, nor is it desirable that it should compete with institutions established for a special purpose. The science of war in its broadest sense should form, direct, and fix the curriculum of this Academy.

On the other hand, I believe that for thoroughness of instruction upon the branches taught, for methods of imparting information, for instruction that sustains the interest of the student, for methods of developing correct habits of study and for acquiring knowledge quickly and accurately, there is no institution in any country which is superior to the United States Military Academy.

APPENDIX F<sub>1</sub>.

Organization of third class, department of mathematics.

| Section.     | Number of members. | Attendance.           | Time.           | Room. | Instructor.         |
|--------------|--------------------|-----------------------|-----------------|-------|---------------------|
| First .....  | 12                 | Daily except Sunday.. | 9.30 to 11..... | 214   | Lieutenant Palmer.  |
| Second ..... | 12                 | do .....              | 8 to 9.30....   | 214   | Do.                 |
| Third .....  | 11                 | do .....              | do .....        | 210   | Lieutenant Winn.    |
| Fourth ..... | 11                 | do .....              | do .....        | 213   | Lieutenant Johnson. |
| Fifth .....  | 11                 | do .....              | 9.30 to 11..... | 210   | Lieutenant Winn.    |
| Sixth .....  | 11                 | do .....              | do .....        | 213   | Lieutenant Johnson. |

Generally the associate professor of mathematics instructs the first section. From September 1 to December 31, 1895, the associate professor instructed the first section.

E. W. BASS,  
Professor of Mathematics.

WEST POINT, N. Y., May 27, 1896.

APPENDIX F<sub>2</sub>.

Organization of fourth class, department of mathematics.

| Section.      | Number of members. | Attendance.           | Time.           | Room. | Instructor.            |
|---------------|--------------------|-----------------------|-----------------|-------|------------------------|
| First .....   | 11                 | Daily except Sunday.. | 9.30 to 11..... | 215   | Lieutenant Echols.     |
| Second .....  | 11                 | do .....              | 8 to 9.30....   | 215   | Do.                    |
| Third .....   | 11                 | do .....              | do .....        | 308   | Lieutenant Cruikshank. |
| Fourth .....  | 11                 | do .....              | do .....        | 306   | Lieutenant Rice.       |
| Fifth .....   | 10                 | do .....              | do .....        | 312   | Lieutenant Barrette.   |
| Sixth .....   | 10                 | do .....              | 9.30 to 11..... | 308   | Lieutenant Cruikshank. |
| Seventh ..... | 10                 | do .....              | do .....        | 306   | Lieutenant Rice.       |
| Eighth .....  | 10                 | do .....              | do .....        | 312   | Lieutenant Barrette.   |
| Ninth .....   | 10                 | do .....              | do .....        | 314   | Lieutenant Devore.     |

From September 1 to December 31, 1895, Lieutenant Devore instructed two sections.

E. W. BASS,  
Professor of Mathematics.

WEST POINT, N. Y., May 27, 1896.

APPENDIX F<sub>3</sub>.

[Third class, second section, 1896. Department of mathematics.]

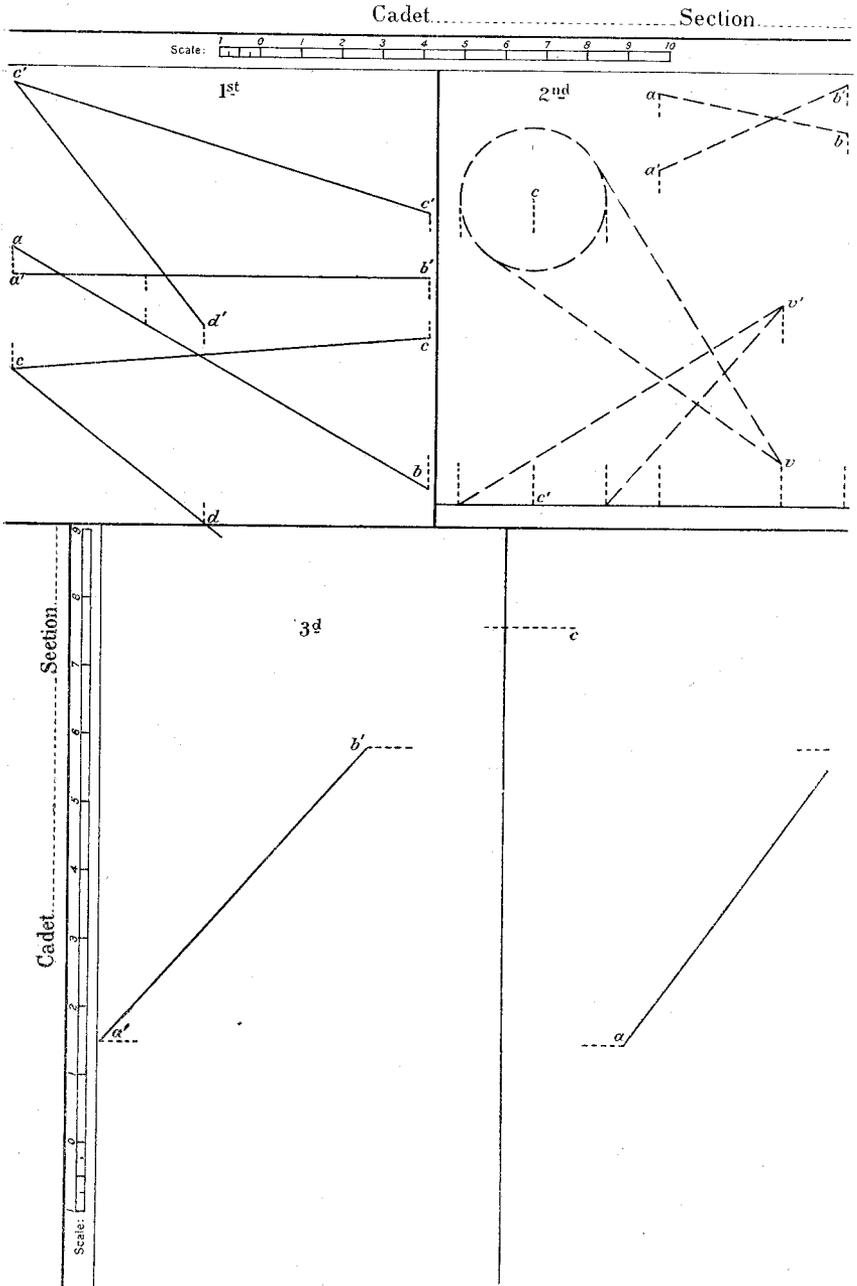
| Name.           | May 11. | May 12. | May 13. | May 14. | May 15. | May 16. | Total. |
|-----------------|---------|---------|---------|---------|---------|---------|--------|
| Otwell .....    | .....   | 2.5     | 2.9     | 2.5     | 2.6     | 2.5     | 13.0   |
| Munton .....    | 3.0     | 2.3     | 2.9     | 2.8     | 2.6     | .....   | 13.6   |
| Spinks .....    | 3.0     | 3.0     | 2.9     | 3.0     | 2.9     | .....   | 14.8   |
| Fries .....     | 3.0     | 3.0     | 3.0     | 2.9     | 3.0     | .....   | 14.9   |
| Hamilton .....  | 2.8     | .....   | 2.8     | 2.7     | 2.9     | A       | 14.0   |
| Woodyard .....  | A       | A       | 2.7     | 2.8     | 2.7     | 2.4     | 13.3   |
| Brieker .....   | .....   | A       | 2.7     | 2.9     | 2.9     | 3.0     | 14.4   |
| Cole .....      | 2.9     | 3.0     | .....   | 2.9     | 3.0     | .....   | 14.5   |
| Nugent .....    | 3.0     | .....   | 3.0     | 3.0     | 2.3     | 2.5     | 13.8   |
| Hammond .....   | 2.6     | 2.9     | 2.8     | 3.0     | 2.8     | .....   | 14.1   |
| Conner, F ..... | 2.9     | 3.0     | 2.9     | 3.0     | 2.5     | .....   | 14.3   |
| Newbold .....   | 2.8     | 3.0     | 2.9     | .....   | 3.0     | 2.7     | 14.4   |
|                 | P       | P       | P       | P       | W & J   |         |        |

APPENDIX F<sub>4</sub>.

Data for blackboard.

1. Project AB [(3.25, 00, 1.25) (10, 4, 1.25)] upon the plane of CD [(0, 1.25, 6) (4.75, 5, 6)] and CE [(0, 1.25, 6) (10, 0.25, 2.75)].

2. Ground line 0.5 above lower edge. Parallel to AB [(5.5, -10.125, 8.25) (10, -9.25, 10.25)] construct a plane tangent to cone having vertex V (8.5, -1, 4.875) and base in H, circle, center at C (2.5, -75, 0), radius=1.875.



3. Revolve C (9.375, 10, 6) about AB [(3.25, 1.875, 60) (7.625, 5, 2)] through an angle whose sine is  $\frac{2}{3}$ .

## APPENDIX F<sub>5</sub>.

*Scheme for the use of colored crayons.*

### DESCRIPTIVE GEOMETRY.

|                       |   |                           |        |
|-----------------------|---|---------------------------|--------|
| Given magnitudes..... | Yellow, supplemented with brown when desirable. | Construction lines .....  | White. |
|                       |   | Required magnitudes ..... | Red.   |

### SHADES AND SHADOWS.

|                         |         |              |   |
|-------------------------|---------|--------------|---|
| Assumed figures.....    | Yellow. | Shadows..... | Brown, supplemented with blue when desirable. |
| Construction lines..... | White.  |              |   |
| Shades .....            | Red.    |              |   |

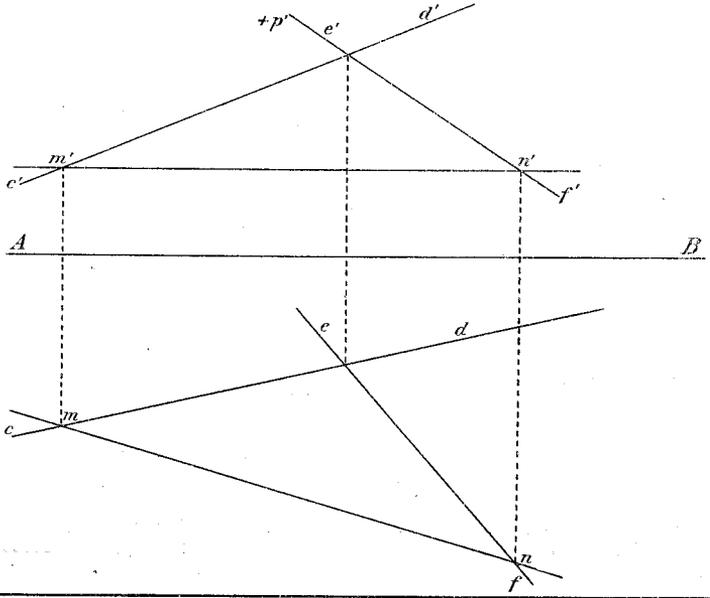
### PERSPECTIVE.<sup>1</sup>

|                              |         |              |   |
|------------------------------|---------|--------------|---|
| Projections of figures.....  | White.  | Shades ..... | Red.  |
| Construction lines .....     | White.  | Shadows..... | Brown, supplemented with blue when desirable. |
| Perspectives of figures..... | Yellow. |              |   |

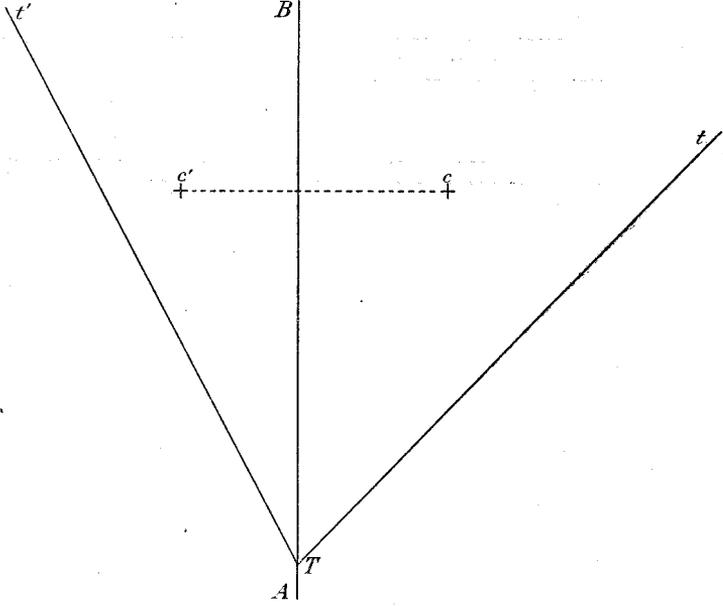
APPENDIX F<sub>6</sub>.

Cadet ..... Section .....

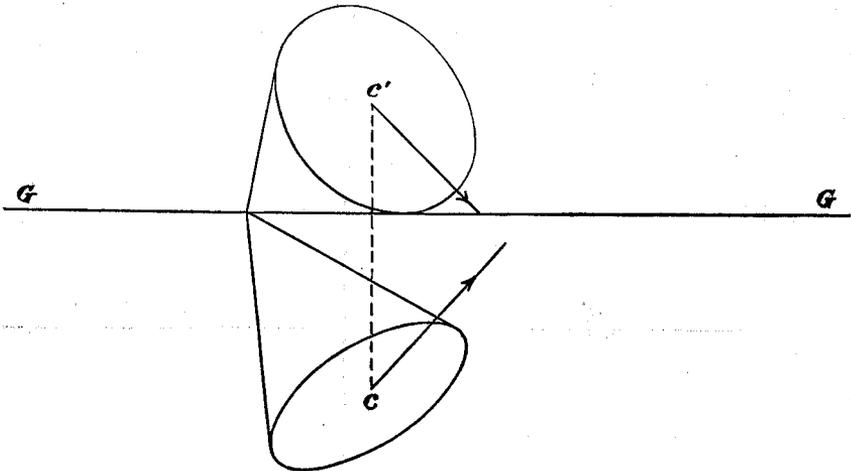
*Revolve the plane of lines CD and EF about MN until it is parallel to H, and find the H and V projections of that point of the plane whose V projection, in true position, is p'.*



845. Construct the H and V projections of the circle in the plane  $t.T.t'$ , whose centre is at C and radius equal to



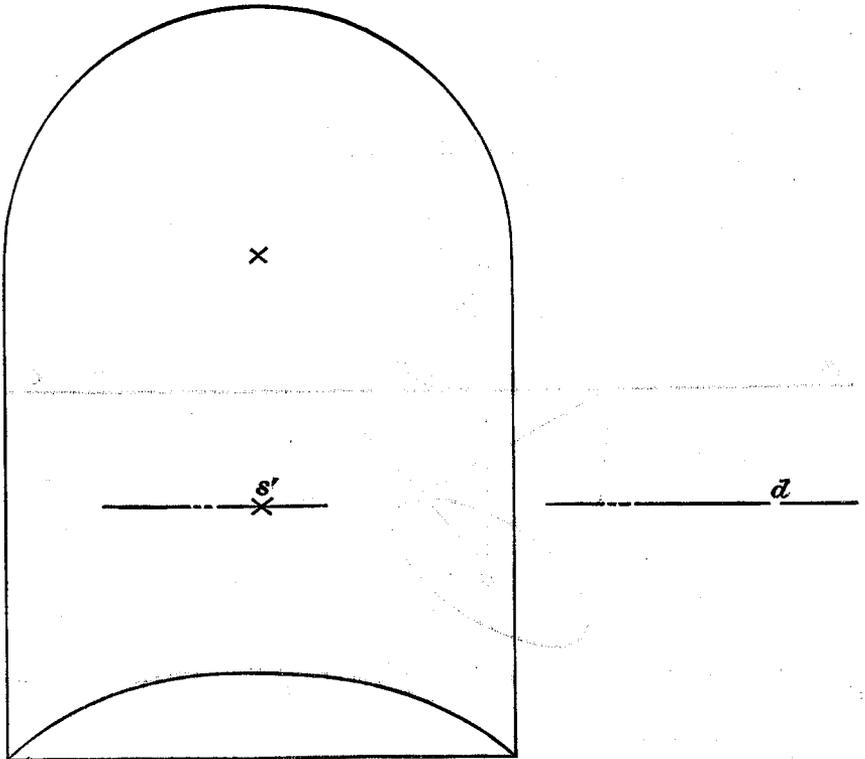
APPENDIX F<sub>7</sub>.



ART. 253.—Construct the shade of the cone of revolution, assumed above, its shadow on the planes of projection and on its interior surface.

5732 M A—7

APPENDIX F<sub>8</sub>.



Cadet \_\_\_\_\_, Section \_\_\_\_\_

1. Complete the perspective.  
 Upper base of cylinder to be constructed by conj. diameters..... 0.8
2. Construct shadows—
  - On lower base..... 0.2
  - On cylinder, ..... of rectilinear part of line of shade..... 0.3
  - circular part of line of shade)..... 0.7
  - On spherical surface, ..... point in V..... 0.3
  - upper base of cylinder..... 0.7

APPENDIX F<sub>9</sub>.

UNITED STATES MILITARY ACADEMY, THIRD CLASS, FIRST AND SECOND SECTIONS, DEPARTMENT OF MATHEMATICS.

Report for the week ending May 16, 1896.

[Scale of daily merit: Thorough, 3; good, 2.5; indifferent, 2; bad, 1.5; very imperfect, 1; complete failure, 0; maximum for the week, 15.]

| No.             | Name.                  | Monday. | Tuesday. | Wednesday. | Thursday. | Friday. | Saturday. | Total. | Progress during the week.  |
|-----------------|------------------------|---------|----------|------------|-----------|---------|-----------|--------|--|
| FIRST SECTION.  |                        |         |          |            |           |         |           |        |  |
| 1               | Boggs .....            | 3.0     | 3.0      | 3.0        | 3.0       | 3.0     | .....     | 15.0   | Johnson's Least Squares advanced to end.<br>Bass's Differential Calculus.<br>General review to 92, p. 102, from beginning. |
| 2               | Brown, L. (first)..... | 3.0     | 3.0      | 3.0        | 3.0       | 2.9     | .....     | 14.9   |  |
| 3               | Wooten .....           | 3.0     | 3.0      | 3.0        | 2.8       | 3.0     | 2.0       | 14.9   |  |
| 4               | Kerr, R. D. ....       | 2.8     | 3.0      | 3.0        | 2.8       | .....   | 3.0       | 14.6   |  |
| 5               | Smith, C. S. ....      | A       | A        | A          | 3.0       | 2.9     | 3.0       | 14.9   |  |
| 6               | Stephens, J. E. ....   | 2.7     | 3.0      | 3.0        | 2.5       | 2.9     | .....     | 14.1   |  |
| 7               | Butner .....           | 2.7     | 3.0      | 3.0        | 2.7       | .....   | 3.0       | 14.4   |  |
| 8               | Meade .....            | 2.7     | 3.0      | 3.0        | 2.9       | 3.0     | .....     | 14.6   |  |
| 9               | Nicholls .....         | 2.8     | 3.0      | 3.0        | 3.0       | 3.0     | .....     | 14.8   |  |
| 10              | Kerth .....            | 2.6     | 3.0      | 3.0        | 3.0       | 3.0     | .....     | 14.6   |  |
| 11              | Brown, E. I. ....      | 2.7     | 3.0      | 3.0        | 2.6       | 2.5     | .....     | 13.8   |  |
| 12              | Merrill .....          | 3.0     | 3.0      | 3.0        | 3.0       | 2.9     | .....     | 14.9   |  |
| SECOND SECTION. |                        |         |          |            |           |         |           |        |  |
| 1               | Otwell .....           | .....   | 2.5      | 2.9        | 2.5       | 2.6     | 2.5       | 13.0   | Bass's Differential Calculus.<br>General review to 115, p. 154.<br>Written recitation Friday.                              |
| 2               | Munton .....           | 3.0     | 2.3      | 2.9        | 2.8       | 2.6     | .....     | 13.6   |  |
| 3               | Spinks .....           | 3.0     | 3.0      | 2.9        | 3.0       | 2.9     | .....     | 14.8   |  |
| 4               | Fries .....            | 3.0     | 3.0      | 3.0        | 2.9       | 3.0     | .....     | 14.9   |  |
| 5               | Hamilton .....         | 2.8     | .....    | 2.8        | 2.7       | 2.9     | A         | 14.0   |  |
| 6               | Woodyard .....         | A       | A        | 2.7        | 2.8       | 2.7     | 2.4       | 13.3   |  |
| 7               | Bricker .....          | .....   | A        | 2.7        | 2.9       | 2.9     | 3.0       | 14.4   |  |
| 8               | Cole .....             | 2.9     | 3.0      | 2.7        | 2.9       | 3.0     | .....     | 14.5   |  |
| 9               | Nugent .....           | 3.0     | .....    | 3.0        | 3.0       | 2.3     | 2.5       | 13.8   |  |
| 10              | Hammond .....          | 2.6     | 2.9      | 2.8        | 3.0       | 2.8     | .....     | 14.1   |  |
| 11              | Conner, F. ....        | 2.9     | 3.0      | 2.9        | 3.0       | 2.5     | .....     | 14.3   |  |
| 12              | Newbold .....          | 2.8     | 3.0      | 2.9        | .....     | 3.0     | 2.7       | 14.4   |  |
|                 |                        | P       | P        | P          | P         | WJ      | P         |        |  |

Respectfully submitted.

CHAS. D. PALMER,  
*First Lieutenant, Third Artillery, Instructor.*

To Prof. EDGAR W. BASS,  
*Department of Mathematics, U. S. Military Academy,*

APPENDIX F<sub>10</sub>.

UNITED STATES MILITARY ACADEMY, FOURTH CLASS, FIFTH AND EIGHTH SECTIONS, DEPARTMENT OF MATHEMATICS.

Report for the week ending May 16, 1896.

[Scale of daily merit: Thorough, 3; good, 2.5; indifferent, 2; bad, 1.5; very imperfect, 1; complete failure, 0; maximum for week, 9.0.]

| No.             | Names.             | Monday. <sup>a</sup> | Tuesday. | Wednesday. <sup>a</sup> | Thursday. <sup>b</sup> | Friday. | Saturday. | Total. | Progress during the week.   |
|-----------------|--------------------|----------------------|----------|-------------------------|------------------------|---------|-----------|--------|---|
| FIFTH SECTION.  |                    |                      |          |                         |                        |         |           |        |   |
| 1               | Marshall.....      |                      | 1.5      |                         |                        | 2.2     | 2.9       | 6.6    | Davies' Surveying.<br>Review from 165, p. 145, to 349, p. 317.<br>Written recitation on Tuesday.<br>Transfers recommended: Cadet Hanson to fourth section. Cadets Brown, W. S., and Justice to sixth section. E. W. Bass, Professor of Mathematics. |
| 2               | Hanson.....        |                      | 2.7      |                         |                        | 2.8     | 2.9       | 8.4    |   |
| 3               | Brown, W. S.....   |                      | 1.7      |                         |                        | 2.0     |           | 5.6    |   |
| 4               | Burt, W. B.....    |                      | 2.4      |                         |                        | 2.9     | 2.8       | 8.1    |   |
| 5               | Yates, H. E.....   |                      | 2.6      |                         |                        | 1.6     | 2.7       | 7.9    |   |
| 6               | Rhea, J. C.....    |                      | 2.8      |                         |                        | 1.5     | 1.0       | 5.3    |   |
| 7               | Minus.....         |                      | 2.5      |                         |                        | 2.4     | 3.0       | 7.9    |   |
| 8               | Justice.....       |                      | 2.0      |                         |                        | 1.0     | 3.0       | 6.0    |   |
| 9               | Merry.....         |                      | 1.6      |                         |                        | 2.2     | 2.5       | 6.3    |   |
| 10              | Watson, J.....     |                      | 2.3      |                         |                        | 2.3     | 2.2       | 6.7    |   |
|                 |                    |                      | B        | B                       | B                      | B       | B         |        |   |
| EIGHTH SECTION. |                    |                      |          |                         |                        |         |           |        |   |
| 1               | Way.....           |                      | A        | A                       |                        | 1.0     | 2.2       | 4.3    | Same as above.  |
| 2               | Begle.....         |                      | 0.7      |                         |                        | 2.9     | 2.7       | 6.3    |   |
| 3               | Oldenburg.....     |                      | 1.2      |                         |                        | 1.8     | 2.5       | 5.5    |   |
| 4               | McClure, A. N..... |                      | 1.2      |                         |                        | 2.8     | 3.0       | 7.0    |   |
| 5               | Game.....          |                      | 0.8      |                         |                        | 2.0     | 2.4       | 5.2    |   |
| 6               | Burke.....         |                      | 1.3      |                         |                        | 1.0     | 2.0       | 4.3    |   |
| 7               | Kerr, T. B.....    |                      | 1.2      |                         |                        | 2.8     | 2.5       | 6.5    |   |
| 8               | Brown, F. R.....   |                      | 1.0      |                         |                        | 2.4     | 2.4       | 5.8    |   |
| 9               | Watson, F. V.....  |                      | 0.6      |                         |                        | 2.0     |           | 3.9    |   |
| 10              | Major.....         |                      | 2.6      |                         |                        | 2.4     |           | 7.5    |   |
|                 |                    |                      | B        | B                       | B                      | B       | B         |        |   |

<sup>a</sup> Field work, transit.

<sup>b</sup> Field work, level.

Respectfully submitted.

J. D. BARRETTE,

First Lieutenant, Third Artillery, Instructor.

To E. W. BASS,

Professor of Mathematics, U. S. M. A.

APPENDIX F<sub>11</sub>.

Cadet Blank, third class.

| Week ending—                   | Section. | Weekly maximum. | Weekly mark. | Total mark. | Total maximum. | Week weighted. | Total weighted. | Instructor. | Weighted maximum. |
|--------------------------------|----------|-----------------|--------------|-------------|----------------|----------------|-----------------|-------------|-------------------|
| January 11.....                | 4        | 6               | 4.2          | 4.2         | 6              |                |                 | W.          |                   |
| January 18.....                | 4        | 15              | 8.0          | 12.2        | 21             |                |                 | W.          |                   |
| January 25.....                | 4        | 15              | 10.4         | 22.6        | 36             |                |                 | W.          |                   |
| February 1.....                | 4        | 12              | 7.7          | 30.3        | 48             |                |                 | W.          |                   |
| February 5.....                | 4        | 9               | 6.7          | 37.0        | 57             |                |                 | W.          |                   |
| February 8.....                | 4        | 9               | 4.0          | 41.0        | 66             | 10.0           | 47.0            | W.          | 79.5              |
| February 11.....               | 6        | 6               | 5.4          | 46.4        | 72             | 13.5           | 60.5            | W.          | 94.5              |
| February 12 <sup>a</sup> ..... | 6        | 15              |              |             |                | 13.2           | 73.7            |             | 109.5             |
| February 15.....               | 6        | 6               | 4.9          | 51.3        | 78             | 4.9            | 78.6            | W.          | 115.5             |
| February 22.....               | 6        | 15              | b 10.5       | 61.8        | 93             | 10.5           | 89.1            | W.          | 130.5             |
| February 29.....               | 6        | 15              | b 10.5       | 72.3        | 108            | 10.5           | 99.6            | W.          | 145.5             |
| March 7.....                   | 5        | 15              | 8.0          | 80.3        | 123            | 8.0            | 107.6           | W.          | 160.5             |

<sup>a</sup> Examination.

<sup>b</sup> Absent.

APPENDIX F<sub>12</sub>.

[Extract from Regulations United States Military Academy, 1894.]

\* \* \* \* \*

52. Every professor, assistant professor, or instructor, having the immediate charge of one or more sections of a class, shall keep daily notes of the progress of each, and of the relative merit of the members, and at the end of each week shall report the result to the Superintendent, in all cases through the head of the department, with such additional explanations as may be necessary to show the relative progress of the members of the respective sections. The head of the department shall at the same time recommend such transfers from section to section as he may consider expedient.

G.

REPORT ON COURSE OF STUDIES AND METHOD OF INSTRUCTION IN THE DEPARTMENT OF CHEMISTRY, MINERALOGY, AND GEOLOGY, UNITED STATES MILITARY ACADEMY, WITH HISTORICAL SKETCH OF THE DEPARTMENT.

The earliest information that I have been able to find relating to the introduction at the Military Academy of the studies pertaining to the department of chemistry, etc., is embodied in the following memoranda:

1815.

Extract from letter of A. J. Dallas, Acting Secretary of War, to General Swift, dated April 28, 1815, on the subject of instruction at the Military Academy. \* \* \*

"In a school of engineering I should think a professor of chemistry would be important."

\* \* \* \* \*

Plan for the organization of three military academies (including the one at West Point), agreed to by the staff at West Point and forwarded by Captain Partridge, May 9, 1815.

\* \* \* \* \*

5. Let there be allowed at each of the academies the following professors and teachers, viz, a professor of chemistry and mineralogy.

\* \* \* \* \*

Circular dated West Point, October 30, 1815. "Captain Douglass, superintendent, requests the professors, assistant professors, and teachers of the Military Academy as a body to deliberate on the propriety of arranging a course of study for the Academy, and of casting the cadets into grades according to their progress in that course." \* \* \*

"The academic staff assembled on the same evening at Colonel Mansfield's quarters, and having elected Colonel Mansfield president and Lieut. S. H. Long secretary, proceeded to the consideration of the subjects proposed." \* \* \*

With respect to the course of study it was unanimously agreed that the following ought to be included, viz, \* \* \* natural philosophy and chemistry, astronomy.

1816.

Dated United States Military Academy, West Point, May 22, 1816. A course of studies and instruction submitted to the Secretary of War. "The following branches of science and instruction shall be considered as comprising a complete course of education at the Military Academy at West Point, N. Y.: Philosophy: A complete course of philosophy shall embrace the following branches, viz: \* \* \* The elements of chemistry, electricity, magnetism, and astronomy."

1818.

"A plan for a new organization of the Military Academy," dated at West Point, January 20, 1818. \* \* \* "A professor of chemistry and mineralogy. Chemistry and mineralogy have not heretofore constituted a part of the instruction at the Military Academy. They are, however, a necessary supplement to the course of science now taught, and when a professor shall be provided he shall give lectures to the two senior classes of the institution." \* \* \*

1819.

Propositions and observations on the course of instruction necessary for the officers of the different arms of the Army, submitted to the Secretary of War January 7, 1819, by Brig. Gen. S. Bernard and Maj. William McKee. \* \* \*

"The subjoined table exhibits the two principal divisions of the instruction; the first part includes the branches of knowledge that are necessary to all who are destined for any arm of the military establishment, either as officers in the exercise of their professional duties or as men of information liable in the course of their military career to be intrusted with other interests. It is therefore that mathematics, for instance, is extended further than is strictly necessary to the officer of infantry; that natural and experimental philosophy and chemistry are inserted under the elementary division, rather as forming a part of a liberal education, than of mere military utility." \* \* \*

Table of course of instruction, etc. \* \* \* "Chemistry, animal, vegetable, and mineralogy, 1 professor."

J. Du Commun, teacher of French at West Point, by letter dated February 1, 1819, states that, "Having been informed of a bill for the better organization of the Military Academy, submitted to the Congress by Mr. Williams, of Tennessee, from the Committee on Military Affairs, and this bill making provisions for a professor of chemistry, \* \* \* I immediately determined to make this application to your excellency for the professorship of chemistry." \* \* \*

REPORT OF BOARD OF VISITORS, 1819.

"As chemistry and mineralogy are now universally acknowledged to be essential parts of a scientific education, the board would suggest the propriety of employing a well-qualified teacher of those two kindred branches of science."

1820.

[Military Academy Regulations (printed with Army Regulations), 1820.]

COURSE OF INSTRUCTION AND STUDIES.

"*Philosophy*.—A complete course of philosophy shall embrace the following branches: The principles of mechanics, with their general application, hydrostatics; hydraulics, pneumatics; the elements of chemistry; electricity; magnetism and astronomy."

MILITARY ACADEMY,  
West Point, April 26, 1820.

DEAR SIR: I have just received your letter of the 20th instant and hasten to say in reply that I am highly pleased with your proposition to appoint Dr. Cutbush a post surgeon and to station him at West Point, with instructions to deliver each year a course of lectures on chemistry. The cadets of the first and second classes (about 100) would be permitted to attend, and it is probable that few would decline the opportunity. I am of opinion that \$5 from each cadet for a single course would be a reasonable compensation.

The sum of \$500, if necessary, may be spared from the appropriation of the present year to be applied to the purchase of chemical apparatus.

I am, sir, with great respect and esteem, your obedient and humble servant,

S. THAYER,  
*Brevet Major, Superintendent Military Academy.*

Dr. JOSEPH LOVELL,  
*Surgeon-General United States Army.*

The above extracts and letter were supplied me by the Adjutant-General of the Army, Gen. George D. Ruggles.

It thus appears that the detail of Dr. Cutbush and consequent beginning of instruction in the department was immediately due to the suggestion of the Surgeon-General, Dr. Joseph Lovell. Dr. Cutbush was appointed post surgeon May 16, 1820, and his name appears on the Academic Register of June, 1820, as acting professor of chemistry. Instruction in the department was begun October 9, 1820, as shown by the following order:

UNITED STATES MILITARY ACADEMY,  
West Point, N. Y., October 8, 1820.

POST ORDERS.]

Dr. Cutbush, having completed his arrangements for a course of lectures in chemistry and mineralogy, will deliver the introductory lecture to-morrow at 12 o'clock. The course will be attended by the cadets of the first and second classes, which

will be formed into one squad and marched to the lecture room at 12 o'clock every week day by the adjutant of the battalion or, in his absence, by the squad marcher of the first section of the first class. Seats will be assigned to the cadets in such manner as to enable the whole to see the experiments to the best advantage, after which they are not to change seats. All officers of the post are permitted to attend the lectures. \* \* \*

To enable Cadet Triste, retired assistant teacher of French, to attend the chemical lectures with his class, the fourth French section of the fourth class is to recite for the future in the evening, and will assemble for that purpose at the signal to return to quarters after supper.

By order:

GEO. BLANEY,  
*Lieutenant and Post Adjutant.*

These lectures to both classes at the same hour did not long continue, for the regulations of the Academy, adopted in March, 1821, provided separate hours. I have hereto appended (marked G<sub>1</sub>, G<sub>2</sub>, G<sub>3</sub>, and G<sub>4</sub>) those extracts from the Academic Regulations, from the year 1821 to the present time, which have special reference to this department. These extracts show the manner prescribed for giving instruction, the scope of the studies and the time allotted for lecture or recitation at the respective dates. The early regulations were not strictly adhered to, and accordingly can not be taken as giving a precise history of the department. The historical statements given below, when not in accordance with the provisions of regulations, are based upon other records preserved at the Academy.

Both the first and second classes were examined in chemistry at the January and June examinations of 1821, and although there is no record of an examination in mineralogy, the first class was given a standing in this subject after the June examination, 1821, and it is inferred that it was also taught to the first class during the academic year 1820 and 1821. The regulations of 1821 provided that chemistry and mineralogy should be taught in a course of lectures and experiments to the first and second classes at the rate of three lectures per week to each class, accompanied with suitable interrogatories. These lectures from the beginning must have partaken largely of the nature of recitations, for the classes were divided into sections. One hour (12 to 1) every other day was devoted to lecture and interrogatory and the same hour on the other days to the study of the subject.

The instruction to the first class was at first given both in mineralogy and applied chemistry; to the second class in chemistry only. Geology is first mentioned as one of the subjects upon which the first class was examined in June, 1823. An important departure from the provisions of the regulations was made in December, 1822, when the hour from 11 to 12 was allowed for instruction of the first class in mineralogy, and in the spring of 1823 the same hour was allowed for the recitations of the second class in chemistry.<sup>1</sup>

The regulations of 1825 (approved March 1 of that year) contained substantially the same provisions as those of 1821, in regard to the instruction to be given in the department.

The first class was required to recite three times a week and attend three lectures a week, the recitations and lectures alternating in days. The recitations were from 11 to 12 and the lectures from 12 to 1. One hour each day was prescribed for the study of the subject of recitation or lecture for the following day. The records show that the schedule of the regulations was not strictly followed. In November, 1828, certain members of the first class were permitted to attend lectures in geology from 3 to 4, and this is the first mention of the afternoon hour being devoted to this subject.

In September, 1830, is found the first mention of the suspension of the study of mineralogy for the purpose of taking up that of artillery; the alternation of mineralogy and drill studies soon became permanently established in the routine of instruction. Chemistry was not taught to the first class after June, 1829.

The regulations of the Academy of 1832, approved December 5, 1831, prescribed three lectures each week for the first class in mineralogy and geology, and provided for recitations in the afternoon. It appears that the lectures and recitations replaced each other and did not alternate on days, so that the section-room work involved only three days each week. The regulations, however, were not followed in this respect. The orders published to the corps of cadets show that from June, 1832, to 1841 the recitations in these branches were held for only about half the academic

<sup>1</sup>By Military Academy Order from Engineer Department, dated October 9, 1820, Dr. Cutbush was allowed \$10 per month for extra services as chemical lecturer to date from September 1. On November 18, 1820, he was relieved from his duties as post surgeon. The order announcing the death of Dr. Cutbush was published to the cadets on December 10, 1823, which shows that the date of his death given in Culum's Register (December 15), is erroneous.

year; during the other half of the academic year the same hours were devoted to artillery and infantry recitation. After 1832 the recitations in these branches were fixed for the afternoon hours, 2 to 4 p. m. In the regulations of 1839, in the table for the employment of time, is embodied a recognition of the practice which had prevailed since 1832 of dividing the afternoon hours for recitation between mineralogy, geology, and infantry and artillery studies. From 1841 to 1852 the instruction in mineralogy and geology was had for about half the academic year, recitations being on alternate days from 2 to 4. The subjects were studied from September 1 to about December 10, and from about May 10 to June 1. During the reorganization of the courses between 1854 and 1861, to meet the requirements of a five years' course, the subjects continued to receive the same time. The academic regulations of 1853 retained the provision that three lectures per week should be given to the first class in mineralogy and geology, though these lectures had long been almost entirely replaced by recitations and the number per week was adhered to for only about half the year. In the regulations of 1857 this provision was omitted.

From 1852 to 1872 these subjects received the same amount of time as from 1841 to 1852. From 1841 to 1872 this course commenced September 1 and continued approximately through the first quarter of December; it was then suspended and resumed approximately at the end of the first quarter of May and continued to June 1. From 1831 to 1841 about the same time was given the subjects, but the time was not so definitely limited to the same portions of the academic year. From June, 1872, to June, 1880, these subjects were taught entirely in the term after January in the first class, recitations being had from 2 to 4 every week day, except Saturday, from January to June. After June, 1879, this instruction was transferred to the second-class year, and since then the recitations have been from 11 to 1 daily on all week days except in April, when they are on alternate week days, the portion of the academic year devoted to it being that from the completion of the course in chemistry after January 1, to June 1 of the second-class year.

The history of the instruction to the first class in this department may be summarized as follows:

From 1820 to 1830, when instruction was given in both mineralogy and applied chemistry, an hour each day in the week was allowed for the section-room exercises during the entire year, but instruction was not always continuously given. From 1830 to 1853 the regulations of the Academy prescribe three section-room exercises per week in mineralogy and geology, but this number was actually held for only about one-half the academic year upon alternate week days, except Saturdays. The actual number of recitations or lectures permitted in mineralogy and geology since 1830 has been very nearly the same up to the present. There was a slight increase in the number at the time of the changes in 1872 and 1879 (referred to above), but the number has varied between 45 and 55. Prior to 1830 a greater number of days was given to the instruction of the first class in this department, but the class then devoted time to applied chemistry as well as to mineralogy and geology. The exact time devoted by this department to the instruction of the first class between 1820 and 1830 can not be determined; the regulation schedule was interfered with in many ways.

From June, 1834, to June, 1838, the study of mineralogy appears to have been suspended for lack of a suitable text-book, though that of geology was kept up. In the autumn of 1838 the study of mineralogy was resumed, and with geology has been annually taught since. Although but little time was devoted to these subjects during the second term of the academic year between 1841 and 1872 (about three weeks in May), the class was examined in the branches both in January and June; since 1872 there has been only one examination (in June), all the study of the subjects pertaining to the second term. The previous study given the subject in May (between 1841 and 1872) was merely a review for the June examination.

The text-books used in mineralogy and geology since 1820 are as follows:

Cleveland's *Treatise on Mineralogy and Geology*, 1820 to 1833 or 1834.

Bakewell's *Geology*, 1833 or 1834 to June, 1841.

Lyell's *Geology*, 1841 to 1842.

Dana's *Mineralogy* (manual), first to fifth editions, September, 1839, to January, 1894.

*Elementary Geology*, E. Hitchcock, 1842 to June, 1872.

*Text-book of Geology*, Dana, 1872 to 1882.

*Elements of Geology*, Le Conte, 1882 to 1896.

*Elementary Lesson in Mineralogy*, Tillman, 1894 to 1896.

A *Description of the Common Rocks* (brochure), Tillman, used with Le Conte's *Geology*.

The study of chemistry in the second class was introduced at the same time as that of mineralogy and geology, October 9, 1820. The schedule for this branch of study in this class assumed definite shape very soon after introduction, and with only a few temporary interruptions has continued almost unchanged to the present time. The instruction in general chemistry has always been given to the second class. For a

year or two after the introduction of the subject one hour (12 to 1) a day was devoted to this subject, but in 1823 the hour from 11 to 12 was also given. From 1823 to June, 1880, with the exception of short intervals between 1823 and 1830, recitations in chemistry, or lectures on that subject, have been held on alternate week days throughout the year—half the class reciting one day and the other half the next—each section attending one hour, the first hour being from 11 to 12 and the second from 12 to 1 o'clock. In the reorganization of the course for a five years' term (1854 to 1861) this arrangement was not disturbed. After June, 1879, when instruction in mineralogy and geology was transferred to the second-class year, recitations in chemistry were made daily between November 1 and January 1, and from the close of the January examination to the end of the course in chemistry. The recitations were on alternate days during September and October. When the course in chemistry was completed, after the January examination, the other subjects, transferred to this year from the first-class year, were continued until June, recitations being daily, except during the month of April. In May, 1882, the schedule which appears in the regulations of 1883 was established and is still in operation, except that the additional subject of physiology and hygiene was introduced for the first time in 1887, a law to that effect having been passed in 1886. From 1823 to 1880, approximately, the same allowance of time was given to the chemical recitations and instruction of the second class. Since 1880 there has been a slight increase, due to the changes resulting from the transfer of mineralogy and geology to the second-class year. In this connection it should be remembered that the term chemistry included electricity from 1858 to 1880. The time devoted to the subjects of the department may be summarized as follows:

From 1820 to 1880 instruction was given to two classes—mineralogy and geology to the first class, and chemistry to the second class. From 1820 to 1829 instruction in applied chemistry was also given to the first class. From 1830 to 1880 the first class had, approximately, fifty lesson days in mineralogy and geology, and the second class one hundred and eleven in chemistry, making a total of one hundred and sixty-one days in both classes to the subjects of the department. When the transfer of the first-class instruction to the second-class year was made in 1880, this number was increased to one hundred and eighty-three. In the slight change made in 1882, establishing the schedule now existing, the number was brought to one hundred and eighty-five.

The text-books used in the chemical studies of the department were the following: Henry's Chemistry, from 1820 to June, 1829; Turner's Chemistry, from 1829 to June, 1840; Webster's Chemistry, from 1840 to June, 1843; Kane's Chemistry, from 1843 to June, 1858. During the years 1859 and 1860 both Fowne's and Regnault's Chemistries were used. Fowne's Chemistry from February, 1858, to June, 1884 (seventh to thirteenth editions); Bloxam's Chemistry from June, 1884, to 1896 (fifth to eighth editions).

Principles of Chemical Philosophy or Essential Principles of Chemistry (Tillman) has been used in conjunction with Bloxam. The subject of electricity and magnetism was first taught in this department during the year ending June, 1858. Miller's Physics of Chemistry was the text-book in this subject from that time until January, 1883. In January, 1883, Miller was replaced by S. P. Thompson's Elementary Lessons in Electricity and Magnetism. This book is still used, having passed through several editions, the latest being that of 1895.

Dr. James Cutbush, assistant surgeon, U. S. A., was the first head of the department and acting professor of chemistry at the Academy. He served from the creation of the department until his death, December 10, 1823. Asst. Surg. James G. Percival succeeded Dr. Cutbush, and was acting professor of chemistry, etc., from March 4 to July 6, 1824. Asst. Surg. John Torrey was the acting professor from August 25, 1824, to June 15, 1827. Dr. Torrey afterwards filled many distinguished positions, among which may be mentioned that of professor of chemistry and botany in the College of Physicians and Surgeons in New York City; professor of chemistry at Princeton College, New Jersey; professor of chemistry, mineralogy, and botany at the University of the City of New York.

Lieut. W. F. Hopkins, Fourth Artillery, was acting professor of chemistry, etc., from June 15, 1827, to August 31, 1835. Among the positions subsequently filled by Professor Hopkins may be mentioned that of professor of chemistry and natural philosophy, William and Mary College, 1849-50; professor of natural and experimental philosophy, United States Naval Academy, 1850 to 1859. Lieut. J. W. Bailey, First Artillery, was the acting professor of chemistry, etc., from August 31, 1835, to July 8, 1838. At this latter date he was appointed professor of chemistry, mineralogy, and geology, and occupied the position until his death, February 26, 1857. Capt. H. L. Kendrick, Second Artillery, was appointed professor of chemistry, etc., March 3, 1857, and served until December 13, 1880. Professor Kendrick, prior to his appointment as professor, had served from September, 1835, to January, 1847, as assistant, in the department, to Professor Bailey. Lieut. S. E. Tillman, Corps of Engineers, was appointed to the professorship to succeed Professor Kendrick January 1, 1881.

The foregoing account, together with appended extracts from the Academic Regulations, shows the general development of the department. There has been but little variation in the time devoted to the subjects of the department. The list of text-books given shows that constant effort was made to keep abreast with the advances in the branches taught.

The most important single and distinct change in the department since 1830 was made when all the instruction in the department was transferred to the second class year and the whole placed in the morning hour, from 11 to 1 for recitations. This change first took effect with the second class 1879 and 1880. It allowed twenty-five more lesson days to the department, gave the morning hour for all recitations, and relieved the department from the necessity of conducting simultaneously instruction in two branches, occupying both morning and afternoon, with the same set of instructors, an arrangement which prevented sufficient attention to either branch.

#### PRESENT COURSE.

Since the changes as to time, made in 1879 and 1882, already referred to, the department has had one hundred and eighty-six recitation days; of this number eighty-one come before January and one hundred and five after.

The course before January embraces the subjects heat and chemistry; after January, physiology and hygiene, electricity, mineralogy and geology. The text-books used before January are, Elementary Lessons in Heat, Tillman; Essential Principles of Chemistry (brochure), Tillman; Chemistry, Inorganic and Organic, Bloxam.

The two subjects first named had both been included in the text-books used prior to Bloxam (Fowne), and their appearance as separate texts was made necessary by the deficiency which existed in Bloxam when it was adopted. In the separate treatment the matter considered was somewhat extended and was susceptible to more appropriate discussion. The subject-matter of the brochure is in every respect a fundamental part of the chemical course, and the term "chemistry" will hereafter include the matter of this brochure.

The number of recitations before the January examinations is—

|                | Advance. | First review. | General review. |
|----------------|----------|---------------|-----------------|
| Heat .....     | 10       | 5             | 3               |
| Chemistry..... | 23       | 17            | 10              |

Making a total of 68 recitations.

There are given four lectures on heat, and nine on chemistry. Each lecture occupies the recitation hours for the day. On the day of a lecture the lesson for that day is increased by an amount equal to half that of a full lesson. The total number of lessons of full length in the course is therefore equal to the total number of recitations increased by one-half the number of lectures. In other words, 74 lessons of full length would cover the course.

The text-books used after January are Anatomy, Physiology, and Hygiene, Tracey; Elementary Lessons in Electricity and Magnetism, S. P. Thompson; Elementary Text-book of Mineralogy, S. E. Tillman; Elements of Geology, Joseph Le Conte; Brochure—Description of Common Rocks, to accompany Le Conte's Geology, S. E. Tillman.

The number of recitations after January is :

|                                       | Advance. | First review. | General review. |
|---------------------------------------|----------|---------------|-----------------|
| Anatomy, physiology, and hygiene..... | 6        | 2             | 1               |
| Electricity.....                      | 18       | 8             | 8               |
| Mineralogy.....                       | 7        | 3             | 3               |
| Geology.....                          | 18       | 4             | 8               |

There are also five days' practical work in the electrical laboratory, making 91 section-room exercises not including the lectures, of which there are 14 in this term; in all, 105.

As in the previous term, upon the day of a lecture, the lesson of that day is generally increased by an amount equal to one-half the usual length of lesson, so that the total number of lessons of full length in this term is 98. The lessons, of necessity, vary in length with the difficulty of the subjects.

On the advance, the first time over the subject, the lessons vary in length, from 2,500 words, in the most difficult parts of the course, to 6,000 words in the most easy

parts. The average length over the entire course (the first time over) is about 4,100 words. The lessons upon the two reviews are, of course, longer, but for the majority of the cadets are less difficult than the advance lessons. The lengths of the lessons in advance and review can not be compared by the relative numbers of each, for certain parts studied in advance are omitted on the reviews. The hours devoted to the study of different subjects is different with different cadets, varying greatly with tastes, ability, and inclination. The Academic Regulations up to 1853 prescribed that "the daily allowance of time for the class studies shall not be less than nine hours, nor more than ten." The present regulations of the Academy make about the same amount of time available for class studies, as will be seen from the following considerations: The working day of the cadets begins at reveille (5.45 a. m.) and ends at taps (10 p. m.), embracing 16½ hours. One hour of this time may be considered as unavailable for purely personal reasons, leaving 15½ hours. Of this time each day, except Saturdays and Sundays, the class is in the section room 3½ hours, which must be classed as study time, 2 hours of the day are devoted to meals, which leaves 9½ hours of the day. Assuming 2 hours for military exercises and 1½ hours for other recreation, exercise, or rest, there is left 6½ hours for application to the studies of the second class outside the section room.

It is my belief that the average of time devoted to the study of the subjects of my department, outside the section room, is less than 2½ hours for each recitation. This average arises from the employment of a much smaller amount at some times and a much larger at others. The time in section room above given includes 1½ hours in philosophy and 1 hour in drawing.

The recitations in this department are 1 hour in length; the lectures average about 1½ hours in length. The number of hours in section room for term before January is 89½, and the time devoted to the study of the subjects outside the section room is 202½ hours, or a total of 292½ hours. In the term after January the time in the section room is 114½ hours, and the time devoted to the subjects outside the section room is 262½ hours, making a total of 376½. This estimate of hours assumes that the cadets study for the lecture days the same as for days of recitation. It is also based upon an average of 2½ hours' study for each recitation, which estimate is somewhat too great, especially in the term after January.

The number of lectures during the year is not always the same. The number (27) above given (13 before and 14 after January) was that of the past academic year. In some years there have been a few more than this number, and in others a smaller number. The subjects for instructive lectures are very numerous, and when the progress of the class is such that a lecture seems more desirable than a recitation, the former replaces the latter. The routine instruction, however, usually permits only the number given.

The difference in the amounts of matter studied by the upper and lower sections is slight. Such difference as exists is made between the two halves of the class and depends almost entirely upon the difference in the problems required to be solved. The entire difference does not amount to 5 per cent of the course. This statement refers to the difference in the amounts studied and not in the amounts learned.

#### ORGANIZATION OF THE DEPARTMENT AND DUTIES OF THE PERSONNEL.

The personnel of the department consists of the professor and the requisite number of instructors, a civilian employee, and an enlisted attendant. The number of instructors at the present time is four.

The professor is, by the academic regulations, made responsible for the mode of conveying instruction in his department. He prepares and delivers the lectures that pertain to the course, and with the aid of the instructors and employee he arranges for the illustrations and experiments that accompany them. He arranges and prescribes all the lessons during each term, this tedious duty being often necessary owing to a change of text-books or the date of lectures. He constantly supervises and assists in the instruction by frequent visits to the section rooms, and is always ready to replace any instructor who may be sick or detailed to other duty. He makes constant effort to have the aims and objects of the department thoroughly understood by the instructors, has frequent interviews with them as the course progresses to this end; invites suggestions and discussion from them, individually and collectively, toward the accomplishment of better results. He sees that the same general methods are followed by all the instructors. To this last result it is found very beneficial to have a new instructor present at two or more recitations before he is required to conduct them. The professor, aided by instructors, endeavors to keep note of the most important publications pertaining to the department, and secures them by purchase as the funds warrant. With the same assistance he watches some of the best technical and scientific journals and attempts to provide the department with the best, new and approved apparatus that the funds of the department will purchase, and which can be made useful with available facilities.

The finishing, furnishing, and equipment of the new Academy, the adaptation of its facilities to the best advantage of the department, with possible modifications in the future, require the constant attention of the professor and all of his assistants. It is often possible to greatly improve and simplify the discussions of the text by the addition of drawings or modifications of the textual matter, and to do this is one of the important duties of the professor with the advent of each new text-book. In nearly all the duties enumerated as pertaining to the head of the department much assistance is derived from the instructors, and it is the settled purpose of the head of the department to give the instructors every opportunity and encouragement to aid in its development.

Each instructor has charge of two sections, one reciting from 11 to 12, the other from 12 to 1 o'clock. The instructors are required to be present in the department by 9.30, and as a rule are there much before that time. The senior instructor, or assistant professor, is required to make out a programme for each day's recitation, selecting the matter to be given out at the board, that for questions, and the problems to be solved. All the other instructors use this programme, so that entire uniformity is observed as to the matter recited upon each day, and the experience of the senior instructor is made use of to select it. This programme is the same for all the sections in the same half of the class, but there is often made a difference between the two halves. Each instructor is required to have everything in perfect readiness in his room when the section enters. The problems given out the previous day must be corrected and ready for return to the section. He must see that any chemicals, specimens, or apparatus required in the room for the day are upon the exhibit table.

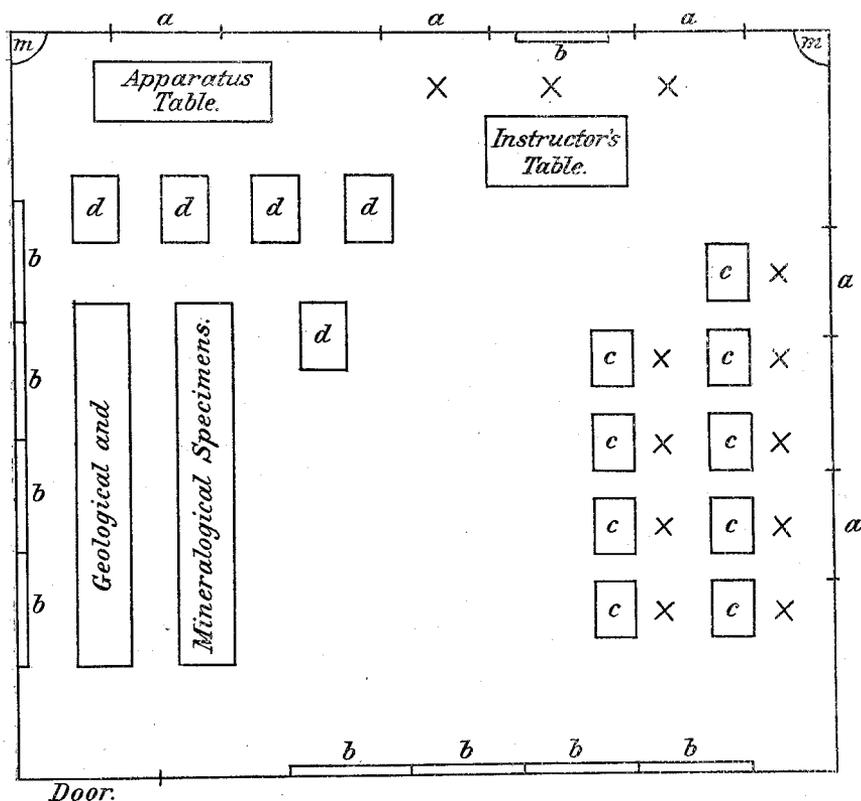
Any drawings upon the board or other work that he may need for the explanation of the lesson of the day, or of the previous day, must be in readiness. The assistant professor is charged with the accounts of purchases, expenditures, etc., and the inventorying of the new property. Included under the above duties are many details, too numerous to mention in full. The past academic year has been especially loaded with labors for them, among which may be mentioned the replacement and rearrangement of the mineralogical and geological cabinet, the placing and improvising of apparatus for electrical use in the laboratory, and the verifying of the inventory of all the property of the department.

The civilian employee has much occupation in the preparation for lectures, getting in readiness the necessary apparatus, preparing the agents, and in removing the material afterwards. He is at the service of any of the instructors in assisting to supply the exhibit of specimens, apparatus, etc., required in each section room, and in removing such exhibit after use, and in replacing it in the proper storage case.

During the instruction in mineralogy and geology he keeps all the working stands and the reagent stands of the different section-rooms properly supplied with chemicals, apparatus, and material, removing that used and replacing it by fresh—a very onerous task. With the enlisted attendant he keeps the various rooms of the department well policed. The cleaning of windows and the policing of the various rooms of the department constitute the principal work of the enlisted attendant, though he is called upon for a variety of other tasks.

The employee and attendant rub off the blackboards prior to each recitation. They both also have important duties in the power and battery-rooms in connection with the electrical part of the course.

DEPARTMENT OF CHEMISTRY, MINERALOGY, AND GEOLOGY.



GENERAL ARRANGEMENT OF SECTION-ROOM, PLAN.

*a a*, etc., windows.

*b b*, etc., blackboards.

*c c*, etc., cadet desks.

*x x*, etc., chairs.

*d d*, etc., working stands, mineralogy, and geology.

*m m*, stone shelves for mineral anvils and mortars.

The *apparatus table* during instruction in mineralogy is used as stand for reagents.

During the instruction in electricity and chemistry the working stands and the specimen tables are removed and four of the cadet seats and desks are placed on that side of the room.

SECTION-ROOM AND RECITATIONS.

The general arrangement of a section-room in the department is shown by the plan herewith. It is desirable never to have more than eight cadets in a section where the recitation lasts but one hour. Some of the larger classes have given nine cadets to some of the sections in this department. The cadets are seated in the room in the order in which they stand in the section, the section marcher being nearest the instructor.

When the section enters and the marcher has made his report, the instructor inquires if there are any questions the section wish to ask about the lesson. If there be any, as is very frequently the case, they are answered as clearly as possible. When the section has nine men, the order of recitation is as follows: After all questions are answered, five of the members are assigned subjects for discussion or description at the board.

The enunciations of the subjects at the board are printed and bound in pamphlet form. The instructor directs Mr. A, B, C, D, and E to discuss at the board subjects 20, 21, 23, 24, and 25, taking them in the order named, the numbers of the subjects being already written upon the boards. Each cadet called writes his name upon the board containing the number of his subject. He uses one of the enunciation pamphlets in preparing for his recitation.

The nature of these pamphlets will be known from the following enunciation taken therefrom: Discuss the subject of HCl. Its occurrence in nature; artificial preparation; the common liquid acid and how produced; commercial source of the common liquid acid; action of heat on; action of acid upon growing plants; upon metals; upon metal oxides.

The enunciation calls the cadets' attention to the important points of the subject, but does not give information upon them. He is permitted to write out under each term of the enunciation such knowledge as he has acquired in regard thereto and is then ready for recitation. While being permitted to write upon the board the substance of his recitation, each cadet is encouraged to outline the matter diagrammatically and only so fully as is necessary to bring readily to mind what he wishes to say and then to bring out the details orally instead of by writing out the whole upon the board. The cadets are supplied with the enunciation pamphlets and have the use of them in their study at their rooms. This greatly assists most cadets, serving to call attention to the principal and essential points of the subjects studied. When the instructor has sent the proper number of cadets to the board, he assigns to two others, sets of problems involving principles already studied. These two proceed at once to the solution of their problems. The nature of these problems is illustrated in the following example:

The specific gravity of a gaseous compound of carbon and hydrogen is 14; in 112 parts by weight of the compound there are 96 parts of C and 16 parts of H; find the molecular formula of the compound.

The simplicity of the problems, of course, depends upon the progress of the course, becoming more complex as principles are acquired in greater number.

The remaining two members of the section not yet mentioned, are called up and take their position in the center of the room and are questioned by the instructor upon parts of the lesson not given out at the board, on the more important parts of the lesson of the previous day, or upon principles pertaining to the subject which should be known. Experience has developed an advantage in having the cadets who are to be questioned take the floor together instead of in succession as was formerly the custom in this department.

After these two cadets are questioned from fifteen to twenty minutes, they are given a set of problems to solve—this set of problems involving less work than that given to the two members who were not questioned. Sometimes a greater number than two is questioned, and then all receive problems afterwards. The exact programme for each day is arranged by the senior instructor and is followed in all the sections.

When the instructor has finished with the cadets on questions, some member at the board is generally ready or nearly ready to recite. This member is then called upon and proceeds to make his recitation. He makes such use of his board work as is necessary to enable him to set forth all the information he possesses upon the points enumerated in his enunciation. During the discussion of each heading the instructor makes only such interruption as is essential to correct understanding and statement. Before leaving any particular heading the instructor brings out by questions all the important points that may have been omitted. At the close of the recitations the instructor endeavors to call attention to all points in any part of the subject which seem not to have been properly appreciated. It is also a prime effort of the department to show the relation between new principles and facts brought out and others already studied and to point to some application which these principles find in the arts and industries. This is done by a simple statement of the instructor or by a query to the cadet as to whether he had ever observed *such* or *such* applications.

The above-described method for section-room exercises is applicable during the study of heat, chemistry, and electricity. During the study of mineralogy and geology the method is materially different. A smaller number of subjects is given out at the board; no problems are given out, but instead several members of the section are assigned a number of mineralogical or geological specimens to determine by practical tests, suitable stands and all the necessary apparatus being in the room for the purpose. In mineralogy and geology the cadets placed upon questions are very frequently asked about the objects themselves. Thus, cadets called up for questions are placed in front of a lot of mineralogical or geological specimens and each, in turn, is directed to pick up one of them and is then asked all of its visible and easily determined characteristics, as color, structure, texture, luster, hardness, tenacity, heaviness, etc.

After being questioned, these gentlemen are given selected specimens to determine by the blowpipe or chemical tests. The cadets who have minerals or other specimens

to determine, after due time bring them up in front of the instructor's desk and give the results of their determinations, being required at the same time to state what tests were applied in the determination. The recitations are so short that in these subjects it is often impossible to hear all recite upon their determined specimens. In such cases those not reciting, leave their names in their trays with their labeled specimens and any serious mistakes of determination are referred to the next day.

The time devoted to the determination of minerals, rocks, and fossils is largely increased by allowing the cadets to use in the section-room certain "tables for the determination of minerals." By this aid they can have the practice upon minerals not in the lesson of the day. In the same way, by the use of their text-books in the section-room, we are enabled to give out rocks and fossils though they have not been mentioned in the lessons of several previous days. In other words, the practical work on rocks and minerals, etc., is not limited to the time that the lithology and mineralogy are studied, but continued through all the course of geology as well.

Thus we have developed a thoroughly practical course of very reasonable length. In each room a full set of ordinary exhibition specimens of minerals, rocks, and fossils is placed, so that the cadets have the benefit of a small cabinet collection in their study of the subject. This exhibit collection is allowed to be used only under such restrictions as tend to cultivate the powers of observation and partially supply the defects of insufficient time. It is of great assistance in acquiring a knowledge of the subjects.

The electrical laboratory exercises are again different from the section room exercises already described. These involve practical work in electricity, and are given in April.

They consist of explanation of apparatus by the instructor and use of the same by the cadets. For this instruction two sections attend daily from 11 to 1 o'clock. During the past year the second assistant instructor, aided by the two junior instructors, had immediate charge of this instruction. For this work a series of practical electrical problems is outlined beforehand and each cadet is supplied with a statement of each problem. It is indicated to each section in advance which of the problems will be involved in the laboratory work of the day. They are thus enabled to look up the principles applicable and the description of the instruments to be used. When they come to the laboratory they put up the necessary apparatus, make the required observations for the solutions of the indicated problems.

The following example will illustrate the nature of this work: "Using a Weston ammeter and a Thomson voltmeter, make the necessary connections and take the data for finding the power consumed in an Edison incandescent lamp."

In the laboratory the sections are divided into squads of four men each and they successively and in rotation use the apparatus for securing the data for the different problems. The three instructors present see that the apparatus is used properly and give assistance when any squad is using too much time in making any observation.

Occasionally written recitations are held, usually as the subjects are being reviewed. In these cases the entire class or half the class attends at the same hour in one of the larger rooms of the Academy. All write answers to a series of questions pertaining to the subjects of the lesson for that day or of principles which are always required. This written recitation is generally adopted when it is desired to include a number of important facts or principles. The attention of each cadet is then called to the desired points and more time is given for them to express their knowledge of them. The written recitation serves to pick out the cadets who are weakest in certain directions. It is also occasionally resorted to as a means of introducing a set of problems involving the application of principles that it is desired to impress promptly upon all. Only a small number of such recitations is found desirable in this department.

In addition to the cabinet tables already referred to in the mineralogical section rooms, there is kept another table in each room at all times. Upon this table are exhibited the special chemical specimens, apparatus, or drawings referred to almost daily in the text. Any members of the section not otherwise engaged are permitted to examine and familiarize themselves with the objects thus exposed. The members around this table are permitted to converse in regard to the objects under consideration, but it is contrary to order to discuss other matters or to seek information upon the subjects not yet recited upon.

Daily merit marks are given upon the results of the section-room work, and when only eight or nine cadets are in a section the methods above described enable the instructor to give each cadet a mark each day, with rare exceptions. The daily assignments of work in the section rooms are such that each cadet shall receive the same proportion of board, question, and problem-subjects during the term. The particular subjects of either class are assigned daily by lot. The scale of marking is: Thorough, 3; good, 2.5; indifferent, 2; bad, 1.5; very imperfect, 1; complete failure, 0.

The head of the department, unless other duties prevent, visits two section rooms daily, remaining one hour in each. He marks the cadets independently of the

instructors, and afterwards compares his marks with theirs, using the comparison to establish as nearly the same standard as possible throughout the department. After the last recitation of the week the daily marks are summed, giving the weekly totals; the whole is transcribed to the weekly class reports, prepared for the purpose, and submitted through the head of the department to the Superintendent of the Academy, who has the marks conveniently posted for the inspection of the cadets or others.

A transcript of the weekly totals is kept by the professor and are added to the totals of the following week as soon as the week closes. He thus has before him at the beginning of each week the total mark of each cadet from the beginning of the term. This, with the section-books of the instructors, supplies the complete section-room record of each cadet in the different subjects of the department. Whenever such a difference exists between the total marks of two cadets in different sections as to clearly indicate that one is mastering the course better than the other a "transfer" is, at the end of the week, recommended by the professor to the Superintendent, and if he approves, he directs the "transfer" to be made. The cadets concerned, at the beginning of the following week change sections. In this way it is endeavored to keep the cadets of about the same proficiency in the same sections so far as the number of members in a section permits.

In recommending these transfers the professor consults with his instructors and makes every effort to avoid changing the sections of cadets upon an inequality of marks due to fortuitous circumstances or to causes other than the proficiency of the cadets. While mistakes may sometimes be made and cadets improperly discouraged thereby, such mistakes are open to early correction if the misplaced cadet shows that he did not deserve a transfer. Cadets often pass down through several sections and by steady effort regain their lost ground.

The lectures which pertain to the course are delivered to the entire class assembled in the lecture room of the department. The arrangement of lectures is such that they, in general, are delivered on the advance course and pertain to the discussion and illustration of principles and subjects already studied by the cadets. Having the lecture precede the study of the subject was tried and found less satisfactory than the method indicated. It frequently happens that the knowledge of the class is such that subjects in advance of the lesson may with advantage be dealt with; it is then done, but as a rule the lectures relate to the subjects already studied. All but a few of the lectures are delivered during the advance lessons of the class and follow each other in such order that the illustrations and demonstrations in each may embrace, as nearly as possible, all the matter studied by the class since the preceding lecture. There were twenty-seven lectures during the last academic year, thus giving one lecture for each three advance lessons of the course, there being eighty-one such lessons. The intervals between lectures is not, however, uniform, so that precisely three recitations do not always intervene between them, even when no review is made.

These frequent assemblies of the class give ready opportunity to enforce considerations in the direction that the section-room consideration shows to be most desirable. They are made the occasion of calling the attention of any members of the class to subjects, principles, etc., that have been slighted or need more study. While the main object of the lectures is to illustrate and elucidate the principles and facts of the text, they are taken advantage of to convey much useful information—scientific, historical, and otherwise—in the effort to show the breadth of the sciences taught, their relations to other branches of knowledge, and in the effort to give to the study a real meaning and create a living interest in the cadets.

#### SEMI-ANNUAL EXAMINATIONS.

The annual and semiannual examinations in this department have, with few exceptions, been oral. The relations between the different subjects pertaining to each term and the present distribution of time to each subject renders intermediate examinations impracticable and undesirable. The oral examinations at the end of each term are considered a part of the course, and each cadet is required to show proficiency at them. When a cadet's work during the term indicates deficiency, in the opinion of the department, he is subjected to a written test at the end of the term. A cadet whose mark during the term indicates doubtful proficiency is given a sufficiently extended oral examination to dispose of such doubt. If in the oral test he still fails to prove his proficiency to the satisfaction of every member of the academic board, he is then given a more extended written test. All those cadets whose marks during the term clearly indicate proficiency are at examination given some subject in the course, usually chosen by lot. These subjects are taken from all parts of the course, and there is little or no repetition among them. A proficient knowledge of such subject indicates a proficient knowledge of the course, and it is so taken. A failure upon one subject is followed by a test upon another selected in the same way. A second failure makes it necessary for the cadet to prove his proficiency upon a more extended test.

At the examinations there is no question as to the proficiency of nearly all the cadets. The oral examinations in these cases is an indication of excellence rather than a test of proficiency. The experience of the department has shown that when a single recitation on the course in advance is given a weight of one, a review recitation should have a weight of two, and the oral examination a weight of five. In this apportionment of weights no distinction is made between the advance and first review. The term review applies only to the last review, where there is more than one. These weights have met the approval of the board and have been adopted by it.

The decision as to the probable proficiency of cadets at the end of the term and before examination is based upon the entire work during the term. The considerations involved are numerous and varied, and differ in different cases. The record made upon general review is given the greatest weight. Generally, when a cadet has made an average of a little over two-thirds of the maximum in all parts of the course, his work is taken by the department to indicate proficiency. An average of a little less than two-thirds of the maximum over all parts of the course indicates doubtful proficiency, and the doubt is decided by the results of the examination. An average considerably less than two-thirds—say 1.8 out of 3—in all parts of the course is considered to indicate deficiency, and an extended written examination is considered essential to determine whether such cadet has been able to make up the deficiency between the time recitations ceased and the examinations are held.

#### COURSE AND METHOD OF INSTRUCTION.

From 1880 to the present time (except the gain of 25 days in 1870) the total time allowed all the subjects of the department has been very nearly the same. The additional time given in 1879 was used first in extending the geology; second, extending the electric; third, to embrace the subjects of physiology and hygiene. As electricity has grown in importance it has been further increased and the geology shortened. At the present time the additions to the electricity and the physiology and hygiene consume all the time gained in 1880. At the time (1879) that the instruction of the first class year was transferred to the second class year, it was arranged to complete the chemistry proper in the first term of the academic year.

This subject has been previously examined in at both the January and June examinations, the second examination including the subject-matter of the first. Since 1880 the chemistry proper is finished in one term and only one examination held in the subject. This change made available a little time for the development of the course. Another slight additional gain has been made by the exercise of a proper discrimination over the different parts of the course. Instead of requiring the cadets to traverse all parts of the course three times (first, second, and third times over), equal benefit and less weariness to cadets is produced by going over certain portions only once, other portions twice, and only the remainder three times. These last two changes, it will be noted, give additional opportunity but not additional time to the department.

It is not possible from the records available to determine the exact extent of the courses taken in the different subjects of this department for more than forty years, but during that time the extent of the courses has gradually increased, and at earlier date it is pretty certain that the extent was still less. Since 1879 the department has had more time and more opportunity than previously, and the course embraces a greater number of lessons and includes more material than at any previous time. The time and attention devoted to the respective studies is now well proportioned, but considerable modification is still possible. As the subjects vary in importance additional adjustments can be made by further extension of lectures wherever found available and by the further exercise of such discrimination as is above referred to, coupled with a corresponding reduction in the amounts required at examination.

The method of instruction is, in general, the same that has long prevailed at the institution. The transfer of all the instruction of the department to the second class year, and of all recitations to the morning hour (made 1880), allows each instructor to devote his entire time at any period to one subject, to the manifest and greatest benefit of the instruction. It permitted a perfection of arrangement in all the details of the section-room work not before possible, adding greatly to the efficiency of the instruction.

In present instruction greater importance than formerly is attached to the practical bearing of all that is taught. To this end, in the subjects of heat, chemistry, and electricity, the solutions of problems involving the principles taught—has become a marked feature of the recitation work. During the day's recitation of two hours in the above subjects, each instructor gives out from twelve to thirty problems. The cadets make an effort to solve them, and the instructor examines, corrects, and

returns them to the section at the next recitation. In mineralogy and geology trays of minerals, rocks, etc., for determination replace the problems, and each instructor must daily provide from eight to ten sets of specimens, each containing from six to ten varieties of minerals, rocks, or fossils. The method now pursued has greatly increased and concentrated the labors of the instructors, with the greatest advantage to the instruction. While it is certain that the course embraces more now than formerly, and while it is thought that as good results are obtained over the broader course, it is believed that no greater effort is required from cadets. This belief is based upon observation and the conversation of cadets, as well as upon the reasons for such results apparent in the facts above set forth.

A comparison between the courses and methods of instruction at this institution and any other, to be of value, would first require a full consideration of the objects and of the conditions surrounding the other institution. In general, it may be said that the subjects which are included in this department (excepting mineralogy and geology) are, in institutions of equal standing elsewhere, taught in connection with a greater proportion of laboratory practice. It is believed, however, that when all the facilities of the new academy are made available, we shall have theory and practice balanced, to the best advantage, when all the considerations connected with this institution are justly weighed.

The marked advantages of this department in accomplishing results may be stated as follows:

1. The division of the class into small sections by which each instructor is enabled to give greater individual attention to each cadet and closer personal supervision of all the work of his section.
2. The assistance of competent, willing, and interested instructors, by which the department is enabled to create and develop the interest of the cadets in the subjects taught. This factor, too, keeps the department in healthy activity, and multiplies the chance of improvement in the course of study and methods of instruction.
3. The lever of effectual compulsion which pertains to all the departments of the institution.

The greatest defect to which the department is subject (without considering the length of its courses) is too great a concentration of the courses. The same actual time devoted to the subjects distributed over a longer period would be better. This was one disadvantage that did not exist when the instruction was extended over two years. It is still possible to largely mitigate this defect by alternation of recitations in the subjects taught in the department, thus extending the period during which each subject is recited upon. A method for accomplishing this result is now under consideration, and will be submitted to the proper authorities in due time.

The necessities of the service, which prevent the retention of instructors beyond a certain number of years, is also frequently a check to the most efficient work of the department.

S. E. TILLMAN,  
*Professor Chemistry, Mineralogy, and Geology.*

G<sub>I</sub>.LECTURE SUBJECTS PERTAINING TO THE DEPARTMENT OF CHEMISTRY, MINERALOGY,  
AND GEOLOGY.

## HEAT.

*Lecture 1.*—Before commencing recitations beginning of academic year; general remarks on arrangement of the section room; objects intended to be accomplished; privileges to be accorded cadets in section rooms; rules of conduct to be observed; definition of physical sciences; branches of the department; chemistry defined; heat defined; how to study the subjects; how to recite; heat as a branch of physics; general effects of heat.

*Lecture 2.*—Thermometry; convection; specific heat (experimental illustrations).

*Lecture 3.*—Maximum pressure and density of vapors; ebullition; liquefaction; evaporation; freezing mixtures (experimental illustrations).

*Lecture 4.*—Hygrometry; conduction; radiation; meteorological phenomena (experimental illustrations).

## CHEMISTRY.

*Lecture 1.*—Additional discussion and elucidation of the essential principles of chemistry; chemical philosophy (experimental illustrations).

*Lecture 2.*—Oxygen; hydrogen; water (experimental illustrations).

*Lecture 3.*—Nitrogen; the atmosphere; carbon; carbon dioxide; carbon monoxide; common hydrocarbons; flame (experimental illustrations).

*Lecture 4.*—Silicon; boron; ammonia; oxides of nitrogen; nitric acid; chlorine; hydrochloric acid; bromine; iodine (experimental illustrations).

*Lecture 5.*—Sulphur; hydrogen sulphide; carbon disulphide; sulphurous oxide; sulphuric acid; phosphorus (experimental illustrations).

*Lecture 6.*—Potassium; sodium; ammonium; barium; calcium; magnesium; aluminium; zinc; iron (explanatory and descriptive of processes, illustrations).

*Lecture 7.*—Cobalt; manganese; chromium; nickel; tin; copper; lead; mercury; gold; platinum (explanatory and descriptive of processes, illustrations).

*Lecture 8.*—High explosives; inspection of gas works (descriptive and experimental).

*Lecture 9.*—Paraffin and petroleum; alcoholic liquors; carbohydrates (descriptive).

## ANATOMY, HYGIENE, AND PHYSIOLOGY.

*Lecture 1.*—Involving matters likely to be of use in the service-experience of officers; frequently delivered by one of the assistant surgeons; two, pertaining to this subject given during the year 1895-96.

## ELECTRICITY.

*Lecture 1.*—Frictional electricity (illustrations).

*Lecture 2.*—Natural and artificial magnets; the needle; compass; cell; local action; amalgamation (slide illustrations).

*Lecture 3.*—Batteries; galvanometers (experiments).

*Lecture 4.*—Faraday's discoveries; induced currents; induction coils (experiments).

*Lecture 5.*—Lines of force; field of force (slide illustrations); magnetic rotations (explanation of).

*Lecture 6.*—Explanation of dynamo machines from models and drawings (for past two years delivered by Lieutenant Davis, senior assistant).

*Lecture 7.*—Electric lighting, machines for.

*Lecture 8.*—Lightning and lightning rods; electric discharge through vacuum tubes; Roëntgen photography.

## GEOLOGY.

*Lecture 1.*—Introduction to geology; historical account of the origin, rise, and development of the science.

*Lecture 2.*—Internal heat of the earth; geysers; volcanoes; earthquakes (descriptive, with slide illustrations of the effects of dynamical agents).

*Lecture 3.*—Paleontology, its relation to geology; origin of great classes; vertebrates; mammals; birds (slide illustrations of extinct forms).

*Lecture 4.*—Scientific evidences of organic evolution.

G<sub>2</sub>.

*Extracts from Regulations United States Military Academy, giving tables of employment of time, 1821-1894, and programme of course of studies, 1866-1894, in department of chemistry, mineralogy, and geology.*

EMPLOYMENT OF TIME.

| Hours.        | First class.  | Second class.  | Regulations.                                       |
|---------------|---|--|--|
| 12 to 1 ...   | Monday, Wednesday, Friday: Lectures on chemistry applied to the arts, or in mineralogy and geology. Tuesday, Thursday, Saturday: Study of the same subject. | Tuesday, Thursday, Saturday: Lectures in chemistry.<br>Monday, Wednesday, Friday: Study of the same subject.   | 1 21.<br>Paragraph 47.                             |
| 11 to 12 ..   | Tuesday, Thursday, Saturday: Recitations in chemistry applied to the arts, or in mineralogy.<br>Monday, Wednesday, Friday: Study of the same subject.       | Monday, Wednesday, Friday: Recitations in chemistry.   | 1825.  |
| 12 to 1 ...   | Monday, Wednesday, Friday: Lectures in chemistry applied to the arts, or in mineralogy and geology. Tuesday, Thursday, Saturday: Study of the same subject. | Tuesday, Thursday, Saturday: Study of the same subject.<br>Tuesday, Thursday, Saturday: Lectures on chemistry.   | Table A.   |
| 11 to 12 ..   | Study of rhetoric, and moral and political science, and mineralogy and geology.   | Monday, Wednesday, Friday: Study of the same subject.  | 1832.  |
| 12 to 1 ...   | Same as preceding .....   | Recitations and study of chemistry.  | 1832.  |
| 2 to 4 ....   | Recitations of rhetoric, and moral and political science, and mineralogy and geology.   | Same as preceding .....  | Paragraph 41.                                      |
| 2 to 4 ....   | Recitations in mineralogy and geology; tactics, or artillery, or study.   | .....  | 1839.  |
| 11 to 1 ..... | .....   | Recitations in chemistry and study of same, or natural philosophy.   | Paragraph 41.                                      |
| 11 to 1 ..... | .....   | Recitations in chemistry, cavalry exercises; study.  | 1853.  |
| 2 to 4 ....   | Recitations in ethics, etc., mineralogy and geology; infantry tactics, artillery; study.  | .....  | Paragraph 41.                                      |
| 11 to 1 ..... | .....   | Recitations in electrics and chemistry; cavalry exercises; study.  | 1857.  |
| 2 to 4 ....   | Recitations in law, etc., mineralogy and geology; infantry tactics, etc.; practical engineering on the field; study.  | .....  | See paragraph 38.                                  |
| 11 to 1 ..... | .....   | Recitations in chemical physics and chemistry; cavalry exercises; study.   | 1866.  |
| 2 to 4 ....   | Recitations in ethics and law; mineralogy and geology; ordnance and gunnery; cavalry tactics; study.  | .....  | Paragraph 41.                                      |
| 11 to 1 ..... | .....   | Recitations in chemical physics and chemistry; cavalry exercises; study.   | 1873.  |
| 2 to 4 ....   | Recitations in ethics and law; ordnance and gunnery; mineralogy and geology; study.   | .....  | Paragraph 40.                                      |
| 11 to 1 ..... | .....   | Recitations in chemical physics and chemistry; cavalry exercises; study.   | 1877.  |
| 2 to 4 ....   | Recitations in law; ordnance and gunnery; mineralogy and geology; study.  | .....  | Paragraph 363; see paragraph 41.                   |
| 11 to 1 ..... | .....   | Recitations in chemistry; chemical physics; mineralogy and geology; tactics; cavalry exercises; study.<br>Recitations in chemistry; chemical physics; hygiene; mineralogy and geology, and in drill regulations; cavalry exercises; study. | 1883; see paragraph 40.<br>1894; see paragraph 45. |

G<sub>2</sub>.—*Extracts from Regulations United States Military Academy, giving tables of employment of time, 1821-1894, and programme of course of studies, 1866-1894, in department of chemistry, mineralogy, and geology—Continued.*

PROGRAMME OF COURSE OF STUDIES.

| Year.     | Class.    | Department.   | Time.   | Allotment of time.  | Regulations.   |
|-----------|-----------|---|---------|---|--|
| Third.... | Second..  | Chemistry, etc.....                                 | 11 to 1 | Every other week day, alternating with riding.  | Paragraph 38, Regulations 1866.  |
| Fourth .. | First ... | Mineralogy and geology.                             | 2 to 4  | Every other week day, Saturdays excepted, from September 1 to second week in December, and three weeks before June for review, alternating with ethics and law.   | To date from July 1, 1867.   |
| Third.... | Second..  | Chemistry.....                                      | 11 to 1 | Every other week day, alternating with riding.  | Paragraph 37.  |
| Fourth .. | First ... | Mineralogy and geology.                             | 2 to 4  | Every other week day, Saturdays excepted, from the close of January; examination to June 1, alternating with ethics and law.  | Regulations 1873.  |
| Third.... | Second..  | Chemistry.....                                      | 11 to 1 | Every other week day, alternating with riding.  | Paragraph 364.   |
| Fourth .. | First ... | Mineralogy and geology.                             | 2 to 4  | Every other week day, Saturdays excepted, from the close of the January examination to June 1, alternating with law.  | Regulations 1877.  |
| Third.... | Second..  | Chemistry, etc.....                                 | 11 to 1 | Every other week day from September 1 to November 1, alternating with tactics; every week day from November 1 to January 1, and from the close of the semiannual examination in January till the completion of the course.                    | Paragraph 364, of Regulations 1877, as modified for the second class of 1879-80. |
| Third.... | Second..  | Mineralogy and geology.                             | 11 to 1 | (a) Every week day from the completion of the course of chemistry till June 1, except during the month of April, and every other day during the month of April, alternating with riding.  |  |
| Third.... | Second..  | Chemistry.....                                      | 11 to 1 | Every week day from September 1 to November 8; every other week day from November 8 till January 1, alternating with tactics, then every week day from the close of the semiannual examination in January till the completion of the courses. | Paragraph 39, 1883.  |
| Third.... | Second..  | Chemical physics, mineralogy, and geology.          | 11 to 1 | Same as paragraph (a) above...  |  |
| Third.... | Second..  | Chemistry.....                                      | 11 to 1 | Same wording as in Regulations of 1883, except alternates with drill regulations instead of with tactics.   | Paragraph 44, Regulations 1894.  |
| Third.... | Second..  | Chemical physics, hygiene, mineralogy, and geology. | 11 to 1 | Same wording as in the Regulations of 1883.   |  |

G<sub>3</sub>.

PARAGRAPHS OF THE REGULATIONS, UNITED STATES MILITARY ACADEMY, 1821 TO 1894, WHICH RELATE TO THE EXTENT OF THE COURSE OF CHEMISTRY, MINERALOGY, AND GEOLOGY.

## CHEMISTRY AND MINERALOGY.

The course of chemistry and mineralogy will embrace—  
Chemical philosophy, including theory and practice of analysis and the examination of vegetable and animal productions.

Par. 36, Regulations, U. S. M. A., 1821.

Application of chemistry to the arts, as agriculture, distilling, tanning, dyeing, bleaching, gilding, pyrotechny, etc.

Mineralogy and geology, viz: Classification and description of mineral substances, general structure and classification of rocks, analysis and uses of minerals, view of different systems of geology and mineralogy and an account of the minerals and geology of the United States.

Par. 1346, Regulations, U. S. M. A., 1825.

Same as in Regulations of 1821.

## CHEMISTRY AND MINERALOGY.

The course will comprise—

Par. 31, Regulations, U. S. M. A., 1832.

Chemical philosophy, including the theory and practice of analysis and the examination of vegetable and animal productions.

Application of chemistry to the arts of agriculture, distilling, tanning, dyeing, bleaching, gilding, pyrotechny, etc.

Mineralogy and geology, viz: Classification and description of mineral substances, general structure and classification of rocks, analysis and uses of minerals, view of the different systems of geology and mineralogy and an account of the minerals and geology of the United States.

## CHEMISTRY, MINERALOGY, AND GEOLOGY.

The course will comprise—

Par. 32, Regulations, U. S. M. A., 1839.

Chemical philosophy, including the theory and practice of analysis and the examination of vegetable and animal productions, electricity, and galvanism.

Application of chemistry to the arts of agriculture, distilling, tanning, dyeing, bleaching, gilding, pyrotechny, etc.

Mineralogy and geology, viz: Classification and description of mineral substances; general structure and classification of rocks; analysis and use of minerals; view of the different systems of geology, and an account of the minerals and geology of the United States.

## CHEMISTRY, MINERALOGY, AND GEOLOGY.

The course will comprise—

Par. 29, Regulations, U. S. M. A., 1853.

Chemical philosophy, including the theory and practice of analysis and the examination of vegetable and animal productions, electricity, and galvanism.

Application of chemistry to the arts of agriculture, distilling, tanning, dyeing, bleaching, gilding, pyrotechny, etc.

Mineralogy and geology, viz: Classification and description of mineral substances; general structure and classification of rocks; analysis and use of minerals; view of the different systems of geology and mineralogy, and an account of the minerals and geology of the United States.

## CHEMISTRY, MINERALOGY, AND GEOLOGY.

The course will comprise—

Par. 25, Regulations, U. S. M. A., 1857.

Chemical philosophy: Electrics, the theory and practice of analysis, and the examination of vegetable and animal productions.

Application of chemistry to the arts of agriculture, distilling, tanning, dyeing, bleaching, gilding, pyrotechny, etc.

Mineralogy and geology, viz: Classification, description, and practical determination of minerals; general structure and classification

of rocks, uses of rocks and minerals; view of the different systems of geology and mineralogy, and an account of the minerals and geology of the United States.

CHEMISTRY, MINERALOGY, AND GEOLOGY.

This course will comprise—

Chemical physics: Magnetism, static and voltaic electricity; electro-magnetism; magneto-electricity; thermo-electricity; animal electricity; construction and use of apparatus illustrating the principles of the foregoing subjects and their mutual relations; heat—the nature, sources, and effects; relation between thermal energy and other forces; measurement and equilibrium of temperatures; thermal and aqueous phenomena of the atmosphere; light as a chemical agent. Par. 31, Regulations, U. S. M. A., 1866.

Chemistry: Its general laws and language; inorganic and organic chemistry; theory of radicals, types, and substitutions; animal chemistry; animal nutrition; heat and force; relation between the mineral, animal, and vegetable kingdoms; applications of chemistry to agriculture, fermentation, etc.

Mineralogy: Crystallography; structure, practical determination, and uses of minerals; descriptive mineralogy.

Geology: The earth's features; classification, structure, modes of occurrence, and distribution of rocks; rock veins; division of geological history into ages; the various agents of geological changes; geology of the United States.

CHEMISTRY, MINERALOGY, AND GEOLOGY.

This course will comprise—

Chemical physics: Magnetism, static and voltaic electricity; electro-magnetism; magneto-electricity; thermo-electricity, animal electricity; construction and use of apparatus illustrating the principles of the foregoing subjects and their mutual relations; heat—its nature, sources, and effects; relation between thermal energy and other forces; measurement and equilibrium of temperatures; thermal and aqueous phenomena of the atmosphere; light as a chemical agent. Par. 30, Regulations, U. S. M. A., 1873.

Chemistry: Its general laws and language; inorganic and organic chemistry; theory of radicals, types, and substitution; animal chemistry; animal nutrition, heat, and force; relation between the animal, mineral, and vegetable kingdoms; application of chemistry to agriculture, fermentation, etc.

Mineralogy: Crystallography; structure, practical determination and uses of minerals; descriptive mineralogy.

Geology: The earth's features; classification, structure, modes of occurrence and distribution of rocks, rock veins; division of geological history into ages; the various agents of geological changes; geology of the United States.

CHEMISTRY, MINERALOGY, AND GEOLOGY.

This course will comprise—

Chemical physics: Magnetism; static and voltaic electricity; electro-magnetism; magneto-electricity; thermo-electricity; animal electricity; construction and use of apparatus illustrating the principles of the foregoing subjects and their mutual relations; heat—its nature, sources, and effects; relation between thermal energy and other forces; measurement and equilibrium of temperatures; thermal and aqueous phenomena of the atmosphere; light as a chemical agent. Par. 31, Regulations, U. S. M. A., 1877.

Chemistry: Its general law and language; inorganic and organic chemistry; theory of radicals, types, and substitutions; animal chemistry; animal nutrition; heat and force; relation between the mineral, vegetable, and animal kingdoms; application of chemistry to agriculture, fermentation, etc.

Mineralogy: Crystallography; structure, practical determination, and uses of minerals; descriptive mineralogy.

Geology: The earth's features; classification, structure, modes of occurrence, and distribution of rocks; rock veins; division of geological history into ages; the various agents of geological changes; geology of the United States.

## CHEMISTRY, MINERALOGY, AND GEOLOGY.

The course will comprise—

Par. 30, Regulations U. S. M. A., 1883.

Chemical physics: Magnetism; static and voltaic electricity; electro-magnetism; magneto-electricity; thermo-electricity; animal electricity; construction and use of apparatus illustrating the principles of the foregoing subjects, their mutual relations, and applications to the arts and sciences; heat—its nature, sources, and effects; relation between thermal energy and other forces; measurements and equilibrium of temperatures; thermal and aqueous phenomena of the atmosphere; light as a chemical agent.

Chemistry: Its philosophy; inorganic and organic chemistry, theory of radicals, types, and substitutions; animal chemistry; animal nutrition, heat, and force; relation between the mineral, vegetable, and animal kingdoms; applications of chemistry to the arts and sciences.

Mineralogy: Crystallography; structure, practical determination, and uses of minerals; descriptive mineralogy and lithology.

Geology: Dynamical, structural, and historical, with special reference to the United States.

## CHEMISTRY, MINERALOGY, AND GEOLOGY.

The course will comprise—

Par. 30, Regulations U. S. M. A., 1883, as modified by letter A. G. O., Dec. 9, 1890.

Chemistry: Chemical philosophy; inorganic chemistry, chemistry of the nonmetallic elements and their compounds, chemistry of the metallic elements and their compounds, useful applications of the principles of inorganic chemistry; organic chemistry, chemistry of the carbon compounds—animal chemistry, chemistry of vegetation, useful applications of the principles of organic chemistry; physiology, action of alcohol and narcotics on the human system.

Chemical physics: Heat, thermometry, dilation of bodies, calorimetry, production and condensation of vapors, latent heat, hygrometry, conduction, radiation, relation between light and heat, thermo-dynamics, terrestrial temperatures, aerial meteors, aqueous meteors; electricity, frictional electricity, sources of electricity, magnetism, current electricity, electrostatics, electro-magnetics, electrical measurements, heat, light, and work from electric currents, thermo-electricity, electro-optics, magneto-electricity, electro-chemistry, construction and use of apparatus illustrating and involving the principles of the foregoing subjects, useful applications of electricity.

Mineralogy: Crystallography, physical and chemical properties of minerals, practical determination and use of minerals, descriptive mineralogy, and petrography.

Geology: Dynamical, structural, and historical, with special reference to the United States.

## CHEMISTRY, MINERALOGY, AND GEOLOGY.

The course will comprise—

Par. 35, Regulations U. S. M. A., 1894.

Chemistry: Chemical philosophy; inorganic chemistry, chemistry of the nonmetallic elements and their compounds, chemistry of the metallic elements and their compounds, useful applications of the principles of inorganic chemistry; organic chemistry, chemistry of the carbon compounds—animal chemistry, chemistry of vegetation, useful applications of the principles of organic chemistry; physiology, hygiene, action of alcohol and narcotics on the human system.

Chemical physics: Heat, thermometry, dilation of bodies, calorimetry, production and condensation of vapors, latent heat, hygrometry, conduction, radiation, relation between heat and light, thermo-dynamics, terrestrial temperatures, aerial meteors, aqueous meteors; electricity, frictional electricity, sources of electricity, magnetism, current electricity, electrostatics, electro-magnetics, electrical measurements, heat, light, and work from electric currents, thermo-electricity, electro-optics, magneto-electricity, electro-chemistry, construction and use of apparatus illustrating and involving the principles of the foregoing subjects, useful applications of electricity.

Mineralogy: Crystallography, physical and chemical properties of minerals, practical determination and use of minerals, descriptive mineralogy and petrography.

Geology: Dynamical, structural and historical, with special reference to the United States.

G<sub>4</sub>.

## PARAGRAPHS OF THE REGULATIONS, UNITED STATES MILITARY ACADEMY, 1821-1894, WHICH RELATE TO THE MANNER OF GIVING INSTRUCTION IN THE DEPARTMENT OF CHEMISTRY, MINERALOGY, AND GEOLOGY.

The course of chemistry and mineralogy will be taught by the professor of these sciences in a course of lectures and experiments to the first and second classes, at the rate of three lectures per week to each, accompanied with suitable interrogatories. Par. 68, Regulations, U. S. M. A., 1821.

Three lectures will be delivered to the second class each week on the first part of the course of chemistry, and the same number to the first class on the second part of the course of chemistry and mineralogy. Par. 1377, Regulations, U. S. M. A., 1825.

Three lectures will be delivered each week to the second class on chemistry, and the same number to the first class on mineralogy and geology. These classes will be separately divided (the second according to general merit in chemistry) into convenient sections for recitation. The professor will be assisted in lecturing and in hearing recitations by a sufficient number of officers selected for that purpose. Par. 48, Regulations, U. S. M. A., 1832.

## CHEMISTRY AND MINERALOGY.

Three lectures shall be delivered each week to the second class on chemistry, and the same number to the first class on mineralogy and geology. These classes will be separately divided (the second according to general merit, the first according to merit in chemistry) into convenient sections for recitation. The professor shall be assisted in lecturing and in hearing recitations by an assistant professor and such other assistants selected for that purpose as may be judged necessary by the superintendent. Par. 48, Regulations, U. S. M. A., 1839.

## CHEMISTRY AND MINERALOGY.

Three lectures shall be delivered each week to the second class on chemistry, and the same number to the first class on mineralogy and geology. These classes will be separately divided into convenient sections for recitation at the commencement of the term, according to "general merit;" and after the January examination in the first class according to merit in the course which shall have most recitations. The professor shall be assisted in lecturing and in hearing recitations by such assistant professors as may be judged necessary by the Superintendent. Par. 48, Regulations, U. S. M. A., 1853.

## ELECTRICS, CHEMISTRY, MINERALOGY, AND GEOLOGY.

For instruction in electrics and chemistry, the second class shall be divided into sections in September according to "general merit;" and after the January examination according to merit in chemistry. Par. 51, Regulations, U. S. M. A., 1857.

For instruction in mineralogy and geology the first class shall, in September, be divided into sections according to merit in chemistry. For review of these subjects the class shall be divided into sections according to merit in ethics, etc.

## CHEMICAL PHYSICS, CHEMISTRY, MINERALOGY, AND GEOLOGY.

For instruction in chemical physics and chemistry the second class shall be divided into sections in September according to "general merit," and after the January examination according to merit in chemistry. Par. 58, Regulations, U. S. M. A., 1866.

For instruction in mineralogy and geology the first class shall, in September, be divided into sections according to merit in chemistry. For review of these subjects the class shall be divided into sections according to merit in ethics and law.

## CHEMICAL PHYSICS, CHEMISTRY, MINERALOGY, AND GEOLOGY.

Par. 57, Regula- For instruction in chemical physics and chemistry the second class  
tions, U. S. M. A., shall be divided into sections, in September, according to general  
1873. merit, and after the January examination according to merit in  
chemistry.

For instruction in mineralogy and geology the first class shall be  
divided into sections according to merit in ethics and law.

## CHEMICAL PHYSICS, CHEMISTRY, MINERALOGY, AND GEOLOGY.

Par. 58, Regula- For instruction in chemical physics and chemistry the second class  
tions, U. S. M. A., shall be divided into sections, in September, according to general  
1877. merit, and after the January examination according to merit in  
chemistry.

For instruction in mineralogy and geology the first class shall be  
divided into two equal parts according to merit in law, and each half  
shall then be arranged according to merit in chemistry.

## CHEMISTRY, CHEMICAL PHYSICS, MINERALOGY, AND GEOLOGY.

Par. 58, Regula- For instruction in chemistry, chemical physics, mineralogy, and  
tions, U. S. M. A., geology the second class shall be divided into sections, in September,  
1883. according to general merit, and after the January examination accord-  
ing to merit in chemistry.

## CHEMISTRY, CHEMICAL PHYSICS, MINERALOGY, AND GEOLOGY.

Par. 64, Regula- For instruction in chemistry, chemical physics, mineralogy, and  
tions, U. S. M. A., geology, the second class shall be divided into sections, in September,  
1884. according to general merit, and after the January examination accord-  
ing to merit in chemistry.

## H.

HEADQUARTERS UNITED STATES CORPS OF CADETS,  
*West Point, N. Y., August 24, 1896.*

SIR: In accordance with the provisions of circular letter, dated October 3, 1895, I  
have the honor to submit the following report:

## HISTORICAL SKETCH OF THE TACTICAL DEPARTMENT, ETC.

From the earliest days of the Military Academy, 1802, cadets have received practical instruction in tactics; it was not, however, until many years later that Congress, by act dated June 12, 1858, recognized the department by law, and designated the commanding officer of the corps or battalion of cadets as commandant of cadets and instructor of artillery, cavalry, and infantry tactics.

The following extracts, taken from General Cullum's history of the Military Academy and from other sources, is of interest, and has a connection in showing the development of this department:

"By the law of May 9, 1794, the grade cadet in the Army was first established, 2 being allowed to each company of the corps of artilleryists and engineers. By subsequent acts an increased number was authorized, though none were appointed until May 12, 1800, and but 9 up to the passage of the law of March 16, 1802, fixing the military peace establishment, by which the Corps of Engineers became a separate branch of service and was made 'to constitute a military academy.' This institution was therefore originally designed as a school for the instruction of engineers, was the headquarters of that corps, and the chief was ex officio its superintendent, but as 40 cadets of artillery, as well as 10 of engineers, were attached to it, the interpretation of the law did not circumscribe the function of the academy, which in fact, under engineer administration, became an educational establishment for all cadets of the Army.

"The law of April 12, 1808, authorized 156 additional cadets of artillery, dragoons, infantry, and riflemen, and that of January 11, 1812, provided for 64 more of artillery and cavalry, making a total of 310, which was reduced to 260 by the act of April 29, 1812, reorganizing the Academy.

"The whole number of cadets attached to the institution up to the latter date had been only 117, all of whom except 2 were appointed prior to President Madison's Administration.

"The greatest number in the Academy at any time from 1802 to 1812 was 36, and the average for that entire period did not exceed 20.

"The pay of the cadets at this period was \$10 a month and two rations; the rations were commuted at 27 cents a day, out of which each cadet purchased his food.

"Small messes were formed, and soldiers, hired by cadets, did the cooking.

"In 1805 the first cadets' mess was established, a captain of engineers and acting professor of mathematics supervising and presiding at each meal. This was continued but for a short period, after which and even before this time cadets were boarded at different private boarding houses, where were required to live unmarried officers.

"*Instruction.*—From 1802 to 1812 the term time varied; usually began in April and ended in November; the remainder of the year the cadets were absent. Study hours after 1805 were from 8 a. m. to 1 p. m., 2 to 4 p. m., and in the evening, and drills and practical exercises from 4 p. m. to sunset and occasionally before breakfast.

"The instructors for all purposes at any one time never exceeded four and sometimes were reduced to one. The instruction in infantry included the manual exercise with the musket and the infantry drill extending to the school of the company, the drill with field pieces and mortars, and a little target practice.

"*Regulations.*—The first regulations were made immediately after the opening of the Academy in 1802; were very brief, and adapted to the small requirements of the institution. After an experience of eight years a more extended code was approved April 30, 1810, and this is the basis upon which the school rests to this day. These regulations established 15 to 20 years as the age of entrance; obliged cadets to serve the United States for four years unless sooner discharged; abolished furloughs except during vacations or under peculiar circumstances; prescribed the same uniform for all cadets of the different arms of the service, and ordained minor rules for interior police and discipline. Previous to the adoption of these regulations and between 1802 and 1810 cadets were admitted to the Academy without mental or physical examinations on any day or in any month of the year. Of the small number that were present at any time, some had good preliminary education before coming to West Point; a few were college graduates; one had been an officer in the British army; another had practiced law in the supreme court of New York, and generally they had more knowledge and maturity of mind than those of the present day, but were of all ages from 12 to 34 years, one or two being married men with several children.

"*Quarters.*—Cadets were lodged with soldiers in the old 'Long Barracks' of the Revolution (near the site of the present hotel) and were instructed in a two-story wooden building which served both as an academy and for headquarters.

"*Discipline.*—Little can be said for the discipline during this period, except when personally supervised by Colonel Williams, the superintendent, but when he was out of the service, 1803–1805, and when absent on other duty, 1806–1809, great irregularities took place from want of proper control on the part of the commanding officer, but more because the instructors were all civilians and foreigners.

"July, 1810, no general examination was held and no cadets graduated; a year with that of 1816, which are the solitary blanks in its long existence that the institution did not graduate any cadet. This is the period, on account of no cadets being appointed and the detail of and dispersion of the few that were attached to company and other duties with troops away from West Point, that the Academy as an educational institution practically ceased to exist.

"The law of April 29, 1812, authorized the appointment of 260 cadets and an academic staff. On the last day of September, 1812, there was present only one officer, a captain of engineers, and one new cadet. April 15, 1813, the Military Academy, with less than a dozen cadets, resumed its existence.

"In 1814 a civilian was appointed to take charge of the cadet commons.

"The prescribed uniform at this time was a coat and pantaloons of blue cloth, round hat with black silk cockade and gilt eagle, and Jefferson shoes. The coat was single-breasted, with one row of bullet buttons and a standing collar. The belts were black, and the muskets the same as those used by soldiers, except a lighter one for the small boys. Each cadet was expected to wear a sword, but few possessed the weapon.

"During the summer of 1814 the cadets, under command of the commanding officer of the post and acting superintendent, made an excursion to Governors Island, New York Harbor, and another excursion of three days to New York was made in the summer of 1816.

"The regulations approved July 2, 1816, under the head of military instruction, prescribed infantry and artillery tactics, practical gunnery and camp duties, and broad and small sword exercises.

"Pierre Thomas was the first sword master, appointed in May, 1814. Sword exercise was only given to such cadets as were specially selected.

"The present uniform for cadets, with slight differences, was adopted September 4, 1816.

"During the period from 1812 to July 28, 1817, when Capt. and Bvt. Maj. Sylvanus Thayer was appointed superintendent, the course of instruction prescribed by Regulations was practically ignored, except infantry and artillery drills, which were the acting superintendent's delight, and were well taught by him in person, but were necessarily limited, owing to the small number of cadets to exercise and the few pieces of ordnance for drill and target practice.

"There was no officer designated specially as instructor of tactics prior to 1818. The acting superintendent from 1814 to 1817 was commander, professor teaching all branches then taught, and, when need be, chaplain."

The record history of this department may be considered, properly speaking, to date from the time that Bvt. Maj. and Capt. Sylvanus Thayer assumed command and the superintendency of the Military Academy.

He at once organized the cadets into a battalion of two companies, officered by members of their own body, with a colonel at its head and an adjutant and a sergeant-major for his staff, and appointed an officer of the Army to command the battalion, as instructor of infantry tactics and in soldierly discipline, and was responsible for the interior police and administration.

Second Lieut. G. W. Gardiner, of the Corps of Artillery, was detailed for this duty temporarily September 15, 1817, and was succeeded by Capt. John Bliss, of the Sixth Infantry, April 2, 1818, who was the first commanding officer of the battalion of cadets and instructor of infantry tactics. The position was not known as commandant of cadets until the Regulations of 1825. The Regulations of 1821 provided that a captain or field officer should be detailed as instructor of infantry tactics.

These regulations also provided for the following instruction in this department: The system of infantry tactics established for the Army of the United States and to include instruction in the school of the soldier, school of the company, school of the battalion, and the evolutions of the line, the exercises and maneuvers of light infantry and riflemen; the duties in camp and garrison of privates, noncommissioned officers, and officers, including those of guard and police.

In 1818 the commanding officer of the battalion of cadets was first designated as the inspector of the cadet commons, and the Regulations of 1825 makes him the permanent president of the board to audit the accounts of the cadets' mess and board of inspectors of supplies.

In 1821 was first introduced the study of infantry tactics as a regular course, recitations upon which were held between 2 and 4 p. m., the text-books being the rules and regulations prescribed for the infantry branch of the service.

From 1820 to 1827 there were two assistant instructors of infantry tactics. After that period for a number of years three were authorized, and later, 1852, four assistants were authorized.

July 20, 1821, the corps of cadets made a notable summer excursion to Boston, Mass., under Maj. William J. Worth, the then commandant and afterwards distinguished general. The corps went by steamer to Albany and thence marched to Boston, where they spent two weeks; thence they marched to Providence, R. I., where they spent several days, then resumed the march to New London, Conn., having marched more than 310 miles; thence by steamer to New Haven; after a few days' stay there they

embarked again for New York and by steamer the same day for West Point, N. Y., where they arrived September 25.

The Regulations of 1825 provides for the battalion being divided into four companies, and designates the instructor of infantry tactics and commanding officer of the battalion of cadets as "commandant of cadets," and first mentions the designation of "officer in charge," and defines his duties, which are practically the same as at present. The Regulations also for the first time provides that the corps of cadets shall be divided into as many squads as there are tables in the mess hall, and when the signal for breakfast, dinner, and supper is sounded, these squads will assemble under the direction of the first or second carver, and shall march to the mess hall by the superintendent of the mess hall.

The regulations of 1829 makes the first mention requiring explanations to be submitted for offenses; from this time until 1857 all explanations were required to be submitted in writing. From 1857 until 1866 they were required to be submitted verbally, and if unsatisfactory to the commandant might be submitted in writing. From 1866 until 1892 they were all to be submitted in writing. From 1892 until the present time they may be submitted verbally and in writing; if unsatisfactory to the commandant may be submitted in writing. From the date when written explanations were first required various forms of submitting the excuses have been prescribed. First, the form prescribed that it should be characterized as "offense," then follows the "excuse," later it was known as "delinquency," then follows the "explanation," then as "report," and followed by "explanation;" finally, and at present, the form is that prescribed for official correspondence in the service.

In 1837 the first instructor of cavalry tactics was appointed.

In 1838 the term of service of cadets was increased to eight years, unless sooner discharged.

In 1839 the regulations prescribe that during the encampment cadets of the first class should study the evolutions of the line in the system of infantry tactics prescribed for the Army, and would recite upon and explain the same to the instructor. Also selected portions of the General Regulations of the Army should in like manner be studied and recited upon. This was continued until the summer of 1862.

In 1839 a sergeant and five dragoons were ordered to West Point, N. Y., from Carlisle Barracks to aid in exercises and instruction of cadets in riding. Twelve horses were supplied by the quartermaster's department. The sergeant was discharged the service and, as a civilian, appointed riding master. At this time was also purchased the necessary horses and harness for the light battery. Previous to this time cadets hauled the pieces and carriages about by means of rope harness.

In 1840 it was provided by law that the commander of the corps of cadets should be either the instructor of infantry tactics, of cavalry and artillery, or of practical military engineering.

In 1842 regulations first designated an officer as instructor of artillery and cavalry tactics.

In 1849 the regulations designated the instructor of cavalry as instructor in riding. The riding master disappears in 1852.

In 1852 the register shows the "commandant" and instructor of infantry tactics with four assistant instructors of infantry. In 1857 the regulations provide that at the hour appointed for breakfast, dinner, and supper the companies would be formed and united, and marched to mess hall by senior cadet officer present.

On June 12, 1858, Congress first recognized the title of "commandant of cadets," and provided by law that "the commandant of cadets shall have the local rank and the pay and allowances of a lieutenant-colonel of engineers, and besides his other duties shall be charged with the duties of instructor in the tactics of the three arms of the service."

February 28, 1853: First mention of an officer as instructor in small arms and military gymnastics. The sword master was his assistant. This instruction was discontinued on April 24, 1861.

September 12, 1859: During the five year course, by direction of the Secretary of War, the subjects of strategy, grand tactics, outpost duty, army organization and administration, equitation, veterinary science were transferred to the second class, department of tactics, and the commandant of cadets was directed to prepare a programme for instruction. For want of proper number of assistants in the tactical department the commandant recommended that the subjects strategy, grand tactics, and outpost duty be continued in the first class, department of engineering. This was approved October 20, 1859.

These subjects, together with infantry and cavalry tactics, were taught in the first class course, to include the June examination of 1860; after that time these subjects were discontinued in that class. After the January examination of 1860 the above-mentioned subjects were also taught in the second class, department of tactics, up to and including the June examination of that year. From September, 1860, until May 4, 1861, these subjects were taught in the second class, department of tactics. At the end of this time the course was again changed to four years, and the subjects of

strategy, grand tactics, and outpost duty were transferred back to the first class, department of engineering. The subjects, viz, army organization and administration and veterinary science were dropped. The other subjects were continued in the second-class course.

The text-books at this period were Tactics of Three Arms; Tactics for Garrison, Siege, and Field Artillery; Youatt on the Horse; Mahan's Treatise on Advanced Guards and Outposts; Jomini's Art of War; Thackeray's Army Organization and Administration, and Army Regulations.

While this additional theoretical course was in this department, it was, under the commandant of cadets, taught as follows:

The cavalry assistant taught cavalry tactics, equitation, and outpost duty; the senior infantry assistant taught infantry tactics, strategy, grand tactics, and logistics; the senior artillery assistant taught artillery tactics and army organization and administration.

After May, 1861, and the return to the four-year course, the theoretical branches taught in the department were those described above, and from which there has been but little change to the present day.

In 1863, during the New York riots, there occurred an incident in the history of West Point and of this department which has never been made of record. Rumors reached the authorities of the intention of the disorderly element of New York City to visit and destroy the Cold Spring Foundry, which at that time was the largest establishment for making guns in the country, and at the same time to visit and burn West Point. Ball cartridges were issued to cadets, and the other military resources of the post were at once made use of, including the issuing of arms and performing of guard duty by civilians and employees attached to the Academy. Pickets of cadets, with a field gun at each point, were established at the south and north docks and Gees Point; the river and back roads at challenging intervals were lined with armed sentinels. This state of armed resistance was kept up for several days and nights. No attack was made. From this time dates the present custom of armed sentinels patrolling the post night and day.

In 1873 the corps of cadets took another excursion from West Point to Washington, D. C., absent several days participating in the ceremonies of the second inauguration of General Grant as President, Lieut. Col. and Bvt. Maj. Gen. Emory Upton in command. In 1876 the corps visited Philadelphia, where they spent a week on the occasion of the centennial celebration of the Declaration of Independence, Lieut. Col. and Bvt. Maj. Gen. Thomas H. Neill in command. The corps has in more recent years made other short excursions from West Point for a day or two, and on one rather notable occasion the corps visited the World's Columbian Exposition at Chicago in the summer of 1893, leaving West Point August 17, and returning to West Point August 30, 1893, Lieut. Col. Sam'l. M. Mills in command.

*List of commandants of cadets.*

| Name.                | Rank and regiment.   | Time.          |                |
|----------------------|--|----------------|----------------|
|                      |  | From—          | To—            |
| George W. Gardiner   | Second lieutenant, Corps of Artillery                        | Sept. 15, 1817 | Apr. 2, 1818   |
| John Bliss           | Captain, Sixth Infantry                                      | Apr. 2, 1818   | Jan. 11, 1819  |
| John R. Bell         | Captain, Light Artillery                                     | Feb. 8, 1819   | Mar. 17, 1820  |
| William J. Worth     | Captain, Second Infantry, brevet major                       | Mar. 17, 1820  | Dec. 2, 1828   |
| Ethan A. Hitchcock   | Captain, First Infantry                                      | Mar. 13, 1829  | June 24, 1833  |
| John Fowle           | Major Third Infantry   | July 10, 1833  | Mar. 31, 1838  |
| Charles F. Smith     | First lieutenant, Second Artillery                           | Apr. 1, 1838   | Sept. 1, 1842  |
| J. Addison Thomas    | First lieutenant, Third Artillery                            | Sept. 1, 1842  | Dec. 14, 1845  |
| Bradford R. Alden    | Captain, Fourth Infantry                                     | Dec. 14, 1845  | Nov. 1, 1852   |
| Robert S. Garnett    | Captain, Seventh Infantry, brevet major, U. S. A.            | Nov. 1, 1852   | July 31, 1854  |
| William H. T. Walker | Captain, Sixth Infantry, brevet lieutenant-colonel, U. S. A. | July 31, 1854  | May 27, 1856   |
| William J. Hardee    | Major Second Cavalry, brevet lieutenant-colonel              | July 22, 1856  | Sept. 8, 1860  |
| John F. Reynolds     | Captain, Third Artillery, brevet major                       | Sept. 8, 1860  | June 25, 1861  |
| Christopher C. Augur | Major Thirteenth Infantry                                    | Aug. 26, 1861  | Dec. 5, 1861   |
| Kenner Garrard       | Captain, Fifth Cavalry                                       | Dec. 5, 1861   | Sept. 25, 1862 |
| Henry B. Clitz       | Major Twelfth Infantry                                       | Oct. 23, 1862  | July 4, 1864   |
| John C. Tidball      | Captain, Second Artillery, colonel volunteers, U. S. A.      | July 10, 1864  | Sept. 22, 1864 |
| Henry M. Black       | Major Seventh Infantry, colonel volunteers, U. S. A.         | Sept. 22, 1864 | July 1, 1870   |
| Emory Upton          | Lieutenant-colonel First Artillery, brevet major-general     | July 1, 1870   | June 3, 1875   |
| Thomas H. Neill      | Lieutenant-colonel Eighth Cavalry, brevet major-general      | July 1, 1875   | June 30, 1879  |
| Henry M. Lazelle     | Lieutenant-colonel Twenty-third Infantry                     | July 1, 1879   | Aug. 4, 1882   |
| Henry C. Hasbrouck   | Captain, Fourth Artillery                                    | Aug. 22, 1882  | Feb. 1, 1888   |
| Hamilton S. Hawkins  | Lieutenant-colonel Twenty-third Infantry                     | Feb. 1, 1888   | Sept. 1, 1892  |
| Samuel M. Mills      | Captain, Fifth Artillery                                     | Sept. 1, 1892  | .....          |

The scope of this department in the beginning included infantry tactics, interior police and discipline, and the supervision of the cadet commons. The functions of the department were not appreciably enlarged until the law of 1858, which made the commandant of cadets instructor of tactics in the three arms of the service and increased for the two years following the theoretical course by transferring to this department the subjects heretofore mentioned and taught in the first class, department of engineering.

The commandant of cadets has always had supervision of the instruction in saber and broadsword exercise, the sword master being a civilian. From February 28, 1858, until April 24, 1861, instruction in small arms and military gymnastics was added to this instruction, and a commissioned officer not attached to the tactical department had charge of it. After 1861 this instruction was returned to the commandant of cadets with a civilian as sword master, but without gymnastics. In 1881 an officer of this department reorganized gymnastics at the Academy, which instruction was continued by an officer, the civilian as sword master, until February 1, 1885, when the present incumbent was appointed and has since, under the direction of the commandant of cadets, had charge of all this instruction. This step has been an important and most successful one in the development of this part of the instruction. The department has developed otherwise along the lines of general improvement in military instruction adopted and employed in the service during the past forty years, a description of which would involve the history of these modern methods.

The following are some of the changes made in the methods of administration and changes of regulations with the approval of the Superintendent that have been introduced in the past four years: The assembling of the officers of the department daily in the commandant's office, to hear reports of the previous day; to receive commandant's instructions for the day, interpret regulations so that in all dealings and intercourse with cadets the practice and rulings should be uniform; adjutant excused from making consolidated morning report, but required, before signing, to make note of required data for details, etc.; revised, reduced, and simplified reports and returns required from cadet companies and from headquarters corps of cadets to correspond with army methods and returns; made the salute of cadets to correspond with the drill regulations; revised, rearranged, and indexed interior regulations, known as blue book; extended the hours of commandant of cadets for transacting business with cadets; introduced verbal explanations; introduced new form in submitting written explanations to correspond with the official correspondence found in the service; revised and printed the lectures for second class on subjects modified to read, staff, post, and company administration; promulgated rules and regulations in the use of the gymnasium and natatorium; attached linen collar to dress and fatigue coat with fastenings; modified riding trousers and introduced leggings; discontinued wearing waist belt to church and equipments in quarters at Sunday morning inspection; discontinued the police inspection after reveille and of signing a certificate pertaining thereto; introduced the system of anthropometric records and extended the same to include other classes besides the fourth; reintroduced the battalion color; introduced the regimental drill and parade; cordage and application of tackles for raising heavy weights; during the encampment all drills and instruction, except dancing, to take place in the morning; during the absence of the second class on furlough all appointments of sergeants made from the first class. Experience has thus far confirmed good results from these changes.

#### STATEMENT OF PRESENT COURSE, ETC.

##### THEORETICAL.

*Text-books used.*—Drill Regulations, United States Infantry, Cavalry, and Artillery; Tidball's Manual of Heavy Artillery; Blunt's Firing Regulations for Small Arms; Fitzwagram upon Horses and Stables; Wagner's Service of Security and Information; Guard Manual; Articles of War and United States Army Regulations. Recitations only in first three named, twelve recitations in infantry and ten in artillery; drill regulations between November 8 and December 31, second class year, and twelve recitations in cavalry drill regulations. February, first class year, sections attending in all cases on alternate days. Length of lessons, about 16 pages, and no lessons in review.

The hours of study and recitation are from 11 a. m. to 1 p. m. The length of the recitation is one hour and the total number of hours allowed to each subject, both inside and outside the section room, is 24 for infantry, 24 for cavalry, and 20 for artillery. The course is the same for all sections. Short lectures upon company, post, and staff administration are given to the second class from November 1 to March 15, weekly, half the class attending at a time for one hour.

The lectures, nine in all, are printed and delivered to the class in advance. The lecture is read to the section by the instructor and the hour spent in explaining points

referred to. The lecture is required to be read over carefully by cadets before coming to the lecture room; notes are not taken upon it. The lectures are compilations from Army Regulations and Orders of the War Department, and deal with the following subjects:

1. Instructions of recruiting officers; reports and returns.
2. Company organization; how men are gained and disposed of.
3. Army ration.
4. Company records; reports and returns.
5. Duties pertaining to the quartermaster's department.
6. Subsistence and ordnance departments.
7. Property accountability.
8. Money accountability.
9. Duties of post treasurer and post adjutant; returns and reports; the post exchange.

These lectures, in pamphlet form, are subsequently and before graduation given to the class to carry into the service.

Three lectures are given to the first class by the senior assistant instructor of cavalry in latter part of June and in connection with field exercises during that period.

The following subjects are treated: Preparations for field service; marching and camping; bits and biting (illustrated); stable management; the horse's foot, shoeing; common diseases of the horse; the conformation and points of the horse; the age of the horse as indicated by the teeth, and packing the Moore pack saddle.

Instructions are also given to members of the first class as to the proper method of making out the daily reports of a company.

In addition to the above one hour is spent daily in camp during latter half of June, when there is but little practical work, in readings and explanations of the guard manual, Articles of War, and regulations upon the police and government of cadets in camp, based upon Army Regulations.

#### PRACTICAL WORK CONTINUES DURING THE FOUR YEARS.

*First year.*—First three weeks, school of the soldier, settings up, manual, and exercises of the squad; three drills daily. Thereafter, and until the new class is sufficiently advanced to become part of the battalion (a period of about two weeks), two drills daily. In camp, from June 30 to August 28, practical instruction in military police and camp discipline. Practical instruction in guard duty from about July 4. From July 5 to August 28, artillery drill each week day, one hour; school of the cannoneer; siege and mortars on alternate days; swimming for one hour, until all the class have qualified—qualification consists in the cadet being able to swim at least ten minutes with chest stroke; infantry drill three-fourths of an hour daily, except Saturday and Sunday, in August, school of the company. September: Infantry drill, school of the company, battalion, and regiment. October: Infantry exercises of the squad in extended order half the month; the remaining half school of the cannoneer, siege and mortar drill, and pointing and aiming drills, small arms. March 15 to 31: Infantry, school of the company. April: Infantry, extended order, use of cover and battle exercises of the squad, and school of the cannoneer, siege and mortar drill. May: Infantry, school of the company and battalion, close and extended order. From October 1 to June 1, three-fourths of an hour daily in the gymnasium, Sundays excepted, use of the sword and bayonet, and military gymnastics.

*Second year.*—In camp June 15 to August 28; practical instruction in guard duty, etc., same as in first year; after July 4, instruction in small arms, gallery practice; artillery drill, school of the cannoneer; instruction in cordage; infantry, school of the company same as first year. Drill masters for the fourth class squads and gunners and chiefs of detachment for fourth class batteries. September: Infantry, school of the company, battalion and regiment. October: Heavy artillery, seacoast battery; squad leaders for fourth class squads, extended order and instruction in small arms; range practice. November 1 to March 15: Riding, school of the trooper on alternate days. March 15 to 31: Same as first year. April: Same as October. May: Same as first year.

*Third year.*—September: Same as first and second years. October: School of the cannoneer, light artillery. November 1 to May 1: Cavalry, school of the trooper, troop, and squadron. March 15 to 31: Infantry, same as in first and second years. April: Artillery, same as October. May: Same as first and second years.

*Fourth year.*—In camp June 15 to August 28. Cavalry exercises, advance and rear guards and outposts, latter half of June. Instructions as to the method of giving commands. Practical instruction in heavy artillery, mechanical maneuvers, use of blocks and tackles and in light artillery, school of the battery. Infantry drill, August, as in first and second years and as officers, noncommissioned officers, and guides of companies. September: Infantry, as in other years. October: Light artillery, school of the battery. September to June: Cavalry, school of the trooper,

troop, and squadron. March 15 to 31: Infantry, as in other years. April: As in October, and infantry extended order, battle exercises. May: As in other years. Practical instruction throughout the year in the exercise and responsibilities of command as officers and noncommissioned officers in camp, in charge of subdivisions in barracks and in command of companies at infantry drill, and of various detachments at artillery and cavalry exercises.

The members of the class before graduation are sent to visit the squad rooms and stables of the cavalry detachment to see the manner in which enlisted men are quartered and cared for.

#### ORGANIZATION OF THE DEPARTMENT.

The department as now organized has charge of all strictly military drills and exercises and military gymnastics, including the sword and bayonet. The personnel is as follows:

A commandant of cadets with the rank of lieutenant-colonel. He is in immediate command of the corps of cadets, the instructor of tactics, inspector of the cadets' mess, president of the board of inspectors of supplies for cadets, and in charge of the police, discipline, and administration of the corps.

One senior assistant instructor of cavalry tactics, usually a captain, member of the board of inspectors of supplies for cadets.

One senior assistant instructor of artillery tactics, usually a first lieutenant. He is under the commandant, the inspector of clothing for cadets.

One senior assistant instructor of infantry tactics, usually a first lieutenant.

Four assistant instructors of tactics, commanding the cadet companies, lieutenants.

One assistant instructor in cavalry, lieutenant.

An instructor of military gymnastics and use of the sword and bayonet, civilian; appointed permanently.

The senior assistant instructor in cavalry and assistant take all the drills in riding.

The infantry and artillery drills are divided as nearly as possible equally among the other officers of the department.

The instructor in military gymnastics, etc., has charge also of the exercises in swimming.

The four assistant instructors, commanding cadet companies, conduct the infantry drills of their companies and are responsible for the ordnance equipments issued to them. They are also under the regulations of the Academy and instructions from the commandant, directly in charge of the police and discipline of the companies. They are required to make inspections of their companies at least twice daily before taps, both in camp and in barracks, with frequent inspections after taps. The official papers of the companies pertaining to delinquencies, privileges, etc., pass through their hands.

All the officers of the department, except the head and the senior in cavalry, form a roster for "officer in charge." This officer is the executive head of the department for the day, and represents the commandant in his absence.

#### DESCRIPTION AND RECITATION; CLASS REPORTS; TRANSFERS, ETC.

For recitation the classes are divided into sections, and the system of instruction marking, etc., conforms to the practice of the other academic departments. Weekly class reports and exhibition of marks the same. Transfers are rarely made on account of the small number of recitations.

#### EXAMINATIONS, WEIGHT OF, ETC.

The examinations are written. The standard required for proficiency conforms to that prescribed in other departments. The subjects (drill regulations for the three arms) in which recitations are prescribed have a total weight of 100 in the general merit roll of the class.

#### CRITICAL REVIEW OF THE PRESENT COURSE, METHOD OF INSTRUCTION, ADVANTAGES, ETC.

The present course designs to give to the cadet the elements of a military education, as comprehended in the drill regulations of the three arms of the service and in the other manuals and lectures referred to in the theoretical course; and in the practical work to impress upon him a thorough knowledge and appreciation of discipline and of military police, both in barracks and in camp; to educate him in the important qualities of attention to detail and of promptness in all his work; to give him the physical training necessary for the work and hardships he may be

called upon to endure; and, in conjunction with the other departments, to instill into his mind during his four years at the Academy a proper spirit of subordination and obedience to authority and to develop his confidence and capacity for command.

The physical training, so far as it relates to work in the gymnasium, aims at the following results:

1. To counteract by judicious and well-regulated exercise the immense mental strain which the successful mastery of the academic course makes necessary;
2. To improve the physical and general carriage, develop strength, health, and endurance, and
3. To develop agility, activity, and grace; also self-reliance, self-control, precision, and accuracy.

These results are accomplished by a thorough system of progressively arranged exercises, from which are excluded all movements of questionable value, and every one in the execution of which the element of danger is involved.

At the beginning of each year every cadet is measured in accordance with the rules prescribed by the American Association for the Advancement of Physical Education. These measurements, nearly 60 in number, are compared with those of the average student of the same age; the weak points are noted, and directions given as to how they may be strengthened. Only members of the fourth class attend the regular drills, but the above measurements are made for cadets of every class and the members of the upper classes are encouraged to avail themselves of the opportunity the gymnasium affords.

Each class spends three of the four summers in camp, a total of about two hundred and ten days. The remainder of the four years, with the exception of two and one-half months on furlough at the end of the second year, is spent in barracks.

The cadets are organized, under regulations prescribed by the Superintendent, into a battalion of four companies, each company composed of fractions of all four classes. The cadet officers for the companies, with an adjutant and quartermaster for the battalion, are selected from the first class. The noncommissioned officers from the second and third classes. The selections are made by the Superintendent, upon the recommendation of the commandant, from "those cadets who have been most studious, soldier-like in the performance of their duties, and most exemplary in their general deportment."

The companies have separate quarters in barracks, separate tents and company streets in camp, and separate tables at meals.

The tents used in camp are the regulation wall tents with flies. Two cadets live in each tent, except members of the fourth class, most of whom live three in a tent.

Two cadets live in a room in barracks.

Cadets are allowed in camp only the minimum of bedding, clothing, etc., needed for the climate and season and consistent with a neat and soldierly appearance at all times.

The commandant of cadets and the four assistant instructors of tactics, with an assistant surgeon, live in camp.

All regular drills in camp are finished before 1 p. m. During the academic term, the practical work in the department is done between the hours of 4 and 6 p. m., with the exception of a portion of the cavalry exercises and the military gymnastics.

Two dress parades are held daily in camp, at troop and retreat, except on Saturday, when the troop parade is replaced by an inspection.

One dress parade is held daily while in barracks, at retreat, except on Saturday, when it is replaced by an inspection at 2 p. m.

A complete guard is maintained at all times in camp and the instruction in this duty is most thorough. During the term in barracks a guard is posted in the divisions of barracks during study hours in the evening only to preserve quiet and to prevent cadets from visiting or from leaving the barracks without authority.

The companies are practiced with the fire engine and apparatus one week each autumn, and are turned out for service whenever the emergency justifies it.

Cadets are formed by companies, classes, details, or sections, and the rolls called for all drills and exercises and for marching to meals and to recitations. Reports of all roll calls are rendered to the cadet officer of the day, whose duty it is to promptly investigate every case of absence reported to him.

Regulations are prescribed by the commandant of cadets, approved by the Superintendent, upon the arrangement of rooms in barracks, tents, in camp methods of conducting official correspondence, uniform for drills, privileges and minor duties of cadets, to more fully carry out the regulations of the Military Academy, these regulations are bound in small book form and issued one copy to each cadet.

The method of instruction, broadly stated, may be said to be based upon the principle of requiring each cadet to learn by actually performing them all the duties of a private soldier in the different arms of the service, beginning with the drill of the recruit, and thereafter the duties of the different grades of noncommissioned officer and of an officer, in so far as the conditions surrounding the course will permit.

Each cadet has at some time during the course the opportunity of exercising command in all the grades of noncommissioned and commissioned officer up to and including that of captain of a company. The method is progressive and follows the logical principle of assigning to a cadet supervision and command in any drill or exercise as soon as practicable after he has himself become proficient in it. To illustrate, the third class furnishes the drillmasters for the fourth-class squads, school of the soldier. These in their work are supervised by cadet officers of the first class and these latter receive their instructions from a commissioned officer, who has general charge of the drill. Thus does the cadet have combined, almost from the beginning of his course, the practice of command and the exercise of authority in drills in which he has become proficient, along with the work and instruction in drills not yet mastered; the proportion in the former division increasing naturally up to his graduation.

The officers of the department are assembled daily by the commandant to receive any instructions he may desire to give them upon the drills and duties of the day; to hear reports and observations of the previous day; to point out and correct errors if any have been made; to interpret tactical and other doubtful points, and to adopt absolutely uniform teaching and practice, so that all cadets, though the battalion be divided for purpose of administration into four companies, shall receive the same and uniform instruction throughout, so far as it is practicable. This supervision of the daily work is a feature introduced by the present head of the department, and has been of incalculable benefit, enabling the commandant through these means to keep closely in touch with every phase of discipline and instruction. This system, together with the more recently adopted provisions of permitting cadets to submit verbal explanations, gives the commandant an opportunity of personally coming in contact with every cadet in the corps and of learning his character and special aptitude for his work, to correct and point out to him the true and proper direction of his line of duty and its connection with the duties that may devolve upon him as an officer.

It is thus by constantly and unceasingly, patiently and earnestly placing before the cadet his obligations to duty and impressing upon him the qualities of mind and character that constitutes the highminded, truthful, and conscientious officer, that the commandant of cadets, in my judgment, fulfills the most important part of his many responsible duties.

Very respectfully,

SAML. M. MILLS,

*Lieutenant-Colonel and Commandant of Cadets.*

THE ADJUTANT UNITED STATES MILITARY ACADEMY.

## I.

DEPARTMENT OF MODERN LANGUAGES,  
UNITED STATES MILITARY ACADEMY,  
*West Point, N. Y., July 1, 1896.*

SIR: In accordance with letter of instructions dated headquarters United States Military Academy, West Point, N. Y., October 3, 1895, I have the honor to submit the following report for the department of modern languages:

### HISTORICAL SKETCH OF THE DEPARTMENT.

The department of modern languages was established by the act of Congress of June 23, 1879, making appropriations for the support of the Army for the fiscal year ending June 30, 1880, which provided that when a vacancy occurs in the office of professor of the French language or in the office of professor of the Spanish language in the Military Academy, both these offices shall cease, and the remaining one of the two professors shall be professor of modern languages, and thereafter there shall be in the Military Academy one, and only one, professor of modern languages.

By the retirement of Prof. Patrice de Janon, professor of the Spanish language, on June 30, 1882, and in accordance with the provisions of the foregoing act of Congress, Prof. George L. Andrews, professor of the French language, became professor of modern languages. The department of modern languages, therefore, dates from June 30, 1882.

As the present department was established by the absorption of the department of the Spanish language by the department of the French language, its history will require a history of the two latter departments.

## DEPARTMENT OF THE FRENCH LANGUAGE.

This department was established by virtue of the act of Congress, approved February 28, 1803, which provided that the President of the United States be, and he is hereby, authorized to appoint one teacher of the French language and one teacher of drawing, to be attached to the Corps of Engineers, whose compensation shall not exceed the pay and emoluments of a captain in the Army. Section 27 of the act of Congress, approved March 16, 1802, had provided that the said Corps of Engineers, when so organized, shall be stationed at West Point, in the State of New York, and shall constitute a Military Academy.

The act of Congress, approved April 29, 1812, which definitely established the Military Academy, provided that the Military Academy shall consist of the Corps of Engineers and certain professors, in addition to the teachers of the French language and drawing already provided:

Under the provisions of the act of Congress of February 28, 1803, Francois Désiré Masson, a native of France, was appointed teacher of the French language July 12, 1803, and was succeeded by his brother, Florimond Masson, April 15, 1810. On the resignation of the latter, January 3, 1815, Claudius Berard, a native of France, was appointed teacher, and as teacher and professor was the head of the department for thirty-three years. The above constituted the teaching force of the department from February 28, 1803, until March 1, 1818, on which date Joseph Du Commun was appointed second teacher of the French language. The office of second teacher was not created by act of Congress, as had been the case with that of teacher, but the appointment was made March 1, 1818, by virtue of an order of the Secretary of War in February, 1818. Pay, however, was appropriated for the second teacher of the French language in the successive appropriation bills for the support of the Military Academy, and it might therefore be said that the existence of the office was sanctioned by Congress. From March, 1818, the two teachers were designated in the regulations and registers of the Military Academy as first teacher and second teacher, respectively, the first teacher being the head of the department. In 1846 the head of the department was made professor by virtue of an act of Congress approved August 8, 1846, which provided that the teacher of drawing and the first teacher of French at the Military Academy shall hereafter be, respectively, professor of drawing and professor of the French language.

The remaining teacher (Hyacinthe R. Agnel) was, however, still designated as second teacher until his appointment, May 16, 1848, as professor of the French language, to succeed Professor Berard, who died May 6, 1848. From May 16, 1848, no more teachers were appointed.

The teaching force of the department from March, 1818, until the appointment of Professor Berard as professor in 1846, consisted of the two teachers, permanent officers of the Military Academy, and such number of officers of the Army and cadets as was deemed necessary detailed as assistants in the department.

In the early part of this period recommendations and efforts were made at several times for the appointment of an additional teacher of the French language, but Congress failed to create the office. These recommendations were evidently based on the belief, quite prevalent in that day, that instruction in French should be given by a native of France. In accordance with this belief, Théophile d'Orémicux, a native of France, was appointed an officer of the Army, receiving the commission of second lieutenant, First Infantry, and detailed as an assistant in the department. He resigned December 8, 1856, having risen to the rank of captain, though serving continuously at the Academy and in the department. Since December 8, 1856, the assistants in the department have invariably been officers of the Army detailed for that purpose, except in some years when cadets were detailed in addition to the officers already serving as assistants. In 1860 the head of the department, Professor Agnel, in his statement to the Congressional committee of that year, gave strong reasons in favor of having officers of the Army as instructors in preference to having natives, his reasons having been based both on his experience and on theory.

During the period above mentioned (from 1818 to 1846) the officers and cadets detailed as assistants in the department were designated as assistant teachers. From 1848, the date of the appointment of the second teacher as professor, the senior officer was designated as assistant professor and the others as acting assistant professors. Professor Agnel served as the head of the department from the date of his appointment as professor, May 16, 1848, to his death, February 10, 1871, thus having a service as professor of twenty-three years; or including his service as second teacher from February 4, 1840, the date of his appointment, a total of thirty-one years' service in the department. He was succeeded by George L. Andrews, brigadier-general and brevet major-general of volunteers, a distinguished graduate of the Military Academy, who was appointed professor February 28, 1871, and who served as head of the department until its incorporation with the department of the

Spanish language June 30, 1882. He then became the first professor of modern languages and served as head of that department until he was retired August 31, 1892, thus having a total service in the departments of the French language and of modern languages of twenty-one years.

He was succeeded by the undersigned, who was appointed professor of modern languages October 1, 1892.

The following table gives the different heads of the department from its organization in 1803:

| Appointment and name.                                | Army rank when appointed.           | Term of service. |               | Remarks.                               |
|--|-------------------------------------|------------------|---------------|--|
|  |                                     | From—            | To—           |  |
| DEPARTMENT OF FRENCH.                                |                                     |                  |               |  |
| <i>First teachers. (a)</i>                           |                                     |                  |               |  |
| 1. F. D. Masson.....                                 |                                     | July 12, 1803    | Apr. 15, 1810 | Resigned.<br>Appointed profes-<br>sor. |
| 2. Florimond Masson.....                             |                                     | Apr. 15, 1810    | Jan. 3, 1815  |  |
| 3. Claudius Berard.....                              |                                     | Jan. 3, 1815     | Aug. 8, 1846  |  |
| <i>Professors. (b)</i>                               |                                     |                  |               |  |
| 4. Claudius Berard, First Teacher of French.....     |                                     | Aug. 8, 1846     | May 6, 1848   | Died.                                  |
| 5. Hyacinthe R. Agnel, Second Teacher of French..... |                                     | May 16, 1848     | Feb. 10, 1871 | Do.                                    |
| 6. George L. Andrews.....                            | Brevet major-general of volunteers. | Feb. 28, 1871    | June 30, 1882 | Professor of modern languages.         |
| DEPARTMENT OF MODERN LANGUAGES. (c)                  |                                     |                  |               |  |
| <i>Professors.</i>                                   |                                     |                  |               |  |
| 7. George L. Andrews, professor of French.....       |                                     | June 30, 1882    | Aug. 31, 1892 | Retired.                               |
| 8. Edward E. Wood.....                               | Captain, Eighth Cavalry.            | Oct. 1, 1892     |               |  |

a The teachership of French, created by law of February 28, 1803.

b The professorship of French, created by law of August 8, 1846.

c The professorship of modern languages, created by law of June 23, 1879; went into effect June 30, 1882.

TIME ALLOTTED TO INSTRUCTION IN THE FRENCH LANGUAGE.

Owing to the lack of complete records relating to the early years of the Military Academy, I am unable to give with exactness and certainty the amount of time allotted to instruction in the French language previous to 1824. From 1803 until 1812 it seems that there were no annual classes. Cadets remained at the Academy for different periods, varying from six months to six years, before they were graduated, the length of time depending upon their previous preparation and upon their capacity. The teaching appears to have been mainly individual, and some cadets supplemented it by private lessons. The French language seems to have been practically a voluntary study, as it was not a requisite for graduation, as appears from the fact that in some years the examinations therein were passed over for the reason that all the cadets had not had the same advantages with respect to their acquirements on entering the Academy. With reference to the hours of recitation, the only information thereon I have been able to obtain is that in 1805 recitations in French were from 11 a. m. to 1 p. m. (probably recitations of one hour), and alternated with drawing, the teacher of French having, at that time, charge of the instruction in the latter branch until the appointment of a teacher of drawing.

Although in the reorganization of the Military Academy in 1812 provision was made for annual classes, and for examinations for passing into the next class and for graduation, yet it does not appear that these provisions were rigidly and systematically carried out until 1817. From the above it should seem that the results of the instruction in French before 1817 could not have been uniformly satisfactory, and it has been stated that, at the examination in 1817, but few cadets could translate with tolerable facility the easiest French author.

From 1817 dates the definite establishment at the Military Academy of annual classes, of uniform and systematic instruction, of regular allotments of time, and of examination for passing from class to class and for graduation.

The earliest official record of a recommended allotment of time to instruction in the French language appears in the report of the academic board made July 1, 1816, which states what should be considered as a complete course of education at the Military Academy. In this report it is recommended that French be studied the

first year (fourth class) in connection with English, and that it be completed the second year (third class). The number of recitations or hours of recitation are not given, but if, as is probable, it was intended that French should alternate with English in afternoon hours of recitation for the first year (fourth class), and that it should have daily recitations in the forenoon in the second year (third class), it would give about 310 recitations of one hour each. I have been unable to ascertain whether this proposed allotment of time went into effect or not. If so, it was changed by the year 1820. A committee of the academic board had been appointed March 1, 1819, to revise the course of studies at the Military Academy, and submitted its report January 29, 1820, in which it recommended that the French language should be taught daily during five days of the week for the first two years (third and fourth classes). This would give about 360 recitations. In a communication to Congress from the honorable Secretary of War, dated February 28, 1820, he incloses a report from the Superintendent of the Military Academy on the course of studies etc., in which two additional teachers of French are recommended. If they were granted, daily attendance in French during the first year (fourth class) and alternately during the second year (third class) would be sufficient, but with an insufficient number of teachers for the two largest classes at the Academy it would require daily recitations for two years.

In 1824 the records show that the allotment of time to instruction in the French language was as follows: Daily recitations during the first year (fourth class) of one hour each, from 2 p. m. to 4 p. m.; daily recitations during the second year (third class) from 12 m. to 1 p. m., being a total of about 400 recitations.

In 1826 this was changed, and the allotment of time was as follows: Daily recitations during the first year (fourth class) of one hour each, from 2 p. m. to 4 p. m.; recitations of one hour each from 11 a. m. to 1 p. m., alternating with English or history in second year (third class), being a total of about 290 recitations.

This allotment of time remained in force until 1845, when it was changed to the following: In the first year (fourth class) recitations of one hour each from 2 p. m. to 4 p. m., from January to June, alternating with English or history; daily recitations of one hour each during the second year (third class) from 11 a. m. to 1 p. m., being a total of about 272 recitations.

A letter from the inspector of the Military Academy dated July 5, 1854, was laid before the academic board at its meeting July 8, 1854, in which the opinion of the board was desired on an arrangement of studies for a five years' course, the Secretary of War being desirous of adding a fifth year. The letter laid down certain considerations to be observed, among which were "(2) No more time to be given to French than at present; (5) the introduction of the Spanish language."

This letter was referred to a committee of the board, which submitted its report July 28, 1854. This report, which was adopted by the academic board and approved by the Secretary of War, recommended the following allotment of time to the French language: To begin the second year (fourth class) and to have during that year daily recitations of one hour each, from 2 p. m. to 4 p. m.; in third year (third class) to have recitations of one hour each, from 11 a. m. to 1 p. m., alternating with Spanish from September to January. This gave a total of about 238 recitations.

The arrangement of studies for the five years' course went into operation September 1, 1854; but as French began the second year, the above allotment of time for instruction therein did not take effect until September 1, 1855.

At a meeting of the academic board held August 30, 1858, a letter from the inspector of the Academy was laid before it, stating that the Secretary of War favored a return to the four years' course, and directing a report and programme of studies to be submitted therefor. The programme submitted allotted the same amount of time to French that it had before the five years' course was adopted—that is, 272 recitations.

The Secretary of War having suggested, among other modifications, that French might be omitted from the fourth class course, leaving it with about 218 recitations, the academic board recommended that French be retained in the fourth class on account of the importance of the language, and also on account of its being one of the best exercises for precision in the use of language, because of the remarkable care of its structure and the exact signification of its words received from some of the most acute minds and lucid writers. On account of the above reasons and also from the difficulties attending its acquirement and the lack of preparation in any language on the part of most of the cadets, less time than proposed (272 lessons) should not be allotted to it.

By direction of the Secretary of War, the five years' course was reduced to one of four years, May 22, 1861. By the programme of studies that was drawn up in accordance with the above order, the allotment of time to French was the same as submitted in 1858, namely, in the first year (fourth class) recitations of one hour each, from 2 p. m. to 4 p. m., from January to June, alternating with English; in the second year (third class) daily recitations of one hour each, from 11 a. m. to 1 p. m., being a total of about 272 recitations.

By the act of Congress approved June 16, 1866, candidates for admission to the Military Academy were required to have, in addition to the previous requirements, a knowledge of the elements of English grammar, of geography, and of history; in consequence, August 31, 1866, the academic board was directed to modify the programme of studies so as to meet the requirements of the above act. The programme adopted and approved went into operation July 1, 1867. It omitted English studies and allotted to the French language the following amount of time: Daily recitations of one hour each during the first year (fourth class) from 2 p. m. to 4 p. m.; recitations of one hour each from 11 a. m. to 1 p. m., alternating with Spanish, in second year (third class), being a total of about 290 recitations.

English studies were restored in 1877, and during the academic year from September, 1877, to June, 1878, 60 lessons were given to the study of the English course; these 60 lessons were taken from the time allotted to French, so that during this year the number of recitations in French was about 230.

On the recommendation of the academic board at its meeting of June 11, 1878, approved by the Secretary of War, June 18, 1878, the department of the French language was charged with the instruction in English studies. The allotment of time to French was modified accordingly, June 25, 1878, and modified as follows: In first year (fourth class), from January to June, three recitations per week of one hour each from 2 p. m. to 4 p. m.; in second year (third class), daily recitations of one hour each from 11 a. m. to 1 p. m., being a total of about 280 recitations. This allotment of time continued in force until the consolidation of the department of the French language and the department of the Spanish language into the department of modern languages, June 30, 1882.

The following table gives the various changes in the time allotted to instruction in the French language until June 30, 1882, the allotments previous to 1824 being either unknown or considered as probable; from 1824 they are taken from records:

| From—  | To—    | Recitations (one hour each).   | Number and hours. |       | Preparation—time of study at quarters (two hours per lesson). |
|--------|--------|--|-------------------|-------|---|
| 1803   | 1817   | Not known.   |                   |       |   |
| 1817   | 1820   | Probable; first year (fourth class), recitations in afternoon, alternating with English.<br>Second year (third class), recitations daily in forenoon.  | 90<br>220         | } 310 | 620   |
| 1820   | 1824   | Probable; first year (fourth class), recitations daily five days per week.<br>Second year (third class), recitations daily five days per week.   | 180<br>180        |       |   |
| 1824   | 1826   | First year (fourth class), recitations daily in afternoon.<br>Second year (third class), recitations daily in forenoon.  | 180<br>220        | } 400 | 800   |
| 1826   | 1845   | First year (fourth class), recitations daily in afternoon.<br>Second year (third class), recitations in forenoon, alternating with English or history.   | 180<br>110        |       |   |
| a 1845 | a 1855 | First year (fourth class), recitations from January to June in afternoon, alternating with English studies.<br>Second year (third class), recitations daily in forenoon.   | 52<br>220         | } 272 | 544   |
| a 1855 | a 1861 | Five years' course adopted in 1854; went into effect in French, September 1, 1855. Second year (fourth class), recitations daily in afternoon.<br>Third year (third class), recitations from September to January in forenoon, alternating with Spanish. | 185<br>53         |       |   |
| a 1861 | b 1867 | Four years' course; first year (fourth class), recitations from January to June in afternoon, alternating with English.<br>Second year (third class), recitations daily in forenoon.   | 52<br>220         | } 272 | 544   |
| b 1867 | a 1877 | First year (fourth class), recitations daily in afternoon.<br>Second year (third class), recitations in forenoon, alternating with Spanish.  | 180<br>110        |       |   |
| a 1877 | a 1878 | During this period 60 lessons were given to English studies from French.   | 230               | 230   | 460   |
| a 1878 | c 1882 | First year (fourth class), from January to June, three recitations per week in afternoon.<br>Second year (third class), recitations daily in forenoon.   | 60<br>220         | } 280 | 560   |

a September 1.

b July 1.

c June 30.

## INSTRUCTION, TEXT-BOOKS, ETC.

As before stated, but little is known concerning the amount and kind of instruction in the French language previous to 1817. The division of the cadets into annual classes was not strictly observed even after 1812, nor were examinations for passing from one class to another or for graduation systematically required. As stated, the examinations in French were sometimes passed over on the ground that the cadets were not on an equality as regards knowledge of the language when they entered the Academy. As a result, the study of the language with respect to application must have been practically voluntary. The amount of instruction appears to have varied according to the capacity and previous knowledge of the cadet and to have been mainly individual in its character. In some cases it was supplemented by private tuition. The only definite information I have been able to obtain concerning the kind of instruction is that about 1814 it consisted in reading aloud for the pronunciation and accent, and in writing from dictation for the orthography. There was but one teacher for all the cadets undergoing instruction in French. His vernacular being that language, the embarrassment and difficulties experienced by the learner from differences of construction and analysis would neither be appreciated nor removed. As a result of the above circumstances, the examination in 1817 appears not to have been satisfactory.

The only information that I have been able to obtain concerning the text-books during this period is that Masson's French Grammar and Masson's French Reader were used in 1814.

Systematic instruction, regular allotment of time, requirement of examinations, and division of classes into sections for recitation date from 1817.

March 1, 1818, a second teacher of French was provided, and from that date until the establishment of a professorship of French, August 8, 1846, the instruction was given by the two teachers, supplemented by the detail of such number of officers and, at times, cadets as was required. From 1846, or rather from the appointment of Second Teacher Agnel to the professorship of French, May 16, 1848, the assistants of the head of the department were officers of the Army, supplemented at times by cadets detailed as instructors.

Previous to the January examination in 1821 the third and fourth classes in French were examined together, the sections being numbered consecutively throughout the two classes. Beginning with the above-named examination and down to the present day, the two classes have always been examined separately, the sections being numbered consecutively in each class.

The earliest record of what was considered to be the requirements of a course of French at the Military Academy is found in the report made by the academic board, July 1, 1816, which states as follows: A course of French shall consist in pronouncing the language tolerably, and translating from French into English, and from English into French, with accuracy.

January 29, 1820, the academic board adopted the report of the committee appointed March 1, 1819, to revise the course of studies. This report stated the requirements of the French course to be as follows: The course of French shall consist in teaching to pronounce that language tolerably, to read and translate French into English, and to convert English into French. The elementary instruction in this department will be conveyed nearly in a like manner to all the sections. An extent of French reading, however, will be admitted in the higher sections proportional to their progress and capacity.

The system of relative weights to be given the different subjects of instruction at the Military Academy was first adopted June 2, 1818. The weight given to the French language was 1, that of mathematical studies being 2.

The earliest official record of the text-books used in the department is that for the year 1821-22. The text-books in use at that time were as follows: In the first year, or fourth class, Wonostrocht's French Grammar, Murray's *Lecteur Français*, and *Gil Blas* (Vol. I); in the second year, or third class, Wonostrocht's French Grammar, *Lecteur Français*, *Gil Blas* (Vols. II, III, IV), and Voltaire's *Charles XII*. Under the two general heads of grammars and of readers the above text-books were changed at varying intervals. A complete list of the various text-books used in the department from 1821 to 1882 is given below.

The following programme of the course in French and requirements thereof was adopted by the academic board at its meeting, March 13, 1840:

1. The elements of pronunciation, so as to impart a thorough knowledge of all the sounds of the language.
2. Reading with a correct pronunciation and the proper modulation of the voice.
3. French grammar in its general principles and particular rules.
4. Exercises in English translated into French on the blackboard, so as to reduce all the rules of the language to familiar practice.
5. Reading and translating into English the whole of the *Leçons Françaises* and as many volumes of *Gil Blas* as the capacity and progress of the pupils will allow.

6. Translating into French Murray's English Reader.

N. B.—This last exercise is now (1840) confined to the first section of the third class.

7. Speaking French. This can not be done except with the upper sections of the fourth and third classes.

In 1853 the requirements were as follows: French grammar; reading French with a correct pronunciation; translating English into French and French into English accurately.

In 1882, when incorporated with Spanish, the requirements were as follows:

*French language.*—Grammar; reading and writing French; translating (from text and orally) English into French and French into English.

From between 1817 and 1821 up to 1859 instruction was imparted by lessons assigned in the grammar and in the reader, the lessons varying in length and difficulty proportionate to the progress and capacity of the cadet. This progress and capacity would be indicated by the number of his section. During the recitation of one hour certain members of the section would be given subjects in the grammar lesson, comprising rules and principles and their application by illustrative exercises, to be put upon the blackboard and explained and recited upon orally. The remaining members of the section would be called upon to read the reading lesson, reading aloud as much of the French text as the time permitted and then giving the English translation, either literal or free, as might be required. A due alternation was observed in assigning subjects in grammar and in reading. Pronunciation was acquired by the information imparted therein, and by the practice in reading and in oral recitation.

In 1842 an attempt was made to introduce a course of military reading by the adoption of Rocquancourt's Cours Élémentaire d'Art et d'Histoire Militaire as a text-book in the department, but the committee of the academic board reported against it March 1, 1842, on the ground that its style had not sufficient variety, being only an enumeration of military events, and that it presupposed on the part of the student too great a knowledge of military matters and extensive reading; that literary works best possess the qualifications for studying a language.

In 1849 a verb book (Bolmar's) was adopted and used until 1872, which, from its clear and systematic arrangement and explanation of French verbs, both regular and irregular, greatly facilitated the instruction in that difficult subject.

In addition to the text-book used as a grammar, Agnel's Elementary and Practical French Tabular System was adopted in 1859 and used until December 14, 1883, when it was discontinued on account of being out of print. This most valuable and useful text-book, entirely original in method and scope, was devised and written by Prof. H. R. Agnel, then head of the department. It had for its object the methodical classification of the defining words of the language, the important subject of the place and order of personal pronouns, a scheme of derivation for the ready use of regular and irregular verbs, the use of the past tenses of the indicative, the difference between French and English prepositions, the use of the subjunctive mood, and a course of idioms; the whole so framed as to harmonize with the portion of the grammar rules and exercises studied simultaneously with the tables during the whole course of instruction. Each table as successively studied was written out on the blackboard by the cadet from memory, recited upon and explained by him thoroughly in all its bearings. The practical exercises for each table, arranged in the form of question and answer, were translated into French and written out in exercise books by the cadet while studying in quarters. These exercise books were then given to the instructor of the section, who corrected the exercises and returned the book to the cadet. From 1872 these exercises were written upon the blackboard during recitation and recited upon orally.

After the introduction of the tabular system the cadets when writing a French verb were required to write in addition its primitive tenses.

A detailed programme of the course of instruction in the French language in 1859 is given in the appendix and marked A.<sup>1</sup>

This programme, though it gives the respective lessons and course of instruction for 238 lessons only, which was the allotment during the five years' course at the Academy, was yet practically the same until 1872. The text-books remained, with the exception that a second course of idioms was added in 1867, the same as given in the programme, and the only difference was the natural enlargement of the course arising from the change from 238 lessons to 272 and 290 lessons.

After Professor Andrews became head of the department, February 28, 1871, many changes were made in the text-books previously used, their places being supplied by those of more modern date and of better adaptation to the requirements of the course. These changes are shown in the table given below. The methods of instruction were made more uniform throughout the classes undergoing instruction. Great thoroughness was required of the cadets in their comprehension of the grammatical principles

<sup>1</sup> Not forwarded.

and rules, of the construction of the language, and accuracy in their explanation and application thereof. An accurate and natural English translation was required in translating from the reader, accuracy was exacted in pronunciation and clearness in enunciation, and the average acquirement of the language by the cadets was considerably increased, especially in the sections below the first.

As previously stated, the exercises in the tabular system from 1872 were no longer written in exercise books, but were written upon the blackboard during recitation and explained and recited upon orally, thus giving more practice in pronunciation and a better opportunity to verify the cadet's comprehension of the subject. The method of examination was also changed. Previous to January, 1873, the examinations in French were oral, each cadet at examination being given a subject in grammar to explain and illustrate upon the blackboard, and also being required to read in French and translate orally a portion of the course in reading studied during the preceding term. From the January examination, 1873, the examination in grammar and in the tabular system (as long as that text-book was used) was made written. The examination in reading remained oral.

As before, the lessons during this period varied in length and difficulty according to the progress and capacity of the cadet.

A detailed programme of the course of instruction in the French language in 1878-79 is given in the appendix and marked B.<sup>1</sup> This remained practically the programme until 1882, with the exception of changes arising from different text-books; the number of lessons being the same.

The following table gives the text-books used in the department of the French language until June 30, 1882:

| Year.     | Text-books.   | Remarks.   |
|-----------|---|--|
| 1803-1820 | Masson's French Grammar; Masson's French Reader .....   | Not known when these books were first used or when discontinued, but known that they were used in 1814.      |
|           | <i>Third class.</i>   |  |
|           | <i>Fourth class.</i>  |  |
| 1821      | Exercises in Wouostrocht's French Grammar; The Poetry of the Lecteur Français; Voltaire's Charles XII; Gil Blas. Vols. II, III, IV.                   | Wouostrocht's Grammar and the Lecteur Français discontinued between 1820 and 1822, the exact year not known. |
| 1822      | Berard's French Grammar; Voltaire's Charles XII; Gil Blas. Vols. II, III, IV.   | The exact year when adopted not known.   |
| 1841      | Levizac's French Grammar; Berard's Leçons Françaises; Gil Blas. Vols. II, III, IV; Murray's English Reader (used in first section only).              | Gil Blas discontinued September 27, 1841; Murray's Reader adopted April 7, 1840.                             |
| 1842      | Levizac's French Grammar; Berard's Leçons Françaises; Voyage du Jeune Anacharsis; (Murray's English Reader).  | Voyage du Jeune Anacharsis adopted September 27, 1841.   |
| 1848      | LeBrethon's Guide to the French Language; Chapsal's Leçons et Modèles de Littérature Française.   | LeBrethon adopted September 1, 1847; Chapsal adopted August 22, 1848.  |
| 1849      | Bolmar's Levizac's French Grammar and Verb Book; Chapsal's Leçons et Modèles de Littérature Française; Rowan's Morceaux Choisis des Auteurs Modernes. | Bolmar's Levizac and Rowan adopted January 16, 1849.   |
| 1852      | Same, with addition of Berard's Leçons Françaises.  |  |
| 1856..... | Bolmar's Levizac's French Grammar and Verb Book; Chapsal's Leçons et Modèles de Littérature Française; Rowan's Morceaux Choisis des Auteurs Modernes. | Spiers and Surenne's Dictionary adopted June 2, 1856. For reference.   |
| 1859..... | Bolmar's Levizac, etc.; Rowan's Morceaux, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary.  | Agnel's Tabular System used in manuscript from 1859. Adopted in printed form July 1, 1865.                   |

Not forwarded.

| Year.     | Text-books.  |  | Remarks.   |
|-----------|--|--|--|
|           | <i>Third class—Continued.</i>  | <i>Fourth class—Continued.</i>   |  |
| 1862..... | Bolmar's Levizac, etc.; Berard's Leçons, etc.; Chap-sal's Leçons, etc.; Rowan's Morceaux, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary.   | Bolmar's Levizac, etc.; Berard's Leçons, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary.  |  |
| 1868..... | Bolmar's Levizac, etc.; Chap-sal's Leçons, etc.; Rowan's Morceaux, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary.  | Bolmar's Levizac, etc.; Berard's Leçons, etc.; Chap-sal's Leçons, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary.   | A second course of idioms added to the tabular system in 1867. In third class Bolmar's Levizac, Chap-sal and Berard's Leçons, etc., were discontinued June 24, 1872. |
| 1872..... | Borel's Grammaire Française; Reynal's Verb Book; Rowan's Morceaux, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary.  | Böcher's Otto's French Grammar; Reynal's Verb Book; Böcher's French Reader; Böcher's College Series of French Plays, Vols. I and II; Agnel's Tabular System; Spiers and Surenne's French Dictionary. | Böcher's Grammar, Reader, French Plays, Borel's Grammaire and Reynal's Verb Book were adopted June 24, 1872. Böcher's Grammar discontinued July 3, 1878.             |
| 1879..... | Keetels' Analytical and Practical French Grammar; Reynal's Verb Book; Borel's Grammaire Française; Böcher's College Series of French Plays, Vols. I and II; Rowan's Morceaux, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary. | Keetels' Analytical and Practical French Grammar; Reynal's Verb Book; Böcher's French Reader; Agnel's Tabular System; Spiers and Surenne's Dictionary.   | Reynal's Verb Book and Böcher's Reader discontinued Nov. 1, 1881.  |
| 1882..... | Keetels' Analytical and Practical French Grammar; Borel's Grammaire Française; Böcher's College Series of French Plays, Vols. I and II; Rowan's Morceaux, etc.; Agnel's Tabular System; Spiers and Surenne's Dictionary.                     | Keetels' Analytical and Practical French Grammar; Keetels' Analytical French Reader; Agnel's Tabular System; Spiers and Surenne's Dictionary.  | Agnel's Tabular System discontinued Dec. 14, 1883.   |

DEPARTMENT OF THE SPANISH LANGUAGE.

The Secretary of War directed, in a letter from the inspector of the Military Academy, dated July 5, 1854, that the academic board arrange a programme of studies for a five years' course, and observe therein certain conditions, among which was the introduction of the Spanish language. The programme of studies drawn up by the academic board in accordance with the above instructions was subsequently approved by the Secretary of War and went into operation September 1, 1854. The Spanish language as one of the courses of instruction at the Military Academy therefore dates from September 1, 1854.

Previous to this date, however, it appears that there had been some thought of introducing the study of this language. A letter from the Superintendent of the Military Academy, dated January 28, 1824, to the inspector of the Academy, acknowledges the receipt of a letter from the latter, in which it was stated that the authorities at Washington proposed to add to the academic board two professors (or teachers) of the Spanish language. In his reply the superintendent states that the objection to the introduction of the language was the lack of time, unless some studies were dropped.

In 1825 the Board of Visitors recommended that instruction be given in Spanish.

Although the Spanish language as a part of the course of studies dates from September 1, 1854, yet from the fact that in the arrangement of studies it was put in the third year (third class), instruction in it did not begin until September 1, 1856.

From September 1, 1856, to the establishment of a professorship of Spanish by Congress February 16, 1857, and until the appointment of a professor, the instruction in that language was placed under charge of the professor of the French language, who was styled the professor of French and Spanish, and the department was styled the department of French and Spanish.

The act of Congress approved February 16, 1857, provided that "there shall be appointed at the Military Academy, in addition to the professors authorized by the existing laws, a professor of Spanish."

Under the provisions of this act, Patrice De Janon was appointed professor of Spanish July 1, 1857. With the exception of the period from September 16, 1863, to March 4, 1865, during which he was out of service, Professor De Janon was the head of the department until his retirement June 30, 1882, when the department of Spanish was incorporated with the department of the French language, into the department of modern languages.

Professor De Janon was the only professor of Spanish under the above act of Congress, and his total service as head of the department extended over twenty-three years.

From September 16, 1863, to July 27, 1864, the department was again placed under charge of the professor of the French language. From July 27, 1864, to March 4, 1865, when Professor De Janon returned, it was under charge of Capt. Edward R. Platt, Second United States Artillery, and major United States Volunteers, as acting professor.

The following table gives the different heads of the department from September 1, 1856:

| Name.                    | Army rank when appointed.                                      | Term of service. |                | Remarks.        |
|--------------------------|--|------------------|----------------|-----------------|
|                          |  | From—            | To—            |                 |
| <i>Professors.</i>       |  |                  |                |                 |
| Hyaicnthe R. Agnel.      | Professor of French .....                                      | Sept. 1, 1856    | July 1, 1857   | Relieved.       |
| Patrice De Janon ...     | Sword master.....  | July 1, 1857     | Sept. 16, 1863 | Out of service. |
| Hyaicnthe R. Agnel.      | Professor of French .....                                      | Sept. 16, 1863   | July 27, 1864  | Relieved.       |
| <i>Acting Professor.</i> |  |                  |                |                 |
| Edward R. Platt....      | Captain, Second Artillery; major,<br>United States Volunteers. | July 27, 1864    | Mar. 4, 1865   | Do.             |
| <i>Professor.</i>        |  |                  |                |                 |
| Patrice De Janon .....   |  | Mar. 4, 1865     | June 30, 1882  | Retired.        |

#### TIME ALLOTTED TO INSTRUCTION IN THE SPANISH LANGUAGE.

When the instruction in Spanish began, September 1, 1856, the time allotted to it in the programme of studies drawn up and approved in 1854 for the five years' course was as follows:

In the third year (third class), recitations of one hour each from 11 a. m. to 1 p. m., alternating with French, from September to January; daily recitations of one hour each from 11 a. m. to 1 p. m. from January to June; being a total of about 170 recitations.

When the change from the five years' course to one of four years finally took effect, September 1, 1861, the time allotted to Spanish in the new arrangement of studies was as follows:

In the fourth year (first class), recitations of one hour each from 11 a. m. to 1 p. m., alternating with riding, from September to June, being a total of about 110 recitations. As Spanish was changed from the third year to the fourth year, the first class was not reached until September 1, 1862; consequently from September 1, 1861, to September 1, 1862, no instruction was given in Spanish.

In the modification of the arrangement of the course of studies caused by discontinuing English studies, which went into effect September 1, 1867, instruction in Spanish was changed from the fourth year (first class) to the second year (third class), and the following allotment of time was made: In the second year (third class), recitations of one hour each from 11 a. m. to 1 p. m., alternating with French, from September to June, being a total of about 110 recitations.

In the rearrangement of the course of studies made necessary by the restoration of English studies in 1877, instruction in Spanish was, on the recommendation of the academic board, approved June 18, 1878, again changed from the second year (third class) to the fourth year (first class), and the following allotment of time was made: In the fourth year (first class), recitations of one hour each, from 11 a. m. to 1 p. m., alternating with riding from September to June, being a total of about 110 recitations.

As Spanish was changed from the second year to the fourth year, the first class was not reached until September 1, 1880; consequently from September 1, 1878, to September 1, 1880, no instruction was given in Spanish.

This allotment of time was remaining in force June 30, 1882, when the department of Spanish was incorporated with the department of the French language into the department of modern languages.

The following table gives the various changes in the allotment of time to Spanish from September 1, 1856:

| From—         | To—           | Recitations (one hour each).  | Number of recitations. | Preparation—time of study at quarters (two hours per lesson). |
|---------------|---------------|---|------------------------|---|
| Sept. 1, 1856 | Sept. 1, 1861 | Five years' course adopted in 1854; went into effect in Spanish September 1, 1856. Third year (third class), recitations from September to January, alternating with French in forenoon; from January to June, recitations daily in forenoon. | 170                    | 340   |
| Sept. 1, 1862 | Sept. 1, 1868 | Four years' course adopted in 1861; went into effect in Spanish September 1, 1862. Fourth year (first class), recitations in forenoon, alternating with riding.   | 110                    | 220   |
| Sept. 1, 1868 | Sept. 1, 1880 | Change went into effect in Spanish September 1, 1868. Second year (third class), recitations in forenoon, alternating with French.  | 110                    | 220   |
| Sept. 1, 1880 | June 30, 1882 | Change went into effect in Spanish September 1, 1880. Fourth year (first class), recitations in forenoon, alternating with riding.  | 110                    | 220   |

INSTRUCTION, TEXT-BOOKS, ETC.

The instruction in Spanish followed as closely as possible the same system and methods previously described as having been followed in the department of the French language previous to the introduction of the tabular system in 1859. The examinations were oral, and conducted in the same manner as the examinations in French previous to 1873. From September, 1857, to September, 1858, the professor had no assistants, and was the only instructor in the department. The large sections necessitated thereby made it impracticable to give each cadet the requisite amount of individual instruction and practice. From 1858 assistants were provided.

The requirements of the course in Spanish until the absorption of the department June 30, 1882, were as follows: Spanish grammar; reading and writing Spanish; translating (from text and orally) English into Spanish and Spanish into English.

Detailed programmes of the course of instruction in Spanish for 1876 and for 1880 are given in the appendix and marked, respectively, C<sup>1</sup> and D.<sup>1</sup> The latter programme was in force June 30, 1882.

The following table gives the text-books used in the department until June 30, 1882:

| Year.  | Text-books.   | Remarks.   |
|--------|---|--|
| 1856.. | Third class (third year), Josse's Grammar; Romer and Camacho's Spanish Reader; Ollendorff's Oral Method as applied to Spanish by Velazquez.                   | Adopted June 2, 1856. Romer and Camacho's Reader discontinued July 16, 1858.           |
| 1858.. | Josse's Grammar; Morales' Progressive Spanish Reader; Ollendorff's Oral Method, etc.  | Morales' Reader adopted July 16, 1858. Josse's Grammar discontinued September 1, 1874. |
| 1862.. | First class, same as above.   |  |
| 1865.. | Same; Seoane's Neuman and Baretti's Spanish Dictionary.   | For reference.   |
| 1868.. | Third class, same as above.   |  |
| 1874.. | Vingut's Guide to Spanish and English; Ollendorff's Oral Method, etc.; Morales' Reader; Seoane, etc.  |  |
| 1881.. | First class, same as above.   |  |
| 1882.. | Vingut's Guide to Spanish and English; Ollendorff's Oral Method, etc.; Morales' Progressive Spanish Reader; Seoane's Neuman and Baretti's Spanish Dictionary. |  |

ENGLISH STUDIES.

English studies were restored as a part of the course of instruction at the Military Academy June 26, 1877, and from that date until June 18, 1878, were under charge of the chaplain and professor of history, geography, and ethics, although the instructors therefor, with the exception of the assistant professor of geography, history, and

<sup>1</sup> Not forwarded.

ethics, were taken from the department of French. June 18, 1878, the instruction in English studies was placed under charge of the professor of French, who from that date, and until the organization of the department of modern languages, was styled the professor of French and English studies, and the department was styled the department of the French language and English studies.

When the instruction in English studies was transferred to the department of the French language, June 18, 1878, the following allotment of time was made therefor: English studies, first year (fourth class), September to January, daily recitations of one hour each, from 2 p. m. to 4 p. m., being about 84 recitations; first year (fourth class), January to June, recitations of one hour each, from 2 p. m. to 4 p. m., two days each week, being about 40 recitations; a total of 124 recitations, with a preparation of two hours' study in quarters for each lesson, or two hundred and forty-eight hours. This allotment was in force at the organization of the department of modern languages.

English studies from June 18, 1878, comprised instruction in English grammar, rhetoric, and composition, and the use and meaning of words and constructions. Hart's Rhetoric and Abbott and Seeley's English Lessons for English People had been used as text-books during the academic year 1877-78. These two books were retained, and to them was added, July 3, 1878, Whitney's Essentials of English Grammar. Abbott's How to Write Clearly was added to the above, January 16, 1880, and was used in place of certain portions of English Lessons for English People.

The above text-books continued in use to the date of the organization of the department of modern languages.

The order and length of the lessons in English studies at the above date will be seen in so much of the detailed programme for the department of modern languages for 1890 (appended, marked E<sup>1</sup>) as relates to English, the said programme having been in operation in 1882 as regards that branch of instruction.

The examinations were oral at January and written at June.

The requirements of the course in English studies June 30, 1882, were as follows: English grammar; rhetoric; rules and exercises on composition; study of words and sentences.

#### DEPARTMENT OF MODERN LANGUAGES.

The department of modern languages at its organization, June 30, 1882, was made to comprise the three following branches of instruction: (1) English studies; (2) the French language; and (3) the Spanish language.

The requirements in each branch were the same as those previously described under the respective heads of the above three branches.

The following table gives the respective heads of the department from its organization to the present date:

| Name.                       | Army rank when appointed.        | Term of service. |               | Remarks. |
|-----------------------------|----------------------------------|------------------|---------------|----------|
|                             |                                  | From—            | To—           |          |
| George L. Andrews . . . . . | Professor of French . . . . .    | June 30, 1882    | Aug. 31, 1892 | Retired. |
| Edward E. Wood . . . . .    | Captain Eighth Cavalry . . . . . | Oct. 1, 1892     | .....         |          |

#### TIME ALLOTTED TO THE DIFFERENT BRANCHES OF STUDY.

The time allotted to instruction in English studies, the French language, and the Spanish language at the organization of the department has been given under those respective heads. It remained in force for all the above branches until August 27, 1883, when the Secretary of War approved the recommendation of the academic board of March 14, 1883, that the study of history be introduced and that it be allotted the time hitherto allotted to Spanish from September to January in the first class year.

From August 27, 1883, therefore, the allotment of time was as follows:

*English studies.*—Daily recitations of one hour each, from 2 p. m. to 4 p. m., September to January, fourth class year, and two recitations per week from 2 p. m. to 4 p. m., one hour each, from January to June, same year, or 124 recitations.

*French language.*—Three recitations per week of one hour each, from 2 p. m. to 4 p. m., from January to June, fourth class year, or 60 recitations. Daily recitations of one hour each, from 11 a. m. to 1 p. m., from September to January, third class year, or 220 recitations, being a total of 280 recitations.

*Spanish language.*—Recitations of one hour each from 11 a. m. to 1 p. m., alternating with riding, from January to June, first class year, or 60 recitations.

The above allotment remained in force until 1893. June 19, 1893, the academic board adopted a programme rearranging the order and time of certain studies at the Military Academy, which received July 30, 1893, the approval of the Secretary of War for so much as related to the department of modern languages. The allotment of time then made to the department is the one now in force, and will be given in the description of the present course. This new programme took effect September 1, 1893, for English studies; January 1, 1894, for the French language; March 1, 1895, for the Spanish language.

The first class, however, still continued under the previous programme as regards time, lessons, and text-books, until June, 1896, both the third and first classes, therefore, undergoing instruction simultaneously during the years 1895 and 1896.

The following table gives the changes in the time allotted from June 30, 1882, exclusive of the present arrangement:

| From—         | To—           | Recitations (one hour each).   | Number and Hours. |     | Preparation—time of study at quarters (two hours per lesson). |
|---------------|---------------|--|-------------------|-----|---|
| June 30, 1882 | Sept. 1, 1883 | English studies: First year (fourth class), recitations daily in afternoon, September to January; January to June, two recitations per week in afternoon.                                | 124               | 124 | 248   |
|               | .....do.....  | French language: First year (fourth class), January to June, three recitations per week in afternoon.<br>Second year (third class), September to June, daily recitations in forenoon.    | 60                | 280 | 560   |
|               | Jan. 1, 1884  | Spanish language: Fourth year (first class), September to June, alternating with riding, in forenoon.  | 220               |     |   |
| Sept. 1, 1883 | Sept. 1, 1893 | English studies: First year (fourth class), recitations daily in afternoon, September to January; January to June, two recitations per week in afternoon.                                | 124               | 124 | 248   |
|               | Jan. 1, 1894  | French language: First year (fourth class), January to June, three recitations per week in afternoon.<br>Second year (third class), September to January, daily recitations in forenoon. | 60                | 280 | 560   |
|               | Jan. 1, 1884  | Spanish language: Fourth year (first class), January to June, recitations in forenoon, alternating with riding.  | 220               |     |   |

INSTRUCTION, TEXT-BOOKS, ETC.

From the organization of the department, June 30, 1882, to the reorganization of the course of studies therein, July 30, 1893, the instruction in English studies and the French language followed the same methods as previously used, and which are described above under those heads. The same text-books in English studies and the French language remained in use, with the exception that Agnel's Tabular System was discontinued December 14, 1883, on account of having gone out of print. Its place was supplied during this period by selecting for each lesson an exercise selected from the French Reader. This exercise was given to the cadets in English and was required to be written in French upon the blackboard, recited upon, and explained. On the introduction of new text-books in 1893, this practice was discontinued. Rowan's Morceaux Choisis was also discontinued in 1885, and its place supplied by Roemer's Cours de Lecture et de Traduction.

In Spanish, the former text-books (Vingut's Guide to Spanish, Ollendorff's Oral Method by Velazquez, and Morales' Spanish Reader) were discontinued December 8, 1883, and their place supplied by the introduction of Knapp's Spanish Grammar and Knapp's Modern Spanish Readings. The latter were text-books of more modern date and were better adapted to the requirements of the course. Thoroughness and accuracy were required in recitations both in grammar and in reading, and the system and method of instruction were made to harmonize with the system and method followed in English studies and in French.

The method of examination in English studies and in French remained during this period the same as before the organization of the department of modern languages, that is to say, as follows:

- English studies.—January examination, oral; June examination, written.
- French.—All examinations, both oral and written.

In Spanish all examinations were both oral and written from and including that of January, 1883.

A detailed programme of the course of instruction in English, French, and Spanish, department of modern languages in 1890, is given in the appendix and marked E<sup>1</sup>. This programme was in force until 1893.

The following table gives the different text-books used in the department until July 30, 1893:

| From— | To—  | Third class.  | Fourth class.   | Remarks.  |
|-------|------|---|---|---|
| 1882  | 1893 | -----   | English: Whitney's Essentials of English Grammar; Hart's Composition and Rhetoric; Abbott & Seeley's English Lessons for English People; Abbott's How to Write Clearly. | Whitney's Grammar discontinued July 30, 1893. Abbott & Seeley's English Lessons discontinued July 30, 1893. Hart's Rhetoric discontinued July 30, 1893. |
| 1882  | 1885 | French: Keetels' Analytical and Practical French Grammar; Borel's Grammaire Française; Bôcher's College Series of French Plays, Vols. I and II; Rowan's Morceaux Choisis des Auteurs Modernes; Agnel's Tabular System; Spiers and Surrenne's French Dictionary. | French: Keetels' Analytical and Practical French Grammar; Keetels' Analytical French Reader; Agnel's Tabular System; Spiers and Surrenne's French Dictionary.           | Agnel's Tabular System discontinued December 14, 1883. Rowan's Morceaux Choisis discontinued 1885.  |
| 1885  | 1894 | Keetels' Grammar; Borel's Grammaire; Bôcher's Plays, Vols. I and II; Roemer's Cours de Traduction et de Lecture, Vols. I and II; Spiers, etc.   | Keetels' Grammar; Keetels' Reader; Spiers, etc.   | Keetels' Reader discontinued July 30, 1893. Bôcher's College Series of French Plays, Vol. I discontinued July 30, 1893.                                 |
| 1882  | 1883 | Spanish (first class): Ollendorff's Oral Method by Velazquez; Vingut's Guide to Spanish; Morales' Spanish Reader; Seoane's Neuman and Baretti's Spanish Dictionary.   |   | Discontinued December 8, 1883.  |
| 1883  | 1896 | Knapp's Spanish Grammar; Knapp's Modern Spanish Readings; Seoane's Neuman and Baretti's Spanish Dictionary.<br>N. B.—Spanish in first class continued until June, 1896.   |   | Do.   |

#### THE PRESENT COURSE.

The department of modern languages at the present time comprises the following branches of study, taught in the following order and with the following allotment of time:

First. English studies. Taught in first year (fourth class) from September to January, with daily recitations of one hour each, from 2 p. m. to 4 p. m., and with a total of 84 recitations.

Second. The French language. Taught in first year (fourth class) from January to June, with daily recitations of one hour each, from 2 p. m. to 4 p. m., with 100 recitations; in second year (third class) from September 1 to March 1, with daily recitations of one hour each, from 11 a. m. to 1 p. m., with 142 recitations, or a total number of recitations in the French language of 242.

Third. The Spanish language. Taught in second year (third class) from March 1 to June, with daily recitations of one hour each, from 11 a. m. to 1 p. m., with a total of 78 recitations.

#### ENGLISH STUDIES.

The requirements of the course in English studies, as given in the academic regulations of 1894, are as follows: Rhetoric; rules and exercises on composition; study of words and sentences; study of synonyms; history of the English language; history of English literature.

From the above requirements and the authorized text-books, the course in English studies is divided into the following subjects:

1. Rhetoric; study and use of words; rules and exercises in composition.
2. Study of synonyms.
3. History of the English language and literature.

<sup>1</sup>Not forwarded.

## TEXT-BOOKS.

The text-books adopted, with the date of their adoption, for the course in English studies are given below in the order in which they are used. The order and numbers correspond to the order and numbers of the subjects given above:

1. Williams's Rhetoric and Composition, adopted July 30, 1893; Abbott's How to Write Clearly, adopted January 16, 1880.
2. Smith's Synonyms Discriminated, adopted July 30, 1893.
3. Meiklejohn's English Language, adopted July 30, 1893.

## BOOKS OF REFERENCE.

Roget's Thesaurus of English Words, adopted July 30, 1893; Smith's Synonyms Discriminated, adopted July 30, 1893; Webster's Dictionary.

The above books of reference are used as such throughout the entire course of the three languages taught in the department. Webster's Dictionary is furnished to the cadets not merely for use in their language studies, but for use during their entire four years at the Academy.

## LESSONS.

The course in English studies comprises 84 lessons, of which 56 are assigned to lessons in advance and 28 to lessons in review.

*Rhetoric, composition, etc.*—Williams's Rhetoric and Composition, from page 1 to bottom of page 321; 31 advance lessons and 16 review lessons. Abbott's How to Write Clearly, rules, from top of page 14 to bottom of page 40; exercises, I, page 41 to 92, page 59; 9 advance lessons and 4 review lessons.

The total number of lessons in the subject of rhetoric, study and use of words, and rules and exercises in composition is 60, of which 40 are advance lessons and 20 are review lessons.

*Study of synonyms.*—Smith's Synonyms Discriminated: This subject is begun October 1, and is taught by assigning daily one word and its synonyms from the above date until the end of the course in languages in June of the third class year, making a total of 384 words, with their synonyms. (See requirements in French and Spanish.)

*History of the English language and literature:* Meiklejohn's English Language, from Part III, page 271, to bottom of page 443; 16 advance lessons and 8 review lessons, a total of 24.

The respective review lessons in Williams's Rhetoric, Abbott's How to Write Clearly, and Meiklejohn's English Language follow in the order named immediately after the last advance lesson in Meiklejohn's English Language.

The length of each of the lessons in the course of English studies, in advance and in review, is given in the detailed programme or list of lessons for the fourth class, marked F<sup>1</sup> in the appendix.

In English studies there is no difference of course for higher and lower sections, and the subject is taught by lesson and recitation without lectures.

The total number of recitations in English studies being 84, each of one hour in length, with two hours' study or preparation at quarters, the total number of hours devoted to the subject is 252.

Instead of original composition, additional practice in the art of written expression is to be given when the cadet has acquired a fair knowledge of French, short selections from that language to be given in third class year for written translation into the best English form.

## THE FRENCH LANGUAGE.

The requirements of the course in French, as given in the academic regulations of 1894, are as follows: Grammar; reading and writing French; study and use of idioms; military terms; translating (from text and orally) English into French and French into English; study of English synonyms.

The instruction in French is divided into the following courses:

1. First course: First year (fourth class), January to June, daily recitations of one hour each, from 2 p. m. to 4 p. m., with 100 recitations.
2. Second course: Second year (third class), September to January, daily recitations of one hour each, from 11 a. m. to 1 p. m., with 102 recitations.
3. Third course: Second year (third class), January to March 1, daily recitations of one hour each, from 2 p. m. to 4 p. m., with 40 recitations.

## THE FIRST COURSE.

One hundred lessons; 66 advance, 34 review, the proportion between advance and review varying in different text-books.

<sup>1</sup> Not forwarded.

*Text-books.*—De Peiffer's French Pronunciation, adopted July 30, 1893; Keetels' Analytical and Practical French Grammar, adopted July 3, 1878; Castarède's Treatise on the Conjugation of French Verbs, adopted July 30, 1893; Roemer's Cours de Lecture et de Traduction, Vol. I, adopted in 1885; Bôcher's College Series of French Plays, Vol. II, adopted June 24, 1872.

*Books of reference.*—Spiers and Surenné's French Pronouncing Dictionary, adopted June 2, 1856.

*Lessons.*—The course of lessons in the above text-books is divided into the upper course, or course for the first two sections; the lower course, or course for the last two sections, and the middle course, or course for the remaining sections.

In De Peiffer's Pronunciation and Castarède's Verb Book the lessons are the same for all courses.

De Peiffer's French Pronunciation, 2 lessons, from page 7 to bottom of page 31, the book to be used afterwards as a book of reference.

Castarède's Verb Book, 60 lessons advance, 32 review, from page 1 to bottom of page 96; same for all courses; begun at eighth lesson.

Keetels' Grammar, 64 lessons advance, 34 review; begun at third lesson. Upper course: From lesson 1, page 25, to end lesson 56, page 467. Middle course: From lesson 1, page 25, to end of lesson 54, page 462. Lower course: From lesson 1, page 25, to end of lesson 53, page 448.

Readers, 58 lessons advance, 28 review; begun seventeenth lesson. Roemer's Reader, Vol. I: Upper course, 80 pages; middle course, 70 pages; lower course, 60 pages. Bôcher's Plays, Vol. II, Les Petits Oiseaux, 65 pages, for all courses.

The length of each of the above lessons, in advance and in review, is given in the detailed programme or list of lessons for the fourth class, marked F<sup>1</sup> in the appendix.

#### SECOND COURSE.

One hundred and two lessons; 68 advance, 34 review, the proportion between advance and review varying in different text-books.

*Text-books.*—Castarède's Treatise on the Conjugation of French Verbs; Borel's Grammaire Française, adopted June 24, 1872; Hennequin's Lessons in Idiomatic French, adopted July 30, 1893; Bôcher's College Series of French Plays, Vol. II; Roemer's Cours de Lecture et de Traduction, Vol. II, adopted in 1885; Revue Militaire de l'Étranger, six months' subscription each year, adopted July 30, 1893.

*Books of reference.*—De Peiffer's French Pronunciation, Spiers and Surenné's French Pronouncing Dictionary.

*Lessons.*—As in the first course, the lessons are divided into lessons for the upper course, middle course, and lower course, respectively, except in the Verb Book, where the lessons are the same in all the courses.

Castarède's Verb Book, 62 lessons advance, 40 review, from page 1 to middle of page 141.

Borel's Grammaire Française, 70 lessons advance, 32 review. Upper course, from section 15 to section 119; middle course, from section 15 to section 118; lower course, from section 15 to section 116; omissions for all courses, sections 73, 74, 75, 77, 78, 79, 80, 81, 86, 88, 89, 115.

Hennequin's Idiomatic French, 51 lessons advance, 51 review. One lesson per day, omitting in advance French exercises and conversation. In review, upper course take French exercise and theme; the other courses take themes only.

Readers: 70 lessons advance, 32 review. Bôcher's Plays, Vol. II, Le Roman d'un Jeune Homme, 90 pages, all courses. Roemer's Reader, Vol. II. Upper course, 120 pages; middle course, 100 pages; lower course, 70 pages.

Revue Militaire de l'Étranger, one lesson per week; no review lessons. Upper course, 3 pages per lesson; middle course, 2½ pages per lesson; lower course, 2 pages per lesson. The length of each of the above lessons, in advance and in review, is given in the detailed programme or list of lessons for the third class, marked G<sup>1</sup> in the Appendix.

#### THIRD COURSE.

Forty lessons; all advance; no review.

*Text-books.*—Castarède's Treatise on the Conjugation of French Verbs; Edgren's Compendious French Grammar, adopted July 30, 1893; Hennequin's Lessons in Idiomatic French; Roemer's Cours de Lecture et de Traduction, Vol. II; Revue Militaire de l'Étranger; Monday Daily Figaro, three months' subscription each year; adopted July 30, 1893.

*Books of reference.*—De Peiffer's French Pronunciation; Spiers and Surenné's French Dictionary.

<sup>1</sup>Not forwarded.

*Lessons.*—As in the first and second courses, the lessons are divided into lessons for the upper, middle, and lower courses, respectively, except in the verb book, where the lessons are the same in all courses.

Castarède's Verb Book, 40 lessons, no review, from page 50 to bottom of page 141.

Edgren's Grammar, 37 lessons advance, 3 review; selected portions of text to paragraph 171, page 110; thence to end of page 249. Exercises shortened for two lower courses.

Hennequin's Idioms, 1 lesson per day, 40 lessons, no review; composition omitted and exercises shortened for two lower courses.

Readers, no review. Roemer's Reader, Vol. II. Upper course, 4 pages per lesson; middle course, 3½ pages per lesson; lower course, 3 pages per lesson.

Revue Militaire de l'Étranger, 4 lessons per week, 32 lessons. Upper course, 4 pages per lesson; middle course, 3½ pages per lesson; lower course, 3 pages per lesson.

Monday Daily Figaro, three months' subscription yearly; 1 lesson per week; no lesson assigned; reading at sight.

Dictation exercises are given once a week throughout the third-class course, and sight reading is practiced whenever time is available.

The length of each of the above lessons is given in the detailed programme or list of lessons for the third class, marked G<sup>1</sup> in the appendix.

The three courses of the French language are taught by lesson and recitation without lectures.

The total number of recitations in the French language being 242, each of one hour in length, with two hours of study or preparation at quarters, the total number of hours devoted to the subject is 726.

#### THE SPANISH LANGUAGE.

The requirements of the course in Spanish, as given in the Academic Regulations of 1894, are as follows: Grammar; reading and writing Spanish; translating (from text and orally) English into Spanish and Spanish into English; study of English synonyms.

There is one continuous course of 78 lessons; 52 advance, 26 review, the proportion varying in different text-books.

*Text-books.*—Knapp's Spanish Grammar, used as verb book and for pronunciation, adopted December 8, 1883; Monsanto and Languellier's Spanish Grammar, adopted July 30, 1893; Mantilla's Spanish Reader, No. 3, adopted July 30, 1893; Eco de Madrid, adopted July 30, 1893; Knapp's Spanish Readings, adopted December 8, 1883.

*Books of reference.*—Seoane's Neuman and Baretti's Spanish Dictionary, adopted in 1865.

*Lessons.*—The course of lessons in the above text-books is divided into the upper course, or course for the first two sections, and the lower course, or course for the remaining sections. The lesson in pronunciation from Knapp's Grammar and the lessons in verbs from the same text-book are the same for both courses.

Knapp's Grammar, pronunciation, 2 lessons, from page 1 to paragraph 56, page 20, and to be used afterwards for reference.

Knapp's Grammar, verbs, 52 lessons advance, 22 review; from Haber, page 162, to end of paragraph 554. Intermediate review in four lessons of the first eight lessons in verbs; begun at fifth lesson.

Grammar, 49 lessons advance, 27 review; begun at third lesson. Monsanto and Languellier, one lesson daily, omitting lessons 24, 26, 32, 33, 34, 35, 38, 39, 40, 50, 53, 54, 56, 57, 60, 62; the themes are shortened in the lower course. Knapp's Grammar, paragraphs 406 to 412 and paragraph 706; 47 lessons advance, 18 review; begun at fourteenth lesson.

Readers, 47 lessons advance, 1 review. Begun at fourteenth lesson. Upper course: Mantilla's Reader, 20 pages; Eco de Madrid, 35 pages; Knapp's Reader, 50 pages.

Readers, lower course: Mantilla's Reader, 15 pages; Eco de Madrid, 35 pages; Knapp's Reader, 40 pages. Intermediate review, in two lessons, of the first four lessons in reading.

The length of each of the above lessons, in advance and in review, is given in the detailed programme or list of lessons for the third class, marked G<sup>1</sup> in the Appendix.

The Spanish language is taught by lesson and recitation without lectures.

The total number of recitations in the Spanish language being 78, each of one hour in length, with two hours of study or preparation at quarters, the total number of hours devoted to the subject is 234.

#### ORGANIZATION OF THE DEPARTMENT.

The department, as now organized, comprises the professor of modern languages, head of the department, and seven assistants, who are officers of the Army that have

<sup>1</sup> Not forwarded.

been detailed for such duty. The two senior assistants are by rank assistant professor of the French language and assistant professor of the Spanish language, respectively. As two classes (third and fourth) are undergoing instruction daily in the department, each one of the assistants has assigned to him for instruction three sections, either one section of the third class and two sections of the fourth class, or two sections of the third class and one section of the fourth class. The assistant professor of French is the principal assistant as far as relates to the instruction of the fourth class, and the first and last sections in that class are assigned to him for instruction in addition to the section assigned to him in the third class. The assistant professor of Spanish has similar duties assigned to him in the third class, having the first and last sections thereof, as a rule, in addition to the section in the fourth class. The senior of the two assistant professors is a member of the academic board and examining committee, for the purpose of examining cadets, arranging them in order of merit, and determining the proficiency or deficiency in every branch of study in the department.

The various duties of the head of the department and his assistants are as given in Article V, Academic Regulations of 1894.

#### THE RECITATION.

The section rooms are the same in size and form as those used in the other departments of instruction at the Military Academy. The instructor's seat and desk, on a raised platform, are in the center of that side of the section room which is opposite the entrance door. The seats and desks of the cadets are in two lines parallel to those sides of the section room which form right angles with the instructor's side, and arranged so that the two lines of cadets face each other, leaving as much vacant space in the center of the room as possible. Cadets are assigned to seats in the order of their rank in the section, the senior member of the section, or section marcher, having the seat nearest to the instructor and in the line of seats to the right of the latter when facing the door. The next in rank has the seat next to the section marcher, and so on to the last in rank, who has the last seat to the left of the instructor.

The number of cadets in a section varies according to the size of the third and fourth classes. During the past four years the number has varied from nine to twelve or thirteen. The sections are made as equal as possible in their strength, and where it is not possible to do so the lower sections are given the smallest number of cadets.

The members of the section, after entering, take their places in rear of their respective seats and stand at attention until the section marcher reports. The section marcher enters the room last, closes the door, and, standing in front of the instructor, reports the section as all present or gives the names of the absentees, immediately after which all members of the section take their seats. In accordance with the regulations for section rooms, opportunity is now given for members of the section to ask pertinent questions concerning difficulties in the lesson of the day. Immediately after this the recitation proper begins.

#### THE RECITATION IN ENGLISH STUDIES.

In English studies as many members of the section are assigned subjects for recitation at the blackboard as the size of the section will permit, reserving one member, and sometimes two, for questions on the lesson of the day or on the lesson of the preceding day. Each cadet, when his name is called, takes his place in the center of the room facing the instructor, and standing at attention receives his enunciation. He then goes to the particular blackboard assigned to him by the order in which his name was called to receive an enunciation or subject of recitation, the first cadet called taking the first blackboard to the right of the instructor on the side of the room opposite the latter, the others following in consecutive order from right to left. Immediately upon arriving at his proper blackboard the cadet writes his name in the upper right-hand corner and under his name the number indicating the order in which he received his enunciation. He then proceeds to put upon the blackboard the work called for by his subject. He is not permitted to write out the subject-matter of his recitation, but is required to write the different heads thereof in the form of a synopsis showing their relation to one another, and is required to make the explanation orally. At each recitation one member of the section is required to write a synopsis of the lesson of the day and another member to write a synopsis of the lesson of the preceding day. When the cadet is ready for recitation, he indicates it by taking the pointer in his hand and standing at the blackboard facing the instructor. Until the first cadet is called upon to recite at the blackboard, the time has been occupied in questioning those members of the section who were not sent to the blackboard. The cadets questioned make their recitation standing in the center of the room facing the instructor, and when the questions are finished they take their seats or are given subjects at the blackboard when one becomes vacant.

When a cadet at the blackboard is called upon to recite, he first gives from memory the enunciation of his subject in the exact words in which he received it, and then proceeds to explain and illustrate the subject by the knowledge of it that he has obtained by his own study. If his recitation be entirely satisfactory in every respect, he is then told that it is sufficient, and takes his seat. If not so, the instructor then goes over the subject, until by explanation and question the cadet understands it.

The work upon the blackboard, including the cadet's name and number, is required to be written neatly and spelled and punctuated correctly. In the case of illustrative examples and exercises for correction, the whole work, of course, is put upon the blackboard.

#### THE RECITATION IN FRENCH.

The preliminaries up to and including the questions on the lesson of the day are the same as in English studies. At each recitation, immediately after the preliminary questions, a portion of the time, not to exceed ten minutes from the entrance of the section, and limited if possible to five minutes therefrom, is employed for pronunciation exercises and practice.

These exercises and practice vary for different days. One day the time will be devoted to explanation and practice of certain difficult sounds in the language; another, to sentence accentuation; another, the instructor reads aloud a portion of the reading lesson of the day, the members of the section following the reading in their books and observing the pronunciation; another, short sentences in French will be given orally to the members of the section, which they will repeat in French and then translate into English; another, sentences in English will be given, which they will translate orally into French; another, a short extract in French, which the members have not seen, will be read to them, and they will translate it. This practice is carried on during the entire course in French, and in its purpose is equivalent to a daily drill. Each Monday, in the third-class course, this time is employed in dictation exercises, the papers being subsequently corrected and marked by the instructor, and the mark given therefor combined with their mark on the recitation of the day.

Immediately after this daily practice in pronunciation the recitation proper begins. The members of the section are called up in order, and, with the exception of three or four who are reserved for recitations in reading, are given subjects for recitations at the blackboard. These subjects contain grammatical principles to be explained and illustrated and themes and exercises connected therewith, or idioms and exercises thereon; each subject, however, always requires a tense of a verb to be written on the blackboard in addition to the subject-matter proper. Until the first recitation at the blackboard the time is employed in the recitations in reading by those cadets who were not sent to the blackboard. After these cadets have completed their recitation in reading, they are required to write a verb on the blackboard. The recitation at the blackboard is similar in form to that in English studies, except that the subject-matter is all put upon the blackboard, with the exception of explanations.

The recitation in reading is conducted as follows:

1. The cadet, standing in the center of the room and facing the instructor, reads aloud a portion of the French text as an exercise in pronunciation.
2. He then translates literally or freely, as may be required.
3. The book is then closed and as an exercise in ear training portions of the French text that he has read, or, when more advanced, portions of French text that he has not read, are read aloud to him by the instructor, the cadet being required to give, as well as possible, the English translation of what he hears.

In order to counteract the pernicious habit of guessing at the sense without an accurate knowledge of the meaning of each word, and also in order to accustom the cadet to the order of the words in French (differing so much from the order in English), translations strictly literal are required for the first twenty lessons in reading. After that free translations will be given, the instructor, however, whenever deemed necessary, ascertaining that the cadet understands thoroughly the literal translation.

- Reading at sight is practiced whenever time is available.

#### THE RECITATION IN SPANISH.

This recitation is conducted in the same manner and by the same methods as in French.

All recitations are marked on the following scale: 3, thorough; 2.5, good; 2, indifferent; 1.5, bad; 1, very indifferent; 0, complete failure.

The different sections in the two classes, varying in number from 17 to 20 and 21, are visited by the head of the department, when practicable, at least once each week.

## WEEKLY CLASS REPORTS, ETC.

In accordance with the provisions of the Academic Regulations of 1894, each instructor having the immediate charge of one or more sections of a class keeps daily notes of the progress of each and of the relative merit of the members, and at the end of each week reports the result to the Superintendent, through the head of the department, with such additional explanations as may be necessary to show the relative progress of the members of the respective sections. The head of the department at the same time recommends such transfers from section to section as he may consider expedient.

The above-named weekly report is made out in the following form:

[United States Military Academy, third class, first section. Department of modern languages (French).]

*Report for the week ending ———, 189—.*

[Scale of daily merit: Thorough, 3; good, 2.5; indifferent, 2; bad, 1.5; very indifferent, 1; complete failure, 0.]

| No. | Name.  | Monday. | Tuesday. | Wednesday. | Thursday. | Friday. | Saturday. | Total. | Maximum for the week, 18.0.<br>Progress during the week.                                       |
|-----|--------|---------|----------|------------|-----------|---------|-----------|--------|--|
| 1   | A..... | 3       | -----    | 2.5        | 2.5       | 2.8     | 2.9       | 16.4   | Transfers recommended: Cadet B to the second section. E. E. W., professor of modern languages. |
| 2   | B..... | 2.5     | 2        | 2.7        | 2.5       | 2.6     | 2.4       | 14.7   |  |
| 3   | C..... | 2.9     | 3        | 2.9        | 3         | 2.8     | 2.5       | 17.1   |  |

Prof. E. E. W.,  
*Department Modern Languages.*

*Instructor.*

The above weekly report is posted in a convenient place in the Academy building during the week following the one for which it is submitted, thus affording the members of the section an opportunity to see their marks and keep themselves informed of their merit in the study.

As the members of the fourth class in English studies begin that study September 1 with an alphabetical arrangement in their class, the first transfer is effected at the end of the first month by rearranging the whole class in order of merit by the total marks of its members and reassigning the latter to sections accordingly. The same course is followed when the fourth class begins the study of the French language in January. All other transfers from section to section are recommended on the weekly class report, when judged expedient or necessary by the head of the department.

## EXAMINATIONS.

The number and kind of examinations held in the respective classes undergoing instruction in the department are as follows:

Examination of the fourth class in English studies, January—oral.

Examination of the fourth class in French, June—written and oral.

Examination of the third class in French, January—written and oral.

Final examination of the third class in French, March 1—written.

Examination of the third class in Spanish, June—written and oral.

The oral examination of the fourth class in English studies is conducted by means of subjects assigned to each cadet for recitation at the blackboard. Each enunciation contains subjects from both the course in rhetoric and composition and the course in the history of the English language and literature, and also contains such matter as will show the cadet's knowledge of the principles of punctuation. In case his oral examination gives rise to doubt concerning his proficiency, he is reexamined by written examination.

In the oral examinations in French and in Spanish, each cadet is required to read aloud, to test his pronunciation, selections from the course in reading, and to translate them into English; in addition, each cadet is required at each oral examination in French and Spanish (fourth class French in June, third class French in January, and third class Spanish in June) to read at sight selections from those languages.

In the written examinations the examination papers are of such length and contain such a number of sentences as will thoroughly test the cadet's knowledge of the grammatical principles learned during the past term and his knowledge of a number of the idioms.

The sentences of course differ from year to year, but their number for each written examination remains the same, and is as follows:

Fourth class, French, June—Upper course, 80; middle course, 70; lower course, 60.

Third class, French, January—Upper course, 80; middle course, 65; lower course, 50.

Third class, French, March 1—Upper course, 50; middle course, 40; lower course, 30.

Third class, Spanish, June—Upper course, 70; lower course, 60.

The academic board has fixed the weights to be given to all examinations either oral or written, and the respective examinations in the department have in consequence the following weights: Oral examination, fourth class, English studies, in January, 15; written and oral examination, fourth class, French, in June, one-half the weight of review mark; written and oral examination, third class, French, in January, one-half the weight of review mark; written examination, third class, French, on March 1, 15; written and oral examination, third class, Spanish, in June, one-half the weight of the review mark.

After the examination, the examination mark received by the cadet is added to the sum of his total mark received during the past term increased by his review mark, and the sum thus obtained is called his grand total mark. In estimating the deficiency or proficiency of a cadet after examination, it is considered that the knowledge shown by him during his daily recitations and the knowledge shown by him at the examination should give him a mark not varying much from two-thirds of the maximum grand total.

#### REVIEW OF PRESENT COURSE.

In the course of instruction as at present arranged in the department the three languages taught follow one another in succession; each language, English, French, Spanish, is taken up and completed before the succeeding one is begun, and no two languages are studied simultaneously by the same class. By being placed, according to the programme of studies, entirely in the first two years at the Academy (fourth and third classes), they are taught in combination with but one other branch of study, mathematics, thereby affording not only the natural and best correlation of studies for mental training during those years, but also the best opportunity for acquirement.

#### ENGLISH STUDIES.

As a consequence not only of the amount of time available for instruction in this study, but also of the fact that candidates for admission are required to possess a fair knowledge of the elements of English grammar, the study of the latter has been discontinued, and the course in English studies is mainly rhetorical, with the addition of a short course in the history of the language and of its literature.

As the cadets of the Military Academy are destined to be officers of the Army, the primary aim of their instruction in rhetoric and composition is to give them such information, instruction, and training as will enable them to express themselves clearly and plainly, so that their meaning can not be mistaken, and that it be expressed in the most clear and forcible way. The course in rhetoric and composition is therefore prepared with this aim in view. It comprises the essential principles of punctuation, of the selection and right use of words, of the construction of sentences and the errors to be avoided therein, the principles of paragraphing, the outlining of subjects of composition, the effect and use of figures, and the forms to be observed in letters. All of these are supplemented by examples for practice in application. By these means the cadet obtains a knowledge of the errors to be avoided in expression and a knowledge of the various devices used in making it most effective.

As regards oral expression, it is known that errors therein are prevalent among cadets, though it is doubtful whether they are more so than throughout the country or among students elsewhere. Certainly the cadets are fair representatives of the average youth of the various schools throughout the United States. It is simply more noticeable to visitors here on account of the greater opportunity the latter have, from the examinations and recitations, of hearing those errors.

Be this as it may, it is of course desirable to correct as far as possible these errors in oral expression. But it must be borne in mind that they are the result of acquired habit, and can be changed only by another acquired habit. This last can come only by persistent and constant correction of those errors of speech whenever and wherever they are heard in all branches of study. Mere knowledge given to the cadet of these errors is not sufficient to eradicate them; correction of these errors during a recitation of an hour in one branch of study is not sufficient to eradicate them. Daily and constant correction everywhere is the only remedy.

Although the writing of compositions has considerable value, yet to require the cadet to furnish both the ideas and their expression would take far too much of his time, considering his other studies. It is believed that fully as good, if not better, results can be obtained by furnishing him with the ideas and requiring of him their

best expression in accordance with the rhetorical principles he has learned. This is best attained after he has some knowledge of another language, as French, by giving him extracts from that language to be translated and expressed in the best rhetorical way. For this reason practice in composition is to be given in the third class year. After writing this translation, the paper is given to the instructor of the section, who indicates the errors on the margin of the paper. The errors are not corrected by the instructor, but reference is to be made by number of rule to the principle violated. The paper is then returned to the cadet and he makes his corrections; this is to continue until the paper be without error.

A knowledge of the exact and precise meaning of the words to be used is of great value, and some instruction in the distinction of synonyms is desirable. It is thought, however, that consecutive lessons on this subject alone for a definite time as a separate division of English studies would not produce the best results. The knowledge would soon be forgotten by the introduction of new matter. Moreover, any such number of synonyms as would necessarily be given for a single lesson would require considerable time for their proper study. It is believed that the best practicable results are obtained by assigning daily one word and its synonyms (learned from Smith's Synonyms Discriminated) from October 1 of the fourth class year until the end of the entire language course—that is, June of the third class year. The labor required daily to learn one word and its synonyms is a trifling addition to that required for the study of the lesson of that day, and by extending the study over the entire language course the habit of discrimination, resulting from studying 380 synonyms, would, it is hoped, be acquired.

The course in the history and historical elements of the English language and in its literature, though short, fulfills an object of considerable importance, namely: It not only gives information and knowledge such as those having the position of officers of the army should possess, but it is also intended to be suggestive of different courses of reading that the cadet could follow with interest and advantage. This suggestion and indication are by this course given him in his first year at the Academy. It is known that many cadets enter the Academy with a great lack of knowledge and culture derived from reading. Without some such suggestion as is given by this course of literature, the use of the library by many cadets would naturally be desultory and aimless.

#### THE FRENCH LANGUAGE.

Immediately after the completion of English studies the study of the French language is begun in January, fourth-class year, and extends over 242 daily recitations from that time until March 1, third class year, being divided by examinations into the course from January to June, fourth class, September to January, third class, and January to March 1, third class, called the first, second, and third courses, respectively.

#### THE FIRST COURSE.

As regards pronunciation, the aim of the instruction throughout all the courses is to make the cadet acquire, by knowledge and practice, the ability to pronounce accurately each word, to acquire a thorough knowledge of all the principles and sounds of sentence accentuation, and in practice to be fairly able to give the sentence accentuation correctly. Ease in word pronunciation and ease and correctness in sentence accentuation can be acquired only by fluency of speech. Fluency of speech in a foreign language can be acquired only by habitual use of it by one person by association with another using the language, or by residence where it is spoken. In the entire course in French, consisting of 242 recitations or hours of practice, the sections number ten members, and frequently a greater number. This gives little more than twenty-four hours' practice in pronunciation for each cadet during the entire course. The same conditions to a greater or less extent prevail in all institutions where a foreign language is necessarily taught in the class room, and it is for that reason that the power to speak with even moderate fluency a foreign language can not be and never has been acquired in a class room.

As the majority of the cadets when they begin the study of French have no previous knowledge of the language, the first 2 lessons in the course are given solely to pronunciation. Lessons are assigned in the text-book on pronunciation, upon which the cadets recite as well as receive information and example from the instructor. After the first 2 lessons instruction and practice in pronunciation are given by the daily recitations and by the daily pronunciation drill described under the head of recitations.

Instruction in grammar is begun at the third lesson of the course. In the text-book used (Keetels' Analytical and Practical French Grammar), only the grammatical principle and rules, the illustrative examples thereon, and their application in the theme are required to be learned for recitation, the oral exercises and examples being

used for reference only, except that in each lesson the first paragraph of the oral exercises, consisting of a few short sentences, is required to be committed to memory, not to be put upon the blackboard, but to be recited orally as an exercise in sentence accentuation. The first 10 lessons in the grammar are reviewed in 5 lessons, so as to give the cadet an opportunity thoroughly to grasp the first elements of the language. After that the lessons are continuous until the seventieth lesson, when the whole grammar course is reviewed. By those means all of the essential part of each lesson is retained and the labor much lightened, so that more time can be given to reading and translation, which are of prime importance.

It has been found by experience that for the study of the French verb better results are obtained by using a verb book separate and distinct from the grammar. The verb is difficult for beginners and should be made as plain, full, and comprehensible as possible, and the forms and English translations thereof should be constantly repeated in the text-book. In the verb book used all the verbs conjugated are given in full with the English meaning of each word and tense in the opposite column, and the irregular verbs are grouped by classes of similar conjugation. To further aid the study of irregular verbs, a pamphlet has been prepared giving a brief explanation of the derivation of the different verb forms from the primitive tenses, accompanied by a model of the form in which the verb must always be written upon the blackboard.

It is deemed best not to begin the assignment of verbs for study from the verb book until the eighth lesson in the course, or sixth grammar lesson. By that time the cadet has gradually learned from the grammar lessons most of the different forms of "avoir," and he is prepared to take the verb as a whole. After completing the two auxiliary verbs and the four model verbs of the regular conjugation in 16 lessons, they are reviewed. After that the lessons are continuous until the seventy-eighth lesson, when the whole verb course is reviewed.

In reading, no single text-book has been found that is suitable for the course here, and it has been found necessary to use several of them and to make suitable selections therefrom. As much as possible, text-books without vocabularies have been selected, as experience has proved that more French is acquired and more French retained when the learner has to search for the meaning of words and sentences in the dictionary than when he relies upon incomplete and faulty vocabularies and notes in the text-book. The first reader used (Roemer's, Vol. I) contains examples of comparatively easy French for beginners, the extracts gradually increasing in difficulty, and gives the learner acquaintance with literary French. It is followed by a French play, which gives the learner an opportunity of becoming acquainted with conversational and everyday French.

The reading begins at the seventeenth lesson in the course, experience having shown that this is as soon as advisable. The cadet will also then be in the first review in grammar, and can begin reading to better advantage. The lessons are then continuous until the seventy-sixth lesson in the course, when the remaining lessons are given to review.

#### THE SECOND COURSE.

As a thorough and familiar knowledge of the verbs is essential, repetition of their study is necessary. Beginning, therefore, at the first verb in the verb book, two verbs are assigned to each lesson as far as the fiftieth lesson, after which the verbs previously learned are reviewed.

For a text-book in grammar in this course it has proved advantageous to use a grammar entirely in the French language. Though the use of a grammar in French is somewhat difficult in the first lessons therein, yet it soon becomes simple, and the ability of the cadet to read French is much increased thereby. Lessons, simplified as much as possible by the omission of everything except the principles and rules with a sufficient number of illustrative examples to explain them, are assigned continuously in the advance lessons until the seventieth lesson in the course, when the remaining lessons are given to review. Dictation exercises begin in this course, and are given every Monday. In the second course, it is considered that the cadet has made sufficient progress in his knowledge of the language to admit of the introduction of a course in the study of French idioms. The text-book used on that subject is peculiarly suited, on account of the number of lessons into which it is divided and the arrangement of the subject-matter in each lesson, to the limitations and requirements of the course here. The book is divided into 50 lessons, each lesson containing two idioms with explanation, an exercise in French exemplifying the idioms, a short theme or composition, and a conversational exercise. Beginning with the second lesson of the programme of lessons, one lesson in the text-book on idioms is assigned to each lesson in the course, omitting the French exercise and the conversation, and taking only the two idioms and the theme or composition; at the fiftieth lesson the book is completed, and the idioms are then gone over again in 50 lessons. In the review the theme or composition and the conversation are omitted, only the

two idioms and the French exercise being required. As the course in grammar contains no themes, but only principles or rules and illustrative examples, the course of grammar and idioms taken together is no more difficult than an ordinary lesson in grammar.

As the cadet is to be an officer of the Army, the course in the French language should give him something of a military vocabulary. The course in reading, therefore, has a certain amount of military literature. As the cadet at this stage of his progress has a fair acquaintance with literary and everyday French, it has been decided to introduce military literature in this course, keeping it subordinate to general literature. For this purpose one lesson per week is assigned in a French military periodical, the *Revue Militaire de l'Etranger*, thus giving in the second course 16 lessons in military reading. As it is deemed important to acquire as large a military vocabulary as possible, and as the style in military literature is generally quite simple and easy, the reading in the *Revue Militaire de l'Etranger* is continuous without any review. This periodical is taken by a six months' subscription each year, and consequently has the advantage of dealing with current military matters. Moreover, in addition to the instruction it gives in the use of the French language, the information it gives is eminently valuable to the military student, and is likely to be remembered.

The remaining lessons in reading, 86 in number, are devoted to general literature and a French play, and are divided into advance and review.

#### THE THIRD COURSE.

This course has only 40 lessons, and is the final or finishing course in French.

The study of the verb is continued and repeated by assigning two verbs in the verb book to each lesson, as in second course. The lessons in this course, however, are without any review.

It is believed that the grammar course at this stage of the instruction in French should be of the nature of a general review or survey of the general and important principles of the language, combined with some instruction in the historical development of its various forms and constructions, the latter instruction being adapted to the knowledge and capacity of the cadet. Some knowledge of this historical development is not only information proper for an educated man, but is extremely useful in enabling the student to understand, remember, and use the various forms and constructions of the language he is studying. As best answering the above requirements, Edgren's Grammar has been selected for this course. Its explanations of many of the difficulties of French are plain and clear, and its account of the development of the various forms, though sufficient for the purpose, is concise and easily understood. In using this text-book, the themes and illustrative examples are shortened when considered longer than necessary.

The lessons are continuous with no review, as the whole third course is of the character of a general review or survey of the general principles of the language.

As there are only 40 lessons in the third course and 50 lessons in the text-book for idioms, 40 of the most important lessons in the book are selected and assigned to each lesson in this course. Each lesson includes the two idioms, the French exercise, and the conversational exercise, the theme being omitted. This conversational exercise is used orally.

In this course the military reading is made predominant. There is also introduced a course of reading from a French newspaper taken three months each year.

The following division is made of the different kinds of reading during the third course: Military reading from the *Revue Militaire de l'Etranger* during three days of the week; reading in general literature during two days of the week; reading at sight from a French newspaper for one day of the week. The lessons in reading are continuous in all kinds of reading, without any review. Review lessons in reading are necessary in the beginning of the study of a language, in order to test the learner's knowledge of what he has gone over, to reiterate explanations, and to familiarize him with the constructions and the words that make up the framework of a language; but after that it is more advantageous to read continuously and as much as possible, not only on account of acquiring a larger vocabulary, but also on account of the learner's interest in the subject being better maintained.

The characteristics of the course in French are the variety of grammatical instruction arising from the use of many grammars, which enables the same subject to be presented in different ways and which gives more benefit than several reviews in the same book, the extent and variety of the course in reading, military reading, sight reading, the course of idioms, and the daily drill in pronunciation.

#### THE SPANISH LANGUAGE.

The system and methods used in the course in Spanish follow the same lines as in French, with the exception that there is no military reading and no course of idioms,

time not being available therefor. On account of the small number of lessons, the same proficiency as in French can not be attained.

As in French, the first 2 lessons are given to pronunciation, which is afterwards taught and practiced by the same methods as in French. Grammar begins at the second lesson of the course, and the lessons therein are continuous, without any intermediate review, until the fifty-first lesson, when the remaining lessons are given to review.

A good knowledge of the forms of the verb in Spanish is relatively of greater importance than in French, owing to the ordinary omission of its subject. The ease and quickness with which the verb in Spanish may be understood and learned depends almost entirely on the manner in which its forms are named, explained, and presented. For these reasons Knapp's Grammar has been selected as the text-book for verbs, and also for the reason given in the course in French that verbs are always better learned in a verb book separate and distinct from the grammar. By Knapp's method of arranging and naming the different forms, certain peculiarities that are exceedingly difficult for beginners are made clear and comprehensible. His treatment of irregular verbs simplifies greatly their acquirement.

Although beginning a new language, yet as the cadet has had instruction in a foreign language for some time, it is believed that he can easily begin the study of verbs at the third grammar lesson, or fifth lesson of the course. After completing the verb "haber" and the three model verbs of the regular conjugations in 7 lessons, they are reviewed in 5 lessons. After that the lessons are continuous until the fifty-sixth lesson, when the remaining lessons are given to review.

It has been found necessary to use three text-books to answer the requirements of the course in reading. In no other way was it possible to combine the necessary ease for beginners with the necessary variety in vocabulary and construction, and variety in examples of the literature of the language as well as its everyday speech. It is particularly the case in the Spanish course here, where it is necessary to have as much variety as possible in a short period of time. In selecting the three readers used, it has been the aim to secure thereby easy and simple selections for the beginning of the course in reading, good and representative examples of modern Spanish literature, and also reading selections that would give instruction in everyday speech and in the names of the ordinary and usual objects therein mentioned. The *Eco de Madrid* is used for the latter purpose.

The reading course begins with Mantilla's Reader and at the twelfth grammar lesson, or fourteenth lesson of the course. The first 4 lessons in Mantilla's Reader are reviewed in 2 lessons. After that the lessons are continuous until the sixtieth lesson of the course, or forty-sixth lesson in reading, and in the following order: Fifteen lessons in Mantilla's Reader, 15 lessons in the *Eco de Madrid*, 16 lessons in Knapp's Spanish Readings.

The remaining lessons are given to a review, as it is not deemed judicious to omit a review in reading in the short period of time the cadet has to give to the study of Spanish.

In comparing the present course with former courses in the three languages, the comparison must be made between differences in arrangement of time and differences in matter and instruction. Formerly the three languages were in three different departments and under three different professors; now they are all under one head. Formerly and until 1893 two of the three languages were taught at the same time in the same class; now each language is taught separately, and the three languages follow one another in due succession—a great advantage over the former arrangement. In regard to the time devoted to their study, formerly French varied from 400 recitations to 272, having once 238 recitations; now it has 242 recitations. Formerly Spanish varied from 170 recitations to 60; now it has 78 recitations. English studies since their reintroduction in 1877 varied from 60 to 124 recitations; now it has 84 recitations.

In regard to matter and instruction, English at the present time differs from the former courses in the absence of instruction in grammar, in having a course in the history of the language and of its literature, in allowing only the heads of a subject to be put upon the blackboard, and in requiring synopses. French differs from former courses in having a greater variety of text-books in grammar and in reading, in having a course of military reading, in reading from a French newspaper, in the practice of sight reading and in requiring it at all examinations from every cadet, in having dictation exercises, in the method of teaching pronunciation, in having daily pronunciation drill, and in the absence of a review in reading in the final course. Spanish differs in the greater variety of the reading, in having sight reading, requiring it of every cadet at the examination, and in the method of teaching pronunciation.

As the object and aim of the instruction at the Military Academy give it a special character peculiarly its own, I have found it impossible to make any fair comparison between the course here and in other institutions.

The advantages of the present course are in the arrangement of studies, which permits the three languages to be studied separately without interfering with one another, and which permits them to follow one another in due order.

The defects are, first, the short time given to Spanish; second, the fact that the instructors are required to be versed in three languages and are required to teach two different languages at the same time, hearing recitations in both languages on the same day.

Language being so much a matter of acquired and afterwards involuntary habit, it is difficult to pass from the atmosphere of one immediately into the atmosphere of another for the purpose of instruction.

I am, sir, very respectfully, your obedient servant,

E. E. WOOD,

*Professor of Modern Languages, U. S. M. A.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

## K.

### METHODS OF INSTRUCTION IN LAW AND HISTORY.

#### THE DEPARTMENT OF LAW.

The Regulations of the Military Academy, issued under the authority of the Secretary of War on July 10, 1816, prescribed that "a course of ethics shall include natural and political law." It is difficult at this distance of time to understand what was meant by the terms thus used by the Secretary of War. Natural law, a term but little used in England and the United States, relates to a subject which has always been extensively studied on the continent of Europe, especially in those states whose jurisprudence is derived from or based upon the civil law. Natural law, the *jus naturale* of the Roman law, may be defined<sup>1</sup> as "the rule and dictate of right reason, showing the moral deformity or moral necessity there is in any act according to its suitableness or unsuitableness to a reasonable nature," and embraces those fundamental rules of conduct in human affairs which have received general assent and recognition in all civilized states. It also includes matter which in England and the United States would be taught under the name of ethics or moral science. As I can find no record of the adoption or introduction of a text-book on this subject I am constrained to believe that no formal instruction was given at any time in natural law.

The term political law, as used in 1816, is also somewhat vague. The great text-book on that subject, prepared by Sir William Blackstone, and published in 1758, would have been too voluminous for use in a course of study so elementary in all respects as was that which appeared in the Regulations of 1816. I am disposed to believe that the regulation above cited is to be regarded rather as an expression of the executive will, as to the general importance or necessity of the study of law in some form at the Academy, than as a direction that the two subjects named should form a part of the official course of study.

Section 2 of the act of April 14, 1818 (3 Stat. L., 426), provided that there should be "one chaplain stationed at the Military Academy at West Point, who shall be professor of geography, history, and ethics, with the pay and emoluments allowed the professor of mathematics." Under the authority conferred by this statute the Rev. Dr. Thomas Picton was appointed chaplain and professor of ethics on July 23, 1818, and continued in office until January 21, 1825, when he left the service by the resignation of his commission. The first text-book of law studied at the Military Academy seems to have been Vattel's *Law of Nations*, then as now the most widely accepted standard of authority on the subject of which it treats.

The records show that Wheaton's *National Law* was introduced at some time prior to 1839, when it was replaced by Kent's *Commentaries*. I can hardly believe that the title cited is that of the text-book actually adopted and studied. The first edition of Wheaton's *International Law* was issued in 1836 and was, in all probability, adopted as a text-book immediately upon its publication. I have been unable, after considerable inquiry, to learn that Mr. Wheaton ever wrote on the subject of national, as distinguished from international, law. He was for many years the reporter of the decisions of the United States Supreme Court, but never wrote upon the subject of national or constitutional law. His work gave place in 1839 to Kent's *Commentaries*, a single volume covering the subjects of both constitutional and international law, which continued to be used as a text-book in those subjects for more than thirty years.

<sup>1</sup> Taylor's *Civil Law*.

Professor Picton was succeeded in the chair of geography, history, and ethics by the Rev. Charles P. McIlvaine, who resigned on December 31, 1827, and was in turn succeeded by Prof. Thomas Warner, who was appointed on January 1, 1828, and continued in office until September 1, 1838, when he vacated the office by resignation, and was succeeded by Prof. Jasper Adams, during whose incumbency of the office Chancéllor Kent's work was adopted as the principal text-book in the course of study in law.

The register of the Academy for 1841 contains the name of the Rev. M. P. Parks as professor of geography, history, and ethics, and the register for 1842 contains the first outline of the course of study in law, together with a list of the text-books then in use at the Military Academy. In this list appears Kent's Commentaries, including the constitutional and international law, Vattel and Wheaton having both been superseded. The Rev. William T. Sprole became chaplain and professor of geography, history, and ethics on March 2, 1847, and was "superseded" in that office on August 16, 1856, by the Rev. John W. French.

During the incumbency of Professor French, which extended over a period of about fifteen years, an extensive course of study was built up, including all of the subjects mentioned in the act of April 14, 1818. In the academic year 1858-59 instruction in the subject of military law was first given, the text-book adopted for that purpose being De Hart's Courts-Martial. During the ensuing year the study of the rules and articles of war was for the first time made a part of the course of study in law. The register for the year 1862 shows Professor French's pamphlet on Law and Military Law to have been made a part of the course of study. In the academic year 1866-67 Halleck's International Law was introduced, replacing Kent, and Benét's Military Law, replacing De Hart. In the academic year beginning September 1, 1867, all instruction in the subjects of geography, history, and ethics was discontinued, and the course of study pursued under the direction of the chaplain included only the subjects of international, constitutional, and military law.

The vacancy in the chair of geography, history, and ethics, caused by the death of Professor French on July 8, 1871, was filled on the 28th of July following by the appointment of the Rev. Dr. John Forsyth, who continued to give instruction in law until August 28, 1874, when under the authority conferred by the act of June 6, 1874, which provided that "the Secretary of War may assign one of the judge-advocates of the Army to be professor of law," Maj. Asa Bird Gardiner was detailed for duty in the department of law, and the several heads of department have since been assigned by the Secretary of War under the authority conferred by this statute, although under the acts of June 1, 1880, June 27, 1881, and June 30, 1882, any officer of the Army may be assigned to that duty.

Major Gardiner initiated numerous changes in the course of study. In the year 1875-1876, Woolsey's International Law replaced the text-book of General Halleck on that subject, and the new work of Professor Pomeroy on Constitutional Law replaced Kent's Commentaries. Professor French's pamphlet on Law and Military Law, was retained and Benét's Military Law discontinued as a text-book, the latter being replaced by Gardiner's Practical Forms for use in Courts-Martial and Head Notes on the Law of Evidence in Courts-Martial, and the systematic study of General Orders No. 100 of 1863, containing Dr. Francis Lieber's admirable presentation of the rules of modern war, was introduced as a supplement to the course of International Law. Major Gardiner was relieved on August 28, 1878, and Maj. G. Norman Lieber, of the Judge-Advocate-General's department, now the Judge-Advocate-General of the Army, was assigned to duty as professor of law.

During Major Lieber's incumbency of the office, Ives's Treatise on Military Law was introduced and Pomeroy's Constitutional Law was replaced by Judge Cooley's text-book on the same subject, which is still in use. Major Lieber was succeeded by Lieut. Col. Herbert P. Curtis, of the Judge-Advocate-General's department, who was in turn succeeded by Lieut. Col. William Winthrop, during whose incumbency Winthrop's Military Law was introduced during the academic year 1886-87. Colonel Winthrop was succeeded on August 28, 1890, by Maj., now Lieut. Col. John W. Clous, of the Judge-Advocate-General's department. Beginning with the academic year 1891-92, Davis's Outlines of International Law was introduced, replacing Woolsey's Elements of International Law. Colonel Clous was relieved on August 20, 1895, by Lieut. Col. George B. Davis, deputy Judge-Advocate-General, the present incumbent.

The present course of study in law covers the subjects of elementary law, constitutional law, international law, and military law; the text-books being Davis's Introduction to the Study of the Constitutional and Military Law of the United States, Cooley's Constitutional Law, Davis's International Law, and Winthrop's Military Law. The courses of study in elementary and constitutional law are completed during the first half, and those in international and military law during the last half of the academic year. In view of the character of the subjects studied, each text-book is passed through but once in advance and once in review, the general

review being omitted. The course in elementary law embraces 12 lessons in advance and 6 in review, and that in constitutional law embraces 20 in advance and 10 in review. During the half year it is proposed to give, at intervals, a course of 6 lectures upon the following subjects: The common law, the civil law, the constitutional law of the United States, crimes and criminal procedure, and the Government of the United States.

During the second half year the courses of study in international and military law will be passed over, the former in 20 advance and 10 review lessons; the latter in 18 lessons in advance and 9 in review. During this period two lectures will be given, one upon the history of the Articles of War, the other on the subject of military discipline and administration. Under the arrangement of studies which is to go into effect at the beginning of the next academic year (1896-97), the first class will attend recitations in law three times per week throughout the entire year, alternating daily with history, in which subject two hours of recitation per week are required. Instruction in both of these subjects is carried on upon the basis of one and one-half hours of study in quarters to each hour of recitation in the section room.

The mechanism of the recitation has already been fully and accurately described by the professor of mathematics in the article treating of the course of study in that department. It only remains, therefore, to describe those matters in which the course of study in law differs from that pursued in the department of mathematics. Cadets are encouraged to ask questions and to bring to the attention of the instructor any points in the lesson of the day which may have seemed to them either difficult or obscure. These are explained to them before the recitation begins, which is carried on in the same manner as a recitation in mathematics. The practical work in the section room consists in the study of cases bearing upon the lesson of the day, the enactment, modification, and repeal of statutes, the examples being taken from the Revised Statutes and Statutes at Large of the United States, and in the application of the rules of interpretation to the statutes relating to the military establishment of the Federal Government. Cases from the reports of the United States courts are also given out for special study when important points are involved in respect to the military or constitutional law of the United States. The course of study is precisely the same for all the sections.

As at present organized, the department consists of a professor, an assistant professor, and three acting assistant professors, all detailed from the Army. For purposes of recitation the first class is divided into eight sections of nine cadets each, who attend recitations daily from 2 p. m. to 4 p. m. on Monday, Wednesday, and Friday of each week during the entire academic year. The same instructors hear recitations in history on Tuesday and Thursday of each week during the same period. The recitations are carried on, as has already been stated, in the same manner as recitations in mathematics. The same or similar section rooms and furniture are used, and the recitations are marked on the same scale and in accordance with the same system. In each section two or more of the daily recitations are required to be in writing, the subjects being chosen from the lesson for the day or taken in the form of general questions from the lesson of the day before. The recitations in writing are marked on the same scale and have the same value in all respects as the oral recitations. As there are four sections reciting at the same hour, it is impossible for the head of the department to visit each section more frequently than twice per week, the lower sections being visited more frequently than those at the head of the class where any variation is made.

The weekly class reports are made in the same form and convey the same information as those submitted by the department of mathematics. Transfers are made, as a rule, whenever a cadet has an aggregate mark greater by two units than the lowest mark in the section immediately above or less by the same amount than the highest mark in the section immediately below. While this rule is general, exception is made when from sickness, absence, or other unavoidable cause injustice would be done by its strict enforcement. The marks are posted on Saturday of each week in the frames provided for that purpose in the north hall of the Academy Building.

As two courses of study are carried on independently, the examinations are arranged in such a way as to allow one of the classes to be examined orally and the other in writing at each semi-annual examination. In this way each class as it passes through the courses of study in law and history will be examined orally and in writing in each subject of study. The weights to be attached to the term marks in advance and review and the special weight to be given to each form of examination are determined by the Rules for the Guidance of the Academic Board and its Committees.

The present arrangement of the course of study in law is based upon the experience of many years, and seems to be fairly well adapted to the peculiar needs of the institution and at the same time to carry into effect the will of Congress in its several enactments directing that the study of law shall be pursued at the Military Academy.

## THE DEPARTMENT OF HISTORY.

The offices of chaplain and professor of geography, history, and ethics, created by the act of April 14, 1818, after a joint continuance of something more than seventy-eight years, were dissociated by the act of February 18, 1896, which directed the discontinuance of the latter and vested the duties of the former in an officer to be appointed by the President for a term of four years. The study of history was transferred by Executive order to the department of law, thus bringing together after a separation of nearly twenty-two years the closely related studies of history and law.

The present course of study in history went into effect on September 1, 1883, and was comprised in a course of 50 lessons, begun and completed during the first half of the academic year. The re-introduction of history into the official course of study was due to patient and persistent endeavors of the late Rev. Dr. William M. Postlethwaite, who succeeded Rev. Dr. John Forsyth in the chaplaincy and professorship on December 21, 1881. For a little more than twelve years the course of instruction in history was carried on under the able guidance of Professor Postlethwaite, whose labors were interrupted by his untimely death in January, 1896.

For purposes of instruction in history the first class was divided into sections in September of each year, the arrangement of the class being based upon the general merit roll of the preceding year. Each half class attended recitations three times per week from September to December and the course in history closed with the semi-annual examination in January.

With the resumption of academic duties in September, 1896, the new arrangement of the courses of study in law and history will become operative. The entire first class will attend recitation daily between the hours of 2 p. m. and 4 p. m. On Monday, Wednesday, and Friday instruction will be given in law and on Tuesday and Thursday in history, the same instructors and section rooms being used for both branches of study.

Myers's General History, the text-book adopted by the Academic Board, will replace Swinton's Outlines of the World's History, which has been in use since the re-introduction of the course of study in history in 1883. The new text-book is so arranged as to enable the course in ancient history to be completed during the first term, leaving the study of mediæval and modern history for the longer term from January to June.

The methods of instruction in history are the same in all respects as those prevailing in the department of law, which have already been described. The best attainable maps are constantly and freely used in the course of instruction, and a part of the written recitations in this subject will be devoted to the graphic representation of the growth and development of the principal states of antiquity and to the origin, colonization, and territorial development of the great states now constituting the civilized world.

## L.

WEST POINT, N. Y., August 28, 1896.

SIR: In accordance with the requirements of instructions of October 3, 1895, I have the honor to submit the following report of the course of studies and methods of instruction, including practical instruction, employed at the United States Military Academy in the department of civil and military engineering.

In the preparation of part I I have been assisted by notes left by Prof. James Mercur. Parts 2 to 6 are almost wholly the work of Lieut. Thomas H. Rees, Corps of Engineers, acting assistant professor of this department.

Very respectfully,

G. J. FIEBEGER,  
*Professor of Engineering.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

## PART I.

BRIEF HISTORICAL SKETCH OF THE DEPARTMENT, GIVING DATES OF ESTABLISHMENT, ITS SCOPE IN THE BEGINNING, AND IMPORTANT STEPS IN ITS DEVELOPMENT.

Some time during the years 1795 to 1798, while the regiment of artillerists and engineers was stationed at West Point, Colonel Rochefontaine and Captain Rivardi, formerly of the French Army, constructed a small model front of a fortification.

Upon the establishment of the Military Academy, by act of Congress dated March 16, 1802, instruction in military engineering began at once, and the elements of fortification were taught by the use of this model.

Until 1818 the instruction in military engineering was by means of lectures illustrated by the model above mentioned and by field exercises in practical engineering. The lectures were delivered by the superintendent until 1808, by the teacher of French, Francis O. Musson, from 1808 to 1813, and after that by the professor of engineering.

The only text book in use was a small pamphlet of 50 pages, translated from the French by Col. Jonathan Williams, Corps of Engineers, the first Superintendent.

The department of engineering was established by an act of Congress of April 29, 1812:

"SEC. 2. *And be it further enacted*, That the Military Academy shall consist of the Corps of Engineers and the following professors: \* \* \* one professor of the art of engineering in all its branches, \* \* \* and each of the foregoing professors shall have an assistant professor, taken from the most prominent characters of the officers or cadets."

Under this act Capt. Alden Partridge, Corps of Engineers, was appointed professor of engineering September 1, 1813.

Captain Partridge graduated from the Military Academy October 30, 1806, and was assigned to the Corps of Engineers. He served at the Academy as assistant professor of mathematics November 4, 1806, to June 5, 1811; as principal assistant professor of same April 29, 1812, to September 1, 1813; as professor of engineering September 1, 1813, to December 31, 1816. Much of the time while he was professor of engineering he was also Superintendent of the Academy, and therefore gave little attention to the work of his department.

General Cullum, in his history, gives the following as the state of the instruction in engineering at this time:

"Engineering was less attended to than French or drawing, the greater number of cadets on graduating never having gone beyond the definitions to be found in Colonel Williams's little primer of 50 pages on the subject, which was their only text-book. Many cadets scarce knew the difference between the ditch and the glacis of a fort save by the conventional colors adopted in their delineation. It is said that two cadets were graduated in 1815 in the Engineer Corps, whose studies never extended beyond Hutton's Trigonometry."

Captain Partridge was, on March 16, 1817, succeeded by Prof. Claude Crozet, who had been assistant professor of engineering since October 1, 1816.

Professor Crozet was born in France and was educated at the Polytechnic School. He introduced descriptive geometry as a necessary preliminary to the proper study of engineering, made much use of the blackboard in demonstrations, and seems to have made use, as far as practicable, of the methods of the Polytechnic School in developing and teaching the course of engineering.

The work of all the departments in the Academy was at this time (1817) greatly aided by the reforms instituted by the new Superintendent, Col. Sylvanus Thayer.

In 1818 there was introduced as a text-book in the department, *A Treatise on the Science of War and Fortification*, by Colonel de Vernon, professor of fortification in the Polytechnic School, France, and translated by Capt. John M. O'Connor, United States Artillery. This excellent work was used until the introduction of the works of Professor Mahan. The original text had been submitted to the revision of a board of distinguished marshals and engineers, and then, by order of Emperor Napoleon I, was adopted as a text-book of the Polytechnic and Military School of France. It was in two volumes, with a volume of plates. The first treated of the science of war in general, and field fortification; the second of permanent fortification, and in an appendix was given a summary of the principles and maxims of grand tactics and operations.

The staff records for 1819 indicate the method in which it was studied.

"1. The class of the fourth year (the first in rank) to be divided for instruction in the military course into two sections, after the manner practiced in the other classes of the institution.

"2. The first section to be instructed in the entire course of engineering, military science, and grand tactics in the book now used, and to be required to execute a series of drawings and plans connected with these subjects, this course to begin on the 1st of September of each year, and to end on the 20th of March next ensuing, sooner or later.

"3. The second section to be taught, in connection with military science and grand tactics, field engineering only, the whole of which will be comprised in the first volume and appendix to the work."

The other books used in the course were in French, and probably used only as aids to a course of lectures or as books of reference. They were: *Program d'un Cours de Construction* par Sganzin, translated in 1827, and *Traité des Machines* par Hachette

The regulations of 1821 indicate that at this time the professor of engineering taught some of the sections himself.

"The professor of \* \* \* engineering, in order to ascertain the proficiency of the sections entrusted immediately to the assistants and the manner in which they have performed their duty, shall occasionally, and in rotation, when there are more than two sections, instruct the sections entrusted to his assistants, the period for which shall be fixed by the academic staff and reported to the War Department; and the assistant professor, when the professor has his section under instruction, shall take charge of the section usually under instruction of the latter."

Prof. David B. Douglass on May 1, 1823, succeeded Professor Crozet, who resigned April 28, 1823.

Professor Douglass was appointed second lieutenant Corps of Engineers August 1, 1813. He served at the Academy as assistant professor of natural and experimental philosophy June 1, 1815, to August 29, 1820, as professor of mathematics August 29, 1820, to May 1, 1823, and as professor of engineering May 1, 1823, to March 1, 1831.

The records are not definite as to what was accomplished during his incumbency, but it appears that the instruction in civil engineering was much improved.

Professor Douglass resigned March 1, 1831, and was succeeded by Prof. Dennis H. Mahan, January 1, 1832.

Professor Mahan graduated from the Academy July 1, 1824, and was assigned to the Corps of Engineers. He served at the Academy as assistant professor of mathematics August 29, 1824, to August 31, 1825, and as acting professor of engineering September 1, 1830, to January 1, 1832. Between 1825 and 1830 he spent four years in Europe studying public works and military institutions, and was during one of these years a pupil in the military school of application for engineers and artillerymen at Metz, France. The first work of Professor Mahan was to prepare a suitable set of text-books for his department; he temporarily supplied their places by lectures and his notes made while abroad.

The first record of a complete set of text-books is found in the register of 1841, and is as follows: Mahan's Treatise on Field Fortification, Mahan's Lithographic Notes on Permanent Fortification, Mahan's Lithographic Notes on Attack and Defense, Mahan's Lithographic Notes on Mines and other Accessories, Mahan's Lithographic Notes on Composition of Armies and Strategy, Mahan's Course in Civil Engineering, Mahan's Lithographic Notes on Architecture and Stone Cutting, Mahan's Lithographic Notes on Machines (for first section only). These books, frequently revised, constituted the basis of the course of engineering during the time of Professor Mahan. In 1848 he introduced Mahan's Advanced Guard and Outposts, 1858, Moseley's Mechanics of Engineering, and in 1870 Mahan's Industrial Drawing.

The instruction was confined to the fourth, or first-class, year, except during the years 1858 to 1860. The classes of 1859 and 1860 studied civil engineering during the second-class year, and the class of May, 1861, had no instruction in civil engineering.

No records are available giving a description of the methods of instruction, etc., which were in use during the entire time of Professor Mahan. Professor Mercur states that in 1865-66, when he was a student, the classes were divided into sections of 10 to 12 men each, each section receiving instruction for one and a half hours daily, between 8 and 11 o'clock a. m. When engaged in drawing, the entire class attended daily from 8 to 11 o'clock. Each section was under the immediate charge of an officer, usually of the Corps of Engineers, as instructor. The professor visited the sections daily, listening to the recitations, asking questions, making such comments and remarks and giving such additional instruction as seemed to him necessary and desirable. By this means he gained a knowledge of the capacity of the instructors, their methods of teaching and marking, and was also able to compare the individual cadets.

But few lectures were given by Professor Mahan, and these were restricted almost entirely to short descriptions of campaigns and battles, with criticisms upon the tactical positions involved. The greater portion of his oral and personal instruction was given to the cadets during his visits to the section room.

The course of engineering drawing included the accurate construction of a number of problems contained in fortification drawing and stenotomy, drawings of a canal lock in plan, section, and elevation, and the plan, section, and elevation of a half front of fortification, Noizet's Method. The canal lock and Noizet's Method were finished as completely as time allowed, and the sections, slopes, etc., were usually tinted in water colors.

Upon the death of Professor Mahan, September 16, 1871, Prof. Junius B. Wheeler was appointed September 29, 1871.

Professor Wheeler graduated from the Military Academy July 1, 1855, was first assigned to the cavalry and afterwards transferred to the topographical engineers. He served the Academy as acting assistant professor of mathematics October 5, 1859, to April 27, 1861, and assistant professor of same September 5, 1861, to June 18, 1863.

During his incumbency the course and method of instruction established by Professor Mahan remained unchanged in its essential features. Professor Mahan's text-books were revised, new material added, and portions omitted. In engineering drawing, roof and bridge trusses were substituted for the canal lock and other problems, and the Noizet front was slightly changed.

Professor Wheeler retired September 29, 1884, and was succeeded by Prof. James Mercur September 29, 1884.

Professor Mercur graduated from the Academy June 18, 1866, and was assigned to the Corps of Engineers. He served at the Academy as acting assistant professor of natural and experimental philosophy August 31, 1867, to February 21, 1870, and as assistant professor in the same February 21, 1870, to July 31, 1872.

In notes left by him Professor Mercur states that under his direction no radical change has been made either in course or methods of instruction. He revised the text-books previously used to conform to modern engineering practice and the advance in the science and art of war. A description of his methods of instruction is found in parts 2 to 6 of this report.

Professor Mercur died April 21, 1896, and was succeeded May 26, 1896, by Prof. G. J. Fiebegger.

## PART 2.

STATEMENT OF THE PRESENT COURSE, GIVING TITLES OF TEXT-BOOKS, FULL LIST OF SUBJECTS, NUMBER OF LESSONS IN EACH SUBJECT, ADVANCE AND REVIEW, LENGTH OF LESSONS, HOURS OF STUDY, LENGTH OF RECITATIONS, TOTAL NUMBER OF HOURS DEVOTED TO EACH SUBJECT DURING THE TERM INSIDE AND OUTSIDE THE SECTION ROOM, NUMBER OF LECTURES AND SUBJECT OF LECTURES, DIFFERENCES IN COURSE FOR HIGHER AND LOWER SECTIONS, ETC.

The course in the department of civil and military engineering is, as the name implies, divided distinctly into two parts, viz: Civil engineering, which occupies the first term of the Academy year, from September 1 to December 31; and military engineering and the art and science of war, to which is allotted the second term of the Academy year, from the completion of the semiannual examinations in January to May 31.

Throughout the course, recitations in this department are daily on week days from 8 a. m. to 11 a. m., one-half of the class reciting from 8 to 9.30 and the other half from 9.30 to 11, except during the time allotted to engineering drawing, when the entire class attends from 8 to 11 a. m., with an intermission of about eight minutes at 9.30.

It is arranged that three hours of study in preparation for each recitation may be allowed and required.

*Civil engineering, September 1 to December 31.*—Text-books: Civil Engineering, Wheeler (John Wiley & Sons, New York, 1884); and Fortification and Stone Cutting, Mahan (John Wiley & Sons, New York, 1893). The subjects treated in Wheeler's Civil Engineering are as follows, viz: Building materials, strength of materials, framing, masonry, foundations, bridges, roofs, roads, railroads, and canals. This text-book has received from time to time numerous corrections and additions, which are given to the cadets in the form of printed sheets and pamphlets, with a view to keeping this course of instruction in accord with modern developments and methods in the science and art of engineering. At the same time, portions of the text that have become obsolete or which it is thought may be more satisfactorily presented have been omitted.

In this connection may be mentioned, besides minor corrections, a new treatment of the rolling load, also of the pressures sustained by retaining walls and of the loads on bridges and their effects. The subject of the graphical determination of stresses in framed structures is extended and improved, and there are issued to the cadets the following pamphlets, viz: Rivets, Riveted Joints, Pin-connected Joints, and Riveted Girders; Instructions for Truss Computations, and Notes on the Determination of Stresses in Trusses. The first of these takes the place of similar subjects in the text; the other two are for reference and assistance in the solution of problems.

That portion only of Mahan's Fortification and Stone Cutting which relates to the latter subject (stone cutting) is included in the course in civil engineering.

Civil engineering drawing includes generally for the upper part of the class the computations and drawings for an iron or steel highway or railroad bridge, and for the lower part an iron or steel roof truss. The time devoted to this drawing is from about November 20 to about December 11, or from 18 to 20 working days.

Number of lessons, civil engineering and stone cutting, September 1 to December 31 (first class).

|                      | First and second sections. |                |        | Third, fourth, fifth, and sixth sections. |                |        |
|----------------------|----------------------------|----------------|--------|---|----------------|--------|
|                      | Civil engineering.         | Stone cutting. | Total. | Civil engineering.                        | Stone cutting. | Total. |
| Advance .....        | 40                         | 5½             | 45½    | 42  | 3              | 45     |
| First review .....   | 20                         | 2½             | 22½    | 21  | 2              | 23     |
| General review ..... | 13½                        | 1½             | 15     | 14  | 1              | 15     |
| Total .....          | 73½                        | 9½             | 83     | 77  | 6              | 83     |

And in addition, engineering drawing for about eighteen days.

*Average length of lessons (approximate).*

|                      | First and second sections. |                | Third, fourth, fifth and sixth sections. |                |
|----------------------|----------------------------|----------------|--|----------------|
|                      | Civil engineering.         | Stone cutting. | Civil engineering.                       | Stone cutting. |
|                      | Pages.                     | Pages.         | Pages.                                   | Pages.         |
| Advance .....        | 12                         | 6.6            | 11.5                                     | 6½             |
| First review .....   | 24.1                       | 14             | 23                                       | 9.5            |
| General review ..... | 35.7                       | 23½            | 34.4                                     | 19             |

| Each of the higher sections has—                       | Hours.      |
|--|-------------|
| 45½ recitations in advance (1½ hours each) .....       | 68½         |
| 22½ recitations in first review (1½ hours each) .....  | 33½         |
| 15 recitations in general review (1½ hours each) ..... | 22½         |
| 18 sessions in drawing (3 hours each) .....            | 54          |
| <b>Total time in section room .....</b>                | <b>178½</b> |

| Each of the lower sections has—                        | Hours.      |
|--|-------------|
| 45 recitations in advance (1½ hours each) .....        | 67½         |
| 23 recitations in first review (1½ hours each) .....   | 34½         |
| 15 recitations in general review (1½ hours each) ..... | 22½         |
| 18 sessions in drawing (3 hours each) .....            | 54          |
| <b>Total time in section room .....</b>                | <b>178½</b> |

| All of the sections in civil engineering have—                 | Hours.      |
|--|-------------|
| 83 lessons, each requiring 3 hours study .....                 | 249         |
| 18 drawing sessions, each requiring 1½ hours preparation ..... | 27          |
| <b>Total time outside of section room .....</b>                | <b>276</b>  |
| <b>Total time inside of section room .....</b>                 | <b>178½</b> |
| <b>Aggregate .....</b>   | <b>454½</b> |

Allowing five minutes for the sections to form and to enter and leave the Academy building, there remain eighty-five minutes for the session of a single section. This time is employed about as follows:

|  | Minutes.  |
|--|-----------|
| Noting the next lesson; questions and explanations on the day's lesson ..... | 10        |
| Giving out enunciations .....  | 7         |
| One recitation by questions .....  | 12        |
| Seven recitations at blackboards, eight minutes each .....                   | 56        |
| <b>Total .....</b>   | <b>85</b> |

Other cadets in the section are given problems to work out or discussions to write at the board, or on paper at their desks, their work being examined and marked after the section is dismissed.

The higher sections finish the text-book in civil engineering in 40 lessons in advance, while the lower sections take 42 lessons in the same subject. This enables the higher sections to devote more time to stone cutting than the lower, the numbers of advance lessons being 5½ and 3, respectively, for the higher and lower sections.

This is the only difference in the courses of the upper and lower parts of the class, except that many subjects are more fully developed by the higher sections, and that their problem in engineering drawing is more difficult.

When a class has advanced about 18 lessons in civil engineering, a lecture has been delivered by the head of the department on "The materials of construction, the use of engineering formulæ, and the limitations and possibilities of the science of engineering." No other lecture is delivered during this course. The cadets of the first class are, however, given an opportunity to examine the models and engineering apparatus in the model room, with their instructors, who explain the construction and operation of the structures shown.

*Military engineering, January 1 to May 31, first class.*—Text-books: Elements of Field Fortifications, Wheeler (D. Van Nostrand, New York, 1882); Mahan's Permanent Fortifications, Mercur (John Wiley & Sons, New York, 1894); Attack of Fortified Places, Mercur (John Wiley & Sons, New York, 1894); Elements of the Art of War, Mercur (John Wiley & Sons, New York, 1894); Fortifications and Stone Cutting, Mahan (John Wiley & Sons, New York, 1893), of which only that portion which treats of methods of fortification drawing is included in this course.

In addition to the above, there are issued to the cadets of the first class, by the department, pamphlets containing some twenty descriptions of battles, campaigns, and other operations of war, to be studied by the cadets and used to illustrate the principles that are taught in the text-books. With the pamphlets are maps and plates showing the battle fields and theaters of operations described in the pamphlet.

Under the head of field fortifications the subject-matter treated is as follows: General principles and definitions, profile, trace, kinds of field works and lines, size and garrison, construction, revetments, defilade, interior arrangements, ditch defense, obstacles, works on irregular sites, bridge heads, hasty intrenchments, attack and defense of field fortifications, communications, and transportation.

Permanent fortifications is treated under the following heads: Profile, open and covered defenses, communications, encientes, outworks, advanced and detached works, retrenchments, systems and methods of fortification, existing German fortifications, detached forts, works on irregular sites, defilement of permanent works, accessory means of defense, seacoast defense, defensive organization of frontiers, progress of defensive methods, progress in methods of attack, modern construction in iron and steel.

In the attack of fortified places there is described, in part 1, blockade, surprise, assault, bombardment, siege works, including tools, etc., trenches, approaches, parallels, saps, etc.; tracing and construction of trenches and saps, siege batteries and magazines, siege operations, defense against a regular siege, siege parks, depots, etc.; and in part 2 (military mining) is given the nomenclature and theory of mines, galleries and shafts, ventilation, loading and firing, organization and tactics of mines, and demolitions.

The art of war is discussed under the following headings: Army organization and discipline, tactics, minor tactics in relation to logistics, grand tactics, minor operations, logistics, and strategy.

Recitations in this course begin each year about January 10 or 11, pursuant to an order from the Superintendent for the resumption of recitations after the completion of the semiannual examinations, and continue daily, Sundays excepted, until May 31, except during the time devoted to fortification drawing, from about March 20 to about April 23, when the entire class attends in the engineering drawing rooms from 8 to 11 a. m.

This drawing consists in the application of the methods of fortification drawing to the construction of plan, sections, and elevations of a detached fort for an intrenched camp.

*Number of lessons in military engineering, January 10 to May 31 (first class, all sections).*

|                      | Field fortification. | Fortification drawing (text). | Permanent fortifications. | Attack of fortified places. | Art of war. | Total. |
|----------------------|----------------------|-------------------------------|---------------------------|-----------------------------|-------------|--------|
| Advance .....        | 9                    | 3                             | 14                        | 15                          | 20          | 61     |
| General review ..... | 6                    | .....                         | 6                         | 8                           | 11          | 31     |
| Total .....          | 15                   | 3                             | 20                        | 23                          | 31          | 92     |

And in addition about twenty-eight days in fortification drawing.

*Average length of lessons.*

|                      | Field fortification. | Fortification drawing (text). | Permanent fortifications. | Attack of fortified places. | Art of war. |
|----------------------|----------------------|-------------------------------|---------------------------|-----------------------------|-------------|
| Advance .....        | Pages. 29            | Pages. 6                      | Pages. 11.4               | Pages. 12.27                | Pages. 14.6 |
| General review ..... | 45                   | .....                         | 26.7                      | 23                          | 20.7        |

*Number of hours devoted to each subject and to all subjects in military engineering, January 10 to May 31, first class, in section rooms, drawing, and study.*

|                    | Field fortification. | Fortification drawing (text). | Permanent fortifications. | Attack of fortified places. | Art of war. | Fortification drawing. | Total. |
|--------------------|----------------------|-------------------------------|---------------------------|-----------------------------|-------------|------------------------|--------|
|                    | Hours.               | Hours.                        | Hours.                    | Hours.                      | Hours.      | Hours.                 | Hours. |
| Section room ..... | 22½                  | 4½                            | 30                        | 34½                         | 46½         | 84                     | 222    |
| Study .....        | 45                   | 9                             | 60                        | 69                          | 93          | 42                     | 318    |
| Total .....        | 67½                  | 13½                           | 90                        | 103½                        | 139½        | 126                    | 540    |

This table is based on an allowance of one and one-half hours per day in section room and three hours per day study in quarters, and for drawing, three hours per day in drawing rooms and one and one-half hours per day preparation in quarters.

The time of recitation of a section in this course is divided and apportioned in the same manner as in the course in civil engineering, hereinbefore described, to which I would respectfully refer.

The course in military engineering is the same for all sections, except that some subjects are more fully developed by the higher sections than by the lower, and in fortification drawing the higher sections more nearly complete the sections and elevations of the work, whereas the lower sections usually finish only the plan.

At the end of the course a lecture has been delivered by the head of the department on the applications and use that may be made in the military service of the principles and methods taught in this course, with some remarks on courses of reading and study that may be profitably followed by graduates of the Military Academy. The descriptions of campaigns and battles were put in printed form in the pamphlet previously referred to, to serve in lieu of lecture notes.

These are given out as a part of and in addition to the regular lessons, at the rate of one or two per week, depending on their lengths, and form subjects for recitation in the section room. An opportunity is given to the class to visit the engineering museum and model room under the supervision of their instructors, who explain the models and apparatus and answer the questions of the cadets concerning them.

PART 3.

ORGANIZATION OF DEPARTMENT—NUMBER OF INSTRUCTORS—DIVISION OF DUTIES.

The department of civil and military engineering is organized as follows: One professor, head of the department; three instructors, of whom the senior in rank is appointed by the Superintendent to be assistant professor; one draftsman, employed by the department.

The professor of civil and military engineering administers the affairs, executes the business, and, subject to the approval of the Superintendent of the Academy, controls the policy and regulates the methods of the department. He recommends the text-books to be used in the course, revising and correcting them when advisable, prescribes the lessons, apportions the time to the various subjects, and, in order to insure uniformity and efficiency in the work of the department, supervises the instruction of cadets by frequent personal inspections of the progress and methods of his assistants.

There are also provided through his recommendation the necessary books of reference, apparatus, models, maps, materials, and supplies for the use of the department and the instruction of cadets.

The assistant professor, in addition to his duties as instructor, is charged with the care of the property of the department, and attends to the issuing and collecting of the books, pamphlets, maps, models, samples, and other articles used in section rooms, drawing rooms, and in the quarters of cadets, for their instruction. He acts

as instructor for two sections of the first class in engineering and aids the professor in such manner as the latter may direct. Each of the other two instructors is in charge of two sections of the first class in engineering, and, in addition, holds himself at the service of the professor for such other duties as may be prescribed.

The first class in engineering, being arranged originally in the order of their standing in natural and experimental philosophy, is organized into six sections, numbered in order from one to six, inclusive, the first section being the highest. The higher sections usually number one or two more cadets than the lower, in order that more time may be devoted to individual instruction and explanation in the lower part of the class, where presumably they are more needed. This organization of the class is maintained throughout the year, but the members of any or of all the sections may be changed by mutual transfers between the sections.

Each of the three instructors is charged with the instruction of two sections. The assistant professor begins each term with the first and second sections, the instructor second in rank begins with the third and fourth sections, and the junior instructor begins with the fifth and sixth sections. At the end of two weeks the instructors change sections, the senior taking the lower sections, the second in rank taking the higher sections, and the junior taking the middle sections. Thereafter the instructors change sections every two weeks in the order just indicated, except during engineering, drawing, and general review, when they retain the sections with which they began the term.

It is believed that this rotation of instructors eliminates to a great extent the effect of their "personal equations," and makes the merit marks of each section comparable by a just and uniform standard to those of all other sections.

This method has the further advantage of giving to all sections equal shares of the benefits arising from having the ablest instructor, and it enables the instructors to compare and weigh recitations in all parts of the class and to adjust their scales of marks to a truer and more uniform standard.

The personnel of the department during the academic year of 1895-96 was as follows:

Professor, James Mercur, until his death at Fort Monroe, Va., April 21, 1896; afterwards Gustav J. Fiebeger, appointed May 26, 1896.

Assistant professor, Henry C. Newcomer, first lieutenant, Corps of Engineers.

Instructors, Thomas H. Rees, first lieutenant, Corps of Engineers, and Francis R. Shunk, first lieutenant, Corps of Engineers.

Draftsman, Louis Marcy.

*Organization of first class, 1895-96, department of engineering.*

| Section. | Number of members. | Attendance.                | Time.      | Room. | Instructor.          |
|----------|--------------------|----------------------------|------------|-------|----------------------|
| 1        | 13                 | Daily, except Sundays..... | 9.30 to 11 | 206   | Lieutenant Newcomer. |
| 2        | 13                 | .....do.....               | 8 to 9.30  | 206   | Do.                  |
| 3        | 12                 | .....do.....               | 9.30 to 11 | 208   | Lieutenant Rees.     |
| 4        | 12                 | .....do.....               | 8 to 9.30  | 208   | Do.                  |
| 5        | 12                 | .....do.....               | 9.30 to 11 | 207   | Lieutenant Shunk.    |
| 6        | 11                 | .....do.....               | 8 to 9.30  | 207   | Do.                  |

The rooms in the Academy building occupied and used by the department of civil and military engineering are as follows:

|                                  | Numbers.      |
|----------------------------------|---------------|
| Office.....                      | 200           |
| Section rooms.....               | 206, 207, 208 |
| Engineering drawing academy..... | 201, 202      |
| Drafting room.....               | 205           |
| Map and chart rooms.....         | 203, 300      |
| Photography and lithography..... | 305           |
| Model room.....                  | 106           |

PART 4.

THE DESCRIPTION OF A RECITATION, INCLUDING A DESCRIPTION OF A SECTION ROOM—NUMBER OF CADETS IN A SECTION—ASSIGNMENT OF SEATS—QUESTIONS AND EXPLANATORY ANSWERS—ASSIGNMENT OF SUBJECTS FOR RECITATIONS—USE OF THE BLACKBOARD—APPARATUS—MERIT MARKS—VISITS OF THE HEAD OF THE DEPARTMENT.

The section rooms used by the department of civil and military engineering are similar in all respects to the rooms on the same floor used by the department of

mathematics. The formation of the class parade, the report of the sections to the instructor, and the method of conducting oral recitations by blackboard demonstration and by questions are also similar to the general method followed by the department of mathematics. As these subjects have been very fully and carefully described in the report of that department, it is thought advisable to refer to that description and to give in detail in this report only the points in which the two departments differ.

The apparatus belonging to the department and used in the instruction of cadets consists of testing machines, models of engineering implements and machinery, including pile drivers, derricks, dredges, engines, etc.; models of engineering structures, such as arches, bridges, buildings, roof trusses, dams, locks, caissons, piers, crib work, etc.; samples of building material, models of fortifications, battle fields, defensive arrangements, block houses, etc. The smaller models and pieces of apparatus are displayed on the tables in the section rooms when they are subjects of discussion in the lesson. The larger models are in the model room (No. 106), and are described and explained to the cadets when they visit this room with their instructors. The department possesses a number of tables, drawing boards, steel rulers and triangles, color saucers and glasses for the use of cadets in engineering drawing, and the usual instruments used in reconnaissance.

In engineering drawing the entire class attends daily, except Sunday, from 8 a. m. to 11 a. m., with an intermission of about eight minutes at 9.30. Several days before the drawing begins each cadet receives a drawing board, which he takes to his quarters, and upon which he stretches a sheet of drawing paper, bringing it back to be inspected by his instructor. On the first day of drawing the whole class enters the engineering drawing academy (rooms 201 and 202, Academy building), and each cadet, directed by his instructor, seeks the table that contains his drawing board. The tables and boards have been previously arranged so that the two sections of each instructor shall be kept together in a selected portion of the rooms, and the instructor's desk and chair are so placed that he may readily oversee the work of his sections. Cadets remain standing while working at their drawings, and are required to keep at work continuously and to refrain from communicating with their neighbors and from examining adjacent drawings. Their work is inspected daily by their instructor, who points out errors and gives such directions and assistance as may be necessary. The work is marked twice a week, on Tuesdays and Fridays, each mark representing an estimate of the progress, accuracy, neatness, and industry displayed in drawing, the scale of marks used being the same as for ordinary recitations, i. e., the maximum mark for three days of perfect work is 3. At 9.20 a. m. the class is dismissed by sections for a recess of about eight minutes, forming again and returning to their work at 9.30.

Merit marks for recitations and drawings are recorded in the section book furnished to each instructor by the adjutant of the Academy for this purpose. The names of the cadets in a section, arranged in the order of their standing, and their marks for one week are entered on the left-hand page in the appropriate lines and columns, and the subjects upon which they have recited, indicated by the numbers of the paragraphs in the text-book, are entered in corresponding columns on the right-hand page, as may be seen in the following tables:

[First class, third section, 1896, department of engineering.]

LEFT-HAND PAGE.

| No. | Name.  | Monday,<br>Jan. 20. | Tuesday,<br>Jan. 21. | Wednes-<br>day, Jan.<br>22. | Thurs-<br>day, Jan.<br>23. | Friday,<br>Jan. 24. | Satur-<br>day, Jan.<br>25. | Weekly<br>total (18). | Total<br>(42). |
|-----|--------|---------------------|----------------------|-----------------------------|----------------------------|---------------------|----------------------------|-----------------------|----------------|
| 1   | H..... | 2.8                 | 3                    | 2.9                         | 2.2                        | A                   | A                          | 16.4                  | 38.5           |
| 2   | M..... | 2.9                 | 2.8                  | 2.9                         | 2.8                        | 2.7                 | 2.5                        | 16.6                  | 38.8           |
| 3   | H..... | 2.9                 | 3                    | 2.6                         | 1.9                        | A                   | 2.6                        | 15.6                  | 38.3           |
| 4   | H..... | 2.7                 | 2.8                  | 3                           | 2.9                        | A                   | A                          | 17.1                  | 38.9           |
| 5   | B..... | 2.9                 | 2.9                  | 3                           | 1.7                        | 2.5                 | 2.7                        | 15.7                  | 38             |
| 6   | W..... | 2.9                 | 2.9                  | 3                           | 2.9                        | 2.4                 | 2.4                        | 16.5                  | 38.5           |
| 7   | S..... | 2.7                 | 2.8                  | 2.3                         | 2.2                        | 2.6                 | 2.6                        | 15.2                  | 38             |
| 8   | K..... | 2.9                 | 2.5                  | 2.9                         | 2.4                        | 2.5                 | 2.6                        | 15.8                  | 38.8           |
| 9   | M..... | 2.8                 | 2.9                  | 1.6                         | 2.9                        | 2                   | 2.4                        | 14.6                  | 37.3           |
| 10  | H..... | 2.7                 | 2.6                  | 2.5                         | 2.9                        | 2.3                 | 2.4                        | 15.4                  | 37.5           |
| 11  | P..... | 2.9                 | 2.9                  | 3                           | 2.4                        | 1.5                 | 2.8                        | 15.5                  | 37.7           |
| 12  | L..... | 2.8                 | 2.9                  | A                           | 2.3                        | 2.6                 | 1.9                        | 15                    | 37.3           |
|     |        | R                   | R                    | R                           | R                          | RM                  | R                          |                       |                |

## RIGHT-HAND PAGE.

| No.             | Name. | Remarks.   |   |   |   |   |   |
|-----------------|-------|--|---|---|---|---|---|
|                 |       | Monday,<br>Jan. 20.  | Tuesday,<br>Jan. 21.                      | Wednesday,<br>Jan. 22.                    | Thursday,<br>Jan. 23.                     | Friday,<br>Jan. 24.                         | Saturday,<br>Jan. 25.                       |
| 1               | H     | 229-30   | 17  | 28  | Prob. 9                                   | A   | A.  |
| 2               | M     | 215-17   | Q 222, Rev.                               | 26-27                                     | 24, Rev.                                  | 10 <sup>00</sup> -11 <sup>00</sup>          | 18-20.                                      |
| 3               | H     | 231  | 15-16                                     | 25  | Prob. 7                                   | A   | 15-17.                                      |
| 4               | H     | 218-20   | Battle of<br>Franklin.                    | 24  | 29-30, Rev.                               | A   | A.  |
| 5               | B     | 174, etc., Rev.  | 9-14                                      | 23  | Prob. 7                                   | 10 <sup>00</sup>                            | 13-14.                                      |
| 6               | W     | Q 182, etc.,<br>Rev.                                       | Prob. 3                                   | 21-22                                     | 31, Rev.                                  | 7   | 8-9, Rev.                                   |
| 7               | S     | 223-24   | 6-8                                       | 31  | 38  | 8-10 <sup>00</sup>                          | 7, Rev.                                     |
| 8               | K     | 225  | Prob. 2                                   | Battle of<br>Franklin.                    | 37  | 1-6   | 12, Rev.                                    |
| 9               | M     | 210-12   | 3 <sup>00</sup> -5                        | 17-20, Rev.                               | 35-36                                     | Prob. 7                                     | 26.   |
| 10              | H     | 226-28   | 20  | Prob. 6                                   | 34  | 32, Rev.                                    | 25.   |
| 11              | P     | 213-14   | 1-3 <sup>00</sup>                         | 29-30                                     | 33  | Prob. 9                                     | 23-24.                                      |
| 12              | L     | 221-22   | 18-19                                     | A   | 32  | 11 <sup>00</sup> -12                        | 21-23 <sup>00</sup> .                       |
| <i>Lessons.</i> |       |  |   |   |   |   |   |
|                 |       | Field fortifications: To end; omit 192-94; omit Chap. XVI. | Fortification drawing: To art. 21, p. 17. | Fortification drawing: To art. 32, p. 12. | Fortification drawing: To art. 39, p. 17. | Permanent fortification: To art. 13, p. 11. | Permanent fortification: To art. 27, p. 24. |

The letter R at the foot of each column is the initial of the instructor. The initial M indicates that the head of the department visited the section on that day.

The day's lesson is given at the foot of the column on the right-hand page. Subjects of recitations are given by numbers of paragraphs in text-books. Review subjects indicated by Rev.

In determining the final total mark of each cadet in engineering the following schedule of weights of marks in different parts of the course is applied:

|  | Maximum weight. |
|--|-----------------|
| <b>Civil engineering:</b>                        |                 |
| Each recitation in advance ( $\times 1$ )        | 3               |
| Each recitation in first review ( $\times 1$ )   | 3               |
| Each mark in drawing ( $\times 2\frac{1}{2}$ )   | 7.5             |
| Each recitation in general review ( $\times 2$ ) | 6               |
| Examination mark ( $\times 5$ )                  | 15              |
| <b>Military engineering:</b>                     |                 |
| Each recitation in advance ( $\times 1$ )        | 3               |
| Each mark in drawing ( $\times 1$ )              | 3               |
| Each recitation in general review ( $\times 2$ ) | 6               |
| Examination mark ( $\times 5$ )                  | 15              |

The head of the department, as a rule, has made two visits to the section rooms each day, visiting on one day the two sections that attend successively in one section room, say No. 206, on the next day the two that attend in room 207, and on the next the two that attend in room 208, and continuing in this order, so that each section has received a visit from the head of the department every three days, except when these visits are interrupted or prevented by attention to other duties.

The visit usually extended over the last half hour of the recitations of each section.

## PART 5.

## WEEKLY CLASS REPORTS—TRANSFERS—EXHIBITION OF MARKS.

Class reports are made out immediately after the last recitation on Saturday of each week, each instructor reporting the marks, absences, and progress of his two sections on the forms provided for that purpose. These reports are submitted by the instructors to the head of the department. He forwards them, with his recommendations for transfers, to the Superintendent of the Academy, who, if the transfers recommended meet his approval, causes them to be made by published orders, and the class reports are then exhibited in glazed frames in the lower hall of the Academy building, where the cadets may inspect them during release from quarters.

The weekly class report is made out, as mentioned above, by sections, the report for each section being in the main a copy of the left-hand page of the section record

book for the week considered, leaving out the last column of totals, which gives the sum of all marks up to date for each cadet. A single sheet suffices for the report of two sections, as is shown in the following table:

[First class, first and second sections, department of engineering.]

*Report for the week ending October 19, 1896.*

[Scale of daily merit: Thorough, 3; good, 2.5; indifferent, 2; bad, 1.5; very imperfect, 1; complete failure, 0.]

| No.                    | Name. | M.  | T.    | W.    | T.    | F.    | S.    | Total. | Remarks.   |
|------------------------|-------|-----|-------|-------|-------|-------|-------|--------|--|
| <i>First section.</i>  |       |     |       |       |       |       |       |        |  |
| 1                      | H.    | 2.9 | 2.9   | ..... | 2.8   | 2.7   | 2.4   | 16.4   | Wheeler's Civil Engineering: To art. 469, p. 352. Transfer recommended Cadet C to the second section. Jas. Mercur, professor U. S. M. A. |
| 2                      | S.    | 2.8 | 2.8   | 3     | ..... | 2     | 3     | 16.3   |  |
| 3                      | T.    | 2.8 | 2.9   | ..... | 2.7   | 2.6   | 3     | 16.3   |  |
| 4                      | C.    | 3   | 2.9   | 2.8   | ..... | 1.5   | 3     | 15.8   |  |
| 5                      | G.    | 2.7 | 2.6   | 2.7   | 3     | 2.8   | A     | 16.6   |  |
| 6                      | McN.  | 2.5 | 2.6   | 2.8   | 3     | 2.8   | ..... | 16.4   |  |
| 7                      | C.    | 2.8 | 2.4   | 2.6   | 2.6   | 2.9   | ..... | 16     |  |
| 8                      | L.    | 2.9 | 2.9   | 2.8   | 2.5   | 3     | ..... | 16.9   |  |
| 9                      | M.    | 2.8 | 3     | 2.7   | 2.8   | ..... | 2.6   | 16.7   |  |
| 10                     | McC.  | 3   | 2.8   | 2.6   | 2.9   | ..... | 2.9   | 17     |  |
| 11                     | N.    | 3   | 2.6   | A     | 2.7   | 2.7   | 2.4   | 16.1   |  |
| 12                     | D.    | 2.9 | 2.8   | 2.8   | ..... | 2.7   | 1.8   | 15.6   |  |
| 13                     | H.    | 3   | ..... | 2.8   | 2.8   | 2.6   | 2.6   | 16.6   |  |
| <i>Second section.</i> |       |     |       |       |       |       |       |        |  |
| 1                      | E.    | 2.7 | A     | 2.2   | 2.8   | 2.8   | 2.2   | 15.2   | Wheeler's Civil Engineering: To art. 469, p. 352. Transfer recommended Cadet E to the first section. Jas. Mercur, professor U. S. M. A.  |
| 2                      | B.    | 2.8 | 2.7   | ..... | 2.5   | 1.8   | 2.8   | 15.1   |  |
| 3                      | B.    | 2.8 | 2.8   | ..... | 2.9   | 2.9   | 2.8   | 17     |  |
| 4                      | J.    | 2.8 | 2.7   | 2.6   | ..... | 2.4   | 3     | 16.2   |  |
| 5                      | S.    | 2.5 | 2.8   | 2.6   | ..... | 1.5   | 2.9   | 14.8   |  |
| 6                      | T.    | 2.5 | 2.6   | 2.7   | 2.7   | 2.9   | ..... | 16.1   |  |
| 7                      | T.    | 2.4 | 2.8   | 2.7   | 2.7   | 2.9   | ..... | 16.2   |  |
| 8                      | M.    | 2.3 | 2.4   | 2.4   | 2     | 2.9   | ..... | 14.4   |  |
| 9                      | J.    | 2.8 | 3     | 2.5   | 2.6   | ..... | 2.8   | 16.4   |  |
| 10                     | F.    | 2.3 | 2.9   | 2.6   | 2.8   | ..... | 2.7   | 16     |  |
| 11                     | B.    | 1.2 | 2.8   | 2.9   | 3     | 3     | 2.2   | 15.1   |  |
| 12                     | H.    | 2.5 | 2.7   | 2.8   | 2.9   | 2.5   | 2     | 15.4   |  |
| 13                     | H.    | 2.7 | 2.9   | 2.6   | A     | 2.7   | 2.3   | 15.8   |  |
|                        |       | NM  | N     | N     | N     | N     | N     |        |  |

Respectfully submitted.

H. C. NEWCOMER,  
*First Lieutenant of Engineers.*

The PROFESSOR OF ENGINEERING, U. S. M. A.

For the first two or three weeks of each term no transfers are recommended, as it is thought advisable to allow the cadets a sufficient time to become familiar with the new subject and to settle down to work before advancing or dropping them in the class. At the end of this time, and at the end of each week thereafter, transfers are recommended on the following basis: The highest of the total marks of the cadets in one section is compared with the lowest of the total marks of the cadets in the next higher section. Then the second mark of the members of the lower section is compared with the next to the lowest mark in the section above, and so on. Those cadets in the lower section whose marks exceed by a unit or more the marks with which the comparison is made are recommended to be transferred to the next higher section, and the corresponding cadets in the higher section are recommended to be transferred to the lower section.

The exhibition of the weekly marks in the hall of the Academy building enables the cadets to keep track of their progress and of the efficiency of their work and to bring to the attention of their instructors or of the head of the department, for adjustment, any injustice or error that they may think has occurred in the awarding of marks.

PART 6.

EXAMINATIONS, WRITTEN, ORAL, WEIGHT OF—DEFICIENCY OR PROFICIENCY OF CADETS—STANDARD REQUIRED.

The general regulations giving the method to be followed in the examination of all classes are found in the Regulations United States Military Academy, 1894, sections 71 to 83, inclusive.

The examination of the first class in civil engineering in January and in military engineering and art of war in June are conducted orally by a committee of the academic board in the room and at the time prescribed by the Superintendent.

Prior to the examination each instructor prepares a list of subjects upon which he proposes to examine the members of his sections and submits it to the head of the department, who makes such alterations and corrections as may seem necessary, and the revised list is kept securely sealed pending the examination.

The examination begins with the lowest man in the lowest section and proceeds in regular order upward through the class. A section to be examined enters the examination room from three-quarters to one hour before the time appointed for the meeting of the committee of the academic board. Each member of the section, called by the instructor in order, beginning at the bottom of the section, takes from the instructor's desk by lot a paper upon which is written a subject for examination, and going to the blackboard next to the one previously occupied prepares the notes or the demonstration which his subject calls for and then returns to his seat. When the committee meets and is ready to proceed with the examination, the head of the department calls upon the cadet who first received his subject to recite. The recitation is addressed to the committee, but is conducted by the instructor under the supervision of the head of the department, with a view of determining the proficiency and degree of proficiency of the cadet.

Questions may be and sometimes are asked by other members of the committee on the subject under discussion. At the conclusion of the recitation the cadet is dismissed to his quarters, marks on his recitation are awarded by the head of the department, the assistant professor, and the instructor of the section, notes are made by the members of the committee on the degree of proficiency of the cadet, another cadet is called up to draw a subject and take the board just vacated, and the cadet next in order is called upon to recite. As soon as all the members of one section have received their subjects, the next higher section enters the room and its members are called in the same order as before to draw subjects and prepare for recitation at the boards as these become available at the conclusion of recitations.

The subjects are so limited in extent that one hour is ample time for preparation, and a cadet may be required to recite at any time after the expiration of one hour of preparation. If it happen at any time that no cadet is prepared to recite or has had an hour's time for preparation, a cadet not yet called upon may, with the approval of the committee, be required to recite without preparation by answering the questions of his professor or instructor upon a selected subject, the guidance and suggestions unavoidably conveyed in the questions being considered equivalent, in advantages to the cadet, to the opportunity for preparation usually allowed.

The time usually allotted to the examination in engineering permits recitations averaging about eight or nine minutes in length. The actual length of recitation varies from six to ten minutes, depending on the subject and the facility with which the cadet recites.

The drawings executed by the cadets during the term are displayed on a table in the examination room for inspection by the academic board, which inspection is intended to constitute a part of the examination.

The marks given on recitations for examination are based on the usual scale, whose maximum is 3. They are, therefore, in determining the final total mark, multiplied by 3, in order to give to the examination mark its adopted maximum weight of 15.

The proficiency of a cadet in civil or military engineering before examination is considered doubtful if his total mark is less than two-thirds of the maximum total mark, and he is so reported to the examining committee. The question of his proficiency is then to be determined by the examination, and if he is markedly deficient in marks before examination he may be required to undergo a written examination in addition to the usual oral examination. If a cadet fail on his first examination subject, he receives a second subject in order to determine his proficiency, but in determining his standing the mark which he receives on his first subject only is considered. If he fail on the second subject also, he may be required to undergo a written examination.

The standard of proficiency required is that the cadet's total mark shall be at least two-thirds of the maximum total mark, provided that in each case of doubtful proficiency special circumstances that may affect the justice and applicability of this standard are to be considered.

#### PART 7.

#### CRITICAL REVIEW OF THE PRESENT COURSE AND METHOD OF INSTRUCTION—COMPARISON WITH FORMER YEARS AND WITH OTHER INSTITUTIONS.

The gradual development of the present course and methods of instruction are given very fully in the preceding part of this report.

As an engineering school, its influence and methods as compared with schools making the instruction of engineering in its several branches a specialty are brought out in the report of Professor Riedler, of the Royal Polytechnicum at Berlin, in his report on American technological schools. (See Report of the Commissioner of Education, 1892-93, vol. 1, p. 657.)

The number of these colleges giving degrees in civil engineering is 45. The requirements for admission are all higher than at West Point, the course of pure mathematics consequently shorter, and the length of the course generally four years. The course of engineering is divided into recitations, lectures, laboratory work, drawing, and field work. The amount of time given to each division is quite different in the different schools.

As these schools differ very much in their methods, I have limited myself to the following extracts of the report which refer specially to West Point and military schools in general.

"*Military schools.*—Before 1840 real instruction in engineering was offered almost exclusively in the Military Academy at West Point. Up to 1840—even up to 1850—nearly all the civil engineers had received their preparation in this military school. From its establishment, in 1802, up to 1862 it prepared about 2,000 students. Of these, 200 became civil engineers and about 230 entered the military Engineer Corps.

"Among the former number are the most renowned civil engineers of the country. \* \* \*

"Between the years 1880 and 1888 only 2 per cent of the students were admitted to the Engineer Corps of the United States. Service in this corps requires an additional study of two years and a half in the United States School for Engineers at Willets Point, Long Island, organized in 1885. The technical instruction in this school comprises twenty-two weeks in civil engineering, nineteen weeks in chemistry and photography, and forty weeks in science of explosives and torpedoes.

"Since the beginning of the sixties the Military Academy at West Point has lost some of its importance with reference to education of practical civil engineers. The number and importance of engineering schools, pure and proper, have become very great, and the enormous development of this branch has necessitated a division of labor. \* \* \*

"The military schools do not serve the profession of civil and mechanical engineering any longer. The times in which mainly knowledge of mathematics, geometry, and geodesy were considered sufficient for the profession of engineers have passed, and to-day there is no engineering school which does not seek its main work in extensive professional instruction.

"Nevertheless the military schools, with the peculiar education and rather limited theoretical and practical instruction for civil and mechanical engineers they offer, are of great importance. We find the proof of this in the great number of distinguished civil engineers who have graduated from such schools. This holds good not only for America, but for other countries. With us the course of education of a Werner-Siemens' may induce us to deep reflection.

"In face of the present enormous development in exact knowledge of scientific and technical details the actual result of the study is dependent now as formerly upon simple natural conception, clearness, and thoroughness, but not upon the extent of knowledge. Military schools in this respect offer many advantages. The most distinguished technological school in France also is a military institution. If a negative advantage of these schools is the prevention of knowing and learning too many things, then the strict formation of character, the reliability and independence gained, must be a positive advantage that can not be gauged too high. Alas, many a modern school esteems that advantage too little."

## M.

DEPARTMENT OF PRACTICAL MILITARY ENGINEERING,  
*West Point, N. Y., September 10, 1896.*

SIR: In compliance with the requirements of your letter of October 3, 1895, I have the honor to report as follows upon the department of instruction temporarily in my charge.

Very respectfully, your obedient servant,

JAS. L. LUSK,

*Captain, Corps of Engineers, Instructor Practical Military Engineering.*

The ADJUTANT, UNITED STATES MILITARY ACADEMY.

<sup>1</sup>Dr. Ernst Werner von Siemens was born at Lenth in 1816, and received his early education in the Gymnasium of Lubeck. At the age of 18 he entered the Prussian Artillery, and at the same time the War Academy at Berlin, from which he graduated in 1838. He remained in the service until 1848, when he resigned and established the firm of Siemens & Halske. He was among the foremost scientists, inventors, and electricians of his day. For his valuable work he was raised to the nobility and made a knight of the Order "Pour le Mérite," the highest scientific order in the country, by Emperor Frederick III.

## 1. HISTORY OF THE DEPARTMENT.

During the early history of the Academy and up to about 1842 instruction in practical military engineering appears to have been committed to the department of engineering and the science of war, under the title of "actual (or practical) operations on the ground." (See in Appendix M<sub>1</sub><sup>1</sup>; United States Army Regulations, 1821, art. 78, par. 40; United States Army Regulations, 1825, par. 1349; Regulations United States Military Academy, 1839, pars. 34, 35.)

In August, 1842, Capt. A. J. Swift, Corps of Engineers, was assigned to duty as instructor in practical military engineering, and his name is so borne in the Annual Register for 1843. About one year later the head of the department became a member of the academic board. (See in Appendix M<sub>1</sub><sup>1</sup>, Post Orders, No. 22, of 1844.)

From 1844 onward the department has existed without interruption, except during part of the war of the rebellion, when it was probably merged in a greater or less degree in the department of engineering and the science of war. (See Appendix M<sub>2</sub>.)

For information as to the personnel of the department reference is invited to the accompanying Appendix M<sub>3</sub>. (Prepared by First Lieut. E. Eveleth Winslow, Corps of Engineers.)

A detailed programme of instruction first appears in the Academic Regulations in 1853. That programme was somewhat extended in 1857, and again in 1867 and 1892.

Instruction in this branch was confined to the first class until 1867, when it was extended to include the second class. In 1891 it was still further extended to include the third class.

The regulations of 1857 prescribed that in making up the general merit roll of the first class, practical military engineering should have a relative value of  $\frac{1}{2}$  (50) (see in Appendix M<sub>1</sub><sup>1</sup>, par. 67, Regulations Military Academy, 1857), but the provision does not appear to have been carried into effect. In 1891 it was ordered, upon the recommendation of the academic board, that in making up the merit roll of the first class a weight of 45 should be assigned. (See in Appendix M<sub>1</sub><sup>1</sup>, Circular No. 26, Headquarters U. S. M. A., 1891). This provision has been carried into effect in the merit rolls of the first class in 1892 and succeeding years to this time.

In 1863 Capt. S. T. Cushing, acting signal officer, was sent to West Point for the purpose of introducing "instruction in military signaling and telegraphy as a part of the regular course of instruction for cadets." Under this order Captain Cushing was on duty at West Point from July 24, 1863, to January 24, 1864, but no post order appears to have been issued assigning him to duty.

Upon the recommendation of the academic board instruction in military signaling and telegraphy was added to the course in practical military engineering in October, 1867. (See in Appendix M<sub>1</sub><sup>1</sup>, Orders, No. 125, Headquarters U. S. M. A., 1867.)

## 2. STATEMENT OF THE PRESENT COURSE, ETC.

During July and August of each year the first and third classes are under instruction; in October and April, the first and second classes; and during the first week in May the first class alone.

The scope of the course as at present taught can probably be best outlined by the following programme of instruction for the year July 1, 1895 to June 30, 1896:

## FIRST CLASS.

School of the boat.  
Making knots and lashings.  
Bridge by successive pontoons.  
Assembling and launching canvas pontoons.  
Trestle bridge on land.  
Double lock spar bridge.  
Abatis.  
Fascine.  
Hurdle.  
Hoop-iron gabion.  
Brush gabion.  
Gabion revetment.  
Fascine revetment.  
Sand-bag revetment.  
Barrel revetment.  
Wire entanglement.  
Simple trench (one-sixth scale).  
Simple trench (full scale).  
Flying trench (one-sixth scale).

Flying trench (full scale).  
Shelter trenches, various types.  
Russian gun pit.  
Emplacement for breech-loading gun.  
Emplacement for muzzle-loading gun.  
Full sap.  
Planting vertical palisading.  
Planting inclined palisading.  
Gun platform.  
Mortar platform.  
Profiling.  
Signaling with flag.  
Signaling with heliograph.  
Signaling with telegraph.  
Use of reconnaissance instruments.  
Mounted reconnaissance.  
Utilization of ground and stone walls as a means of defense.  
Use of explosives.

<sup>1</sup> Not forwarded.

SECOND CLASS.

THIRD CLASS.

Bridge by successive pontoons.  
 Gabion revetment.  
 Sand-bag revetment.  
 Barrel revetment.  
 Wire entanglement.  
 Making palisading.  
 Planting vertical palisading.  
 Planting inclined palisading.  
 Planting fraises in scarp.  
 Planting fraises in counterscarp.  
 Gun platform.  
 Mortar platform.  
 Signaling with flag.  
 Signaling with telegraph.

School of the boat.  
 Bridge by successive pontoons.  
 Assembling and launching canvas pontoons.  
 Trestle bridge on land.  
 Fascine revetment.  
 Gabion revetment.  
 Shelter trenches, various types.  
 Signaling with flag.  
 Signaling with heliograph.  
 Utilization of ground and stone walls as a means of defense.  
 Use of explosives.

The text-books employed are solely for reference. The list includes Ernst's Manual of Military Engineering, the Woolwich and Chatham text-books on the same subject, the United States Bridge Equipage and Drill, and various other publications bearing upon the subjects taught. The actual instruction to the cadets in each subject is given out mainly in the form of printed cards containing concise descriptions and explanations of the work to be executed. The cards are supplemented by hctographed plans and sections and by oral explanations.

The number of drills possible each season depends to a certain extent upon the weather and upon interruptions in the way of musters, reviews, military funerals, etc., requiring the attendance of all the cadets.

That these causes combine to lessen to a large extent the quantity of instruction possible the following comparison will show:

|                               | October, 1895. | April, 1896. | July and August, 1896. | Total. |
|-------------------------------|----------------|--------------|------------------------|--------|
| Drills possible .....         | 18             | 17           | 47                     | 82     |
| Lost, bad weather .....       | 1              | 2            | 6                      | 9      |
| Lost, military funerals ..... | 1              | 1            | .....                  | 2      |
| Lost, musters .....           | 1              | 1            | .....                  | 2      |
| Actual drills .....           | 15             | 13           | 41                     | 69     |
| Drills lost .....             | 3              | 4            | 6                      | 13     |
| Percentage lost .....         | 16.7           | 23.5         | 12.8                   | 15.9   |

The time devoted to instruction during the year in question was as follows:

|   |        |
|---|--------|
| First class:  | Hours. |
| October, 1895, 15 drills, one hour each .....                       | 15     |
| April, 1896, 13 drills, one hour each .....                         | 13     |
| July and August, 1896, 41 drills, one and one-half hours each ..... | 61½    |
| Total .....   | 89½    |
| Second class:   |        |
| October, 1895, 15 drills, one hour each .....                       | 15     |
| April, 1896, 13 drills, one hour each .....                         | 13     |
| Total .....   | 28     |
| Third class:  |        |
| July and August, 1896, 41 drills, one and one-half hours each ..... | 61½    |

The time lost by the individual cadets is much greater than that due to the number of lost drills. This arises from the absence of cadets who are sick, on old and new guards (during the encampment), or detailed for other duties. Excepting the case of the first class in July and August, the attendance is by half classes on alternate days. During the first class year of the class of 1896 the maximum attendance by any member of the class was 56 drills out of a total possible of 72. The average attendance was about 46 drills out of 72.

In May each cadet of the first class is required to attend one full day at mounted reconnoissance. This exercise involves about six and one-half hours of steady work of observing, recording notes, making a road sketch, and a finished map in ink, all in the field.

No stated lectures are given in this course, but as much oral instruction is imparted as time allows. There is no distinct division of the course into advance and review, but, for the sake of proficiency, certain parts of the course are repeated to a limited extent.

## 3. ORGANIZATION OF DEPARTMENT, ETC.

Since the expansion of the course in 1891, and until quite recently, the number of instructors has been three—the instructor of practical military engineering and two assistants. As a rule, these three officers have all attended at every drill and have found themselves fully occupied. When the classes are large, the summer drills tax the energies of the officers to the utmost. The War Department has recently detached one of the assistants and has assigned no one to take his place.

There is no strict division of duties, the officers being assigned to different lines of instruction at different times, thus having under their observation all the cadets of the different classes. This arrangement is believed to bring about the fairest possible results in marking and grading the classes.

## 4. DESCRIPTION OF A DRILL.

When a class or half class is reported to the instructor, the details are rapidly made by roster for the different kinds of work to be done. The squads are promptly marched to the working points, where instruction cards, rough drawings, and implements are provided. When deemed necessary, oral instruction and explanation are given both before and after the squads begin working. When, in the judgment of the officer in charge, enough work has been done, the members of the squad are questioned sufficiently to ascertain their understanding of the practical features involved. The marking is done upon the method of working, the progress made, and the understanding shown of the subject. In signaling and telegraphy the marking is done upon the recorded messages turned in by each cadet.

## 5. WEEKLY CLASS REPORTS, ETC.

These are made and the marks exhibited in the usual manner, the classes being divided into sections merely for the sake of convenience in marking. As a rule, transfers are not made. In general, first class men are detailed as chiefs of the working parties of the second and third classes, and are required to mark the members of their parties. The marks so given are recorded, but do not affect the final standing in the department, which is determined solely from the marks of the first class year. The members of the first class are marked by the officers alone.

## 6. EXAMINATIONS.

These are entirely practical, and have thus far been conducted in Fort Clinton, and with one exception (that of May, 1892) they have taken place during the period of the annual examination. As there is no room suitable for indoor examination, a postponement will undoubtedly be necessary in case of inclement weather. The mark for each day's drill having a weight of unity, the examination mark has thus far been given a weight of 3, and that for mounted reconnoissance a weight of 5. The usual standard of proficiency is required.

## REVIEW OF COURSE.

The instruction now given is believed to be as full and thorough as the time allowed will permit. Several defects exist, the most important being as follows:

1. *Lost time.*—As stated in detail above, the time lost from instruction due to drills missed from various causes and to the absence of cadets from drills makes up a large total. To partially obviate the evil requires a wearisome repetition of certain drills. There seems to be no remedy for this state of affairs without encroaching upon the practical work of other departments, which is not recommended.

2. *The short terms of service allowed the assistant instructors and the irregularity of their tours of duty.*—These officers are not allowed as long terms of service at the Academy as those in other departments, and are assigned and relieved without reference to the academic year. The work of instruction of the department begins on July 5 and ends with the conclusion of the next annual examination. It is therefore desirable that changes of assistant instructors be made between the end of the annual examination and the succeeding 1st day of July. It is also much to be wished that these officers should have tours of duty at the Academy of not less than three years.

In conclusion I desire to bear witness to the intelligence and fidelity with which the noncommissioned officers and privates of Company E, Battalion of Engineers, have for many years assisted in the instruction of cadets in practical military engineering. Their duties in this regard require much skill and labor and afford no small room for the exercise of patience and tact. That the demands upon them have been well and creditably met is, I am sure, the judgment of all who know the facts.

APPENDIX M<sub>2</sub>.

MEMORANDA CONCERNING DEPARTMENT OF PRACTICAL MILITARY ENGINEERING DURING THE WAR OF THE REBELLION.

Engineer Company A, formed for service in war with Mexico, returned to West Point June 22, 1848, and assisted in instruction of cadets until January 18, 1861, when, under command of Lieut. J. C. Duane, instructor of practical military engineering, it left West Point for Washington, D. C.

On September 30, 1861, company returned with Capt. J. C. Duane and Lieuts. G. Weitzel and John A. Tardy, jr., and remained at West Point till October 30, 1861, when the company and officers again left to join the Army of the Potomac.

A small detachment was left behind under command of Lieut. William P. Craighill, then in department of civil and military engineering, and remained at West Point under his orders (with a temporary absence June 21 to October 25, 1862) till June 18, 1863. From June 18, 1863, to August 19, 1863, the detachment was commanded by Lieut. J. A. Smith, then temporarily by several other officers in succession till September 10, 1863, when Capt. Miles D. McAlester joined as instructor of practical military engineering and commander of detachment.

During the interval between October 30, 1861, and September 10, 1863, the department of practical military engineering was probably merged in the department of civil and military engineering. The same may be true for the interval from January 18, 1861, to September 30, 1861.

The detachment of engineers above referred to was kept at West Point in department of practical military engineering till the return of A Company in 1865.

A Company remained at West Point till September 1, 1867, when a new detachment was formed and left behind till arrival of E Company on March 3, 1871.

APPENDIX M<sub>3</sub>.

*Instructors, department of practical military engineering, signaling, and telegraphy.*

| Instructor.                                      | Assigned.      | Relieved.      | Remarks.  |
|--|----------------|----------------|---|
| Alex. J. Swift, captain engineers...             | Aug. —, 1842   | Sept. 12, 1846 | On duty at West Point June 30, 1841, to Nov. 19, 1841; duty not known, but probably organizing department of practical engineering. |
| Fred. A. Smith, captain, engineers.              | Sept. 12, 1846 | Mar. 25, 1848  |   |
| George W. Cullum, captain, engineers.            | Mar. 25, 1848  | May 19, 1851   |   |
| Alex. H. Bowman, captain, engineers.             | May 19, 1851   | June 1, 1852   |   |
| George W. Cullum, captain, engineers.            | June 1, 1852   | Jan. 1, 1855   |   |
| John G. Barnard, captain, engineers.             | Mar. 2, 1855   | Sept. 8, 1856  | Superintendent U. S. M. A.  |
| Andrew J. Donelson, first lieutenant, engineers. | Sept. 9, 1856  | Oct. 15, 1858  |   |
| James C. Duane, first lieutenant, engineers.     | Oct. 16, 1858  | Jan. 18, 1861  |   |
| Miles D. McAlester, captain, engineers.          | Sept. 30, 1861 | Oct. 30, 1861  |   |
|  | Sept. 10, 1863 | June 22, 1864  |   |
| William P. Craighill, captain, engineers.        | June 22, 1864  | Aug. 31, 1864  |   |
| George H. Mendell, captain, engineers.           | Sept. 21, 1864 | July 3, 1865   |   |
| Henry M. Robert, captain, engineers.             | Aug. 31, 1865  | Aug. 31, 1867  |   |
| Peter S. Michie, captain, engineers.             | Aug. 31, 1867  | Mar. 8, 1871   | Relieved Mar. 8, 1871, on account of having been appointed professor of philosophy, to date from Feb. 14, 1871.                     |
| Oswald H. Ernst, captain, engineers.             | Aug. 1, 1871   | Aug. 28, 1878  |   |
| Charles W. Raymond, captain, engineers.          | Aug. 28, 1878  | Aug. 28, 1881  |   |
| William S. Stanton, captain, engineers.          | Aug. 28, 1881  | Aug. 28, 1885  |   |
| Francis V. Greene, captain, engineers.           | Aug. 28, 1885  | Jan. 12, 1886  |   |
| Philip M. Price, captain, engineers.             | Jan. 15, 1886  | Jan. 4, 1889   |   |
| George McC. Derby, captain, engineers.           | Jan. 4, 1889   | Mar. 4, 1893   |   |
| James L. Lusk, captain, engineers..              | Mar. 31, 1893  | .....          |   |

## N.

## DEPARTMENT OF ORDNANCE AND GUNNERY, UNITED STATES MILITARY ACADEMY.

## HISTORY.

This department is a gradual growth from the department of artillery. In the earlier stages of development the instruction was mostly practical, and little is known of it. General Cullum gives in his account of the early history of West Point the following under the head of "Instruction:" \* \* \* "The first principles of artillery were taught with the drill of field pieces, target practice, and a little laboratory duty. Artillery was little studied, only definitions from Scheele's Artillery were learned, practical pyrotechny and preparation of fixed ammunition taught, and the use of field pieces and mortars in drills and at target practice."

The department of artillery first appears upon the records in 1817, the first instructor being George W. Gardiner, second lieutenant, Corps of Artillery, whose tour of duty extended from September 15, 1817, to February 1, 1820. During part of this time he was also commandant of cadets.

Paragraph 7, Academic Regulations of 1821, prescribes: "There shall be detailed a captain or field officer, and attached to the Academy as instructor of tactics; and the captain or commandant of artillery to be stationed at West Point shall perform the duty of instructor of artillery." \* \* \*

By paragraph 9 of the same regulations the instructor of artillery is constituted a member of the academic board.

In accordance with the above provisions the instructor of artillery, Capt. Fabius Whiting, Corps of Artillery, appears as a member of the academic board for the first time June 30, 1821. The same provisions as to detail of instructor of artillery appear in the regulations of 1839 and also in those of 1853, except that "a captain or lieutenant may be detailed as instructor of artillery."

The department of artillery continued till 1857, and a list of the instructors in that department is given below, with the dates of their services:

*List of instructors of artillery.*

| Name.                   | Rank and regiment.  | From--         | To--           |
|-------------------------|---|----------------|----------------|
| George W. Gardiner..... | Second lieutenant, Corps of Artillery.....                            | Sept. 17, 1817 | Feb. 1, 1820   |
| Fabius Whiting.....     | Captain, Corps of Artillery.....                                      | Aug. 15, 1820  | Aug. 7, 1821   |
| Z. J. D. Kinsley.....   | Second lieutenant, Third Artillery.....                               | Dec. 18, 1823  | Dec. 1, 1835   |
| Robert Anderson.....    | First lieutenant, Third Artillery.....                                | Dec. 1, 1835   | Nov. 6, 1837   |
| Minor Knowlton.....     | First lieutenant, First Artillery.....                                | Nov. 9, 1837   | July 1, 1844   |
| E. D. Keyes.....        | Captain, Third Artillery.....   | July 25, 1844  | Dec. 24, 1848  |
| William H. Shover.....  | Captain, Third Artillery, and brevet major,<br>U. S. A.               | Dec. 24, 1848  | Sept. 7, 1850  |
| George H. Thomas.....   | First lieutenant, Third Artillery, and brevet<br>major, U. S. A.      | Apr. 2, 1851   | May 1, 1854    |
| Fitz John Porter.....   | First lieutenant, Fourth Artillery, and bre-<br>vet major, U. S. A.   | May 1, 1854    | Sept. 11, 1855 |
| Henry F. Clarke.....    | First lieutenant, Second Artillery, and bre-<br>vet captain, U. S. A. | Sept. 11, 1855 | Aug. 6, 1856   |

In 1857 the department of ordnance and gunnery was organized pursuant to the following resolution of the academic board of December 5, 1856:

"6. That the portion of the present course of artillery which comprises the science of gunnery, and what is known in our service as ordnance, be disconnected from that which relates to tactics merely, and be made the subject of a separate department, and that the additional time necessary for the development and improvement of this department be taken from that now given to practical engineering in October."

And on December 9, 1856, the course was finally arranged as follows: "Ordnance and gunnery from 11 a. m. to 1 p. m. from October 1 to end of the first week in March, alternating every other week day with cavalry tactics during October and two weeks in November, and with riding during the remainder of the term."

Paragraph 5, of the Academic Regulations of 1857, provides for the detail of the instructor of ordnance and gunnery, and by paragraph 9, same regulations, he is constituted a member of the academic board.

Under these provisions Capt. James G. Benton, Ordnance Department, was assigned to duty at West Point and became the first instructor of ordnance and gunnery. A list of the instructors in this department is given below with dates of service:

*List of instructors of ordnance and gunnery.*

| Name.                     | Rank and department.                        | From—          | To—            |
|---------------------------|---|----------------|----------------|
| James G. Benton .....     | Captain, Ordnance Department .....          | Feb. 27, 1857  | Apr. 26, 1861  |
| Stephen V. Benét .....    | First lieutenant, Ordnance Department ..... | Apr. 26, 1861  | Feb. 1, 1864   |
| Thomas J. Ireadwell ..... | Captain, Ordnance Department .....          | Feb. 11, 1864  | Sept. 13, 1864 |
| George T. Balch .....     | Captain, Ordnance Department .....          | Sept. 22, 1864 | July 12, 1865  |
| Alfred Mordecai .....     | Captain, Ordnance Department .....          | July 12, 1865  | Aug. 2, 1869   |
| Theo. Edison .....        | Major, Ordnance Department .....            | Aug. 2, 1869   | Nov. 17, 1870  |
| Thomas C. Bradford .....  | Captain, Ordnance Department .....          | Jan. 1, 1871   | Jan. 12, 1872  |
| Stephen C. Lyford .....   | Captain, Ordnance Department .....          | Jan. 30, 1872  | June 28, 1872  |
| John R. McGinness .....   | Captain, Ordnance Department .....          | July 25, 1872  | Aug. 30, 1874  |
| Alfred Mordecai .....     | Captain, Ordnance Department .....          | Aug. 30, 1874  | Aug. 28, 1881  |
| Clifton Comly .....       | Major, Ordnance Department .....            | Aug. 28, 1881  | Aug. 28, 1886  |
| Henry Metcalfe .....      | Captain, Ordnance Department .....          | Aug. 28, 1886  | Aug. 8, 1891   |
| L. L. Bruff .....         | Captain, Ordnance Department .....          | Aug. 17, 1891  | To date.       |

HISTORY OF COURSE.

The early history of the course from the beginning of the Academy up to 1812 has already been given. From 1812 to 1817 General Cullom states "tactics of infantry and artillery were Captain Partridge's delight, and were well taught, but were necessarily limited, owing to the small number of cadets to exercise, and the few pieces of ordnance for drill or target practice."

From this it appears that there was very little theoretical instruction in ordnance proper, but that most of it was practical, belonging rather to the department of tactics than to that of ordnance.

In January, 1820, a committee of the academic board, consisting of Professors Mansfield and Crozet and Assistant Professor Douglas, was appointed to draw up a revised code of the course of studies, and rules for classification. Under the subject of artillery and military science, they state that this course shall consist of "The knowledge and use of the various kinds of ordnance and military projectiles, principles of gunnery, experiments on the strength of powder, and calculation of the initial velocity of balls."

Between this date and 1826 the instruction in the scientific part of the course was transferred to the department of engineering, though the date of transfer is not fixed. It was transferred back to the department of artillery by the following resolution of the academic board of June 26, 1826, viz:

*Resolved*, That it is expedient to transfer from the department of engineering to that of artillery all instruction included under the head of "Science of artillery."

The following extract from the report of the Board of Visitors for 1833 may prove interesting, and it shows that even at that early date the armament of the post was not entirely satisfactory:

"The Board attended the battalion, light infantry, and artillery drills, and had every reason to be satisfied with the instruction of the cadets in their field exercises. They were present likewise in the laboratory when the cadets exhibited their proficiency in pyrotechny, and they subsequently saw them throw shells and fire at the target with light and heavy pieces of artillery; all which they executed with a precision rarely equaled, and not surpassed in any school of practice in Europe.

"This is the more remarkable from the state of the pieces used for practice. They are very defective, and the Board recommend that the several pieces of ordnance which are required for the instruction of the cadets by their able and scientific instructor should be furnished of the best quality and most approved construction.

"Much credit is due to the officer charged with the instruction of the cadets in this department. He has compiled a practical treatise on military pyrotechny and translated an excellent elementary treatise on the forms of cannon and various systems of artillery, and another on the theory and practice of gunnery, from the French of Professor Persy, of Metz; all of which, with numerous plates illustrating the subjects, have been published in the lithographic press of the Academy."

In 1839-40 a programme of studies was drawn up by direction of the chief engineer and the course in artillery was as follows:

"*Pyrotechny*.—Under this head the instruction is both theoretical and practical and extends to the making of slow match, quick match, portfires, priming tubes, cannon cartridges, musket, rifle, and pistol cartridges, canister shot, grape shot,

strap shot, leaden balls, fuses, rockfire, light balls, fireballs, incendiary balls, the mousse, sulphur matches, thundering barrels, carcasses, and signal rockets; to the loading of bombs, howitzers, and grenades, and putting up ammunition for transportation. The manner of making petards, powder sacks, smoke balls, suffocating balls, alarm signals, congreve rockets, and parachute rockets is studied, but not applied to practice.

*Artillery tactics.*—Under this head the organization of a field battery and of the company of artilleryists required for its service. The school of the gunner, school of the piece, and school of the battery are learned theoretically and practically. The evolutions of the batteries are studied, but not practiced in the field.

*Gunnery.*—The theory of gunnery is studied and applied to practice with guns, howitzers, and mortars.

*Manufacture of gunpowder, percussion powder, cannon, and projectiles.*—Under this head the studies include the preparation of materials for gunpowder; the manufacture and inspection of gunpowder; the proof of gunpowder; the proof of gunpowder by the mortar eprouvette, spring eprouvette, ballistic pendulum, cannon pendulum, and rotary machine; the storage and preservation of gunpowder; the restoration of damaged gunpowder; the inflammation and properties of gunpowder; a description of the principal of the different fulminating powders; the manufacture of percussion caps and wafers; the preparation of metals used in the fabrication of arms; the manufacture of cannon of cast iron, wrought iron, and bronze; the inspection and proof of iron guns, howitzers, and mortars; the inspection and proof of guns, howitzers, and mortars of bronze; the preservation of cannon; the manufacture, inspection, and proof of shot and shell.

*General subject of artillery.*—Under this head are included the different kinds of guns, howitzers, and mortars; a description of the different kinds of hollow projectiles and of the manner of filling and preserving them; the description and nomenclature of gun carriages, caissons, etc., with an explanation of their forms; propositions with respect to strength and ease of draft; the manner of spiking and unspiking cannon; the manner of repairing and destroying the material of artillery; the theory of firing; the manner of determining initial velocities; the effects of recoil; the aiming of guns, howitzers, mortars, and stone mortars; the firing of grapeshot, congreve rockets, and grenades; the throwing of hand grenades; the different modes of firing; the manner of firing by night; the causes of deviation in firing; the effect of rifling in correcting the inaccuracy of small arms; the effects produced by balls, howitzers, bombs, grapeshot, etc.; the composition of siege trains; the construction of siege batteries; the manner of battering in breach and counter battering; the construction of coast batteries and the defense of coasts.

*Text books.*—Instructions Theorique de L'Artillere, par Thiroux, upon the general subject of artillery; Exercise and Instruction of Field Artillery, a system prepared by a board of officers at Washington in 1826, by order of the Secretary of War, upon the subject of artillery tactics.

"The remaining parts of the course are taught from notes prepared and lithographed at the Military Academy."

The course, according to the Regulations of 1853, is as follows:

"Par. 31. *Artillery.*—Nomenclature and description of the different kinds and parts of artillery, gun carriages, caissons, and other artillery carriages, of artilleryists' implements, and military projectiles; exercise of the fieldpiece and of mortars, howitzers, siege, garrison, and seacoast guns; manœuvres of a field battery of artillery; mechanical manœuvres.

*Gunnery.*—Theory of gunnery, target practice with the gun, howitzer, and mortar.

*Pyrotechny.*—Making of all kinds of musket, rifle, pistol, cannon, and howitzer cartridges; preparation of strap, grape, and canister shot, priming tubes, fuses, slow and quick match, portfire, rockets, carcasses, fireballs, light balls, and incendiary composition; loading shells, shrapnel shot, and grenades, casting musket balls; putting up stores for transportation; loading caissons, and the manner of proving powder.

"Par. 50. *Manner of giving instruction in artillery.*—Artillery tactics shall be taught according to the most approved system. The instructor will be assisted in the drill by the cadets best qualified acting as commissioned and noncommissioned officers. Select passages from the best works in the different subjects of the course shall be studied and recited. A course of practice shall be connected with the study of gunnery.

"The cadets shall be taught in the laboratory its various duties, and shall by practice acquire facility and correctness in performing them."

In 1857 the course was as follows:

"Par. 27. *Ordnance and science of gunnery.*—Nomenclature and description of the different kinds and parts of artillery, gun carriages, caissons, and other artillery carriages, of artilleryists' implements, and military projectiles.

*Gunnery.*—Theory of gunnery.

*Pyrotechny.*—Making musket, rifle, pistol, cannon, and howitzer cartridges, preparation of strap, grape, and canister shot, priming tubes, fuses, slow and quick match, portfire, rockets, carcasses, fireballs, light balls, and incendiary composition, loading shells, shrapnel shot, and grenades; making musket balls; putting up stores for transportation; loading caissons, and the manner of proving powder, shot, and shells, inspecting guns, etc.

“Par. 53. *Ordnance and the science of gunnery and laboratory duty.*—For instruction in this branch the first class shall be divided into sections when commencing the subject according to general merit, and after the January examination according to merit in this study.

“Practical instruction in the duties of the laboratory shall be given to the first class during a part of the period of the encampment and to the fifth class between the 1st of April and the 15th of May.”

In this year, as already noted, the department of ordnance and gunnery had been organized and hence the tactical part of the course had been transferred to the department of tactics.

The course in 1873 was as follows:

“Par. 32. *Ordnance and gunnery.*—This course will comprise:

*Ordnance.*—(1) The theory and preparation of gunpowder, cannon, artillery carriages, projectiles, implements, machines, small arms, ammunition, and military fireworks. (2) Practical instruction in making musket, rifle, pistol, cannon, and howitzer cartridges; preparation of strap, grape, and canister shot, fuses, slow and quick match, portfire, signal rockets, carcasses, fireballs, light balls, and incendiary composition; loading shells, shrapnel shot, and grenades; putting up stores for transportation; loading caissons; in determining pressure on the bore of a gun; in determining the initial velocity of projectiles; in the manner of proving powder, and, when circumstances will admit of it, the operation of casting cannon solid and hollow, casting of projectiles and the usual method of testing gun metals will be witnessed.

*Gunnery.*—Embracing the study of the movements of projectiles; the theory of pointing firearms; the different kinds of fires and their effect; the art of breaching and the composition of batteries.

“Par. 59. *Ordnance and gunnery and laboratory duty.*—For instruction in this branch the first class shall be divided into sections in September according to general merit, and after January examination according to merit in ordnance and gunnery.

“Practical instruction in the duties of the laboratory shall be given to the first class during a part of the period of the encampment and to the third class at such times as the superintendent may direct.”

The course in 1883 was as follows:

“Par. 32. *Ordnance and gunnery.*—This course will comprise:

“1. The theoretical course of ordnance and gunnery, as follows: Ordnance: The theory and preparation of explosives, projectiles, cannon metals, cannon and portable arms, artillery carriages, harness, and machines. Gunnery: The theory of the motion of projectiles within and without the piece, and their effects. The use of range finders.

“2. The practical course will comprise instruction in the duties of the arsenal and experiments in gunnery. When circumstances will admit of it, the operation of fabricating ordnance material will be witnessed.

“Par. 39. *Ordnance and gunnery.*—Two to four every other week day, Saturdays excepted, alternating with law. The month of April to be devoted to the practical part of the course, explanation of instruments, models, etc.

“Par. 60. *Ordnance and gunnery and laboratory duty.*—For instruction in this branch the first class shall be divided into sections in September according to general merit, and after the January examination according to merit in ordnance and gunnery.

“Practical instruction as prescribed in paragraph 32 of these regulations shall be given to the first class during the month of April, or at such times as the Superintendent may direct.”

The following list of text-books in use in the department has been obtained from the best available sources, and is very imperfect, especially at the beginning of the history of the department:

*Text-books in artillery.*—Sheele's Treatise on Artillery.

1841. Anderson's United States Artillery Tactics; Kinsley's Pyrotechny; Thiroux's Instruction Théorique et Pratique d'Artillerie; Knowlton's Notes on Gunpowder, Percussion Powder, Cannon, and Projectiles.

1842. United States Artillery Tactics; Kinsley's Pyrotechny; Thiroux's Instruction Théorique et Pratique d'Artillerie; Knowlton's Notes on Gunpowder, Percussion Powder, Cannon, and Projectiles.

1850. Tactics for Garrison, Siege, and Field Artillery; Kinsley's Pyrotechuy; Thiroux's Instruction Théorique et Pratique d'Artillerie; Knowlton's Notes on Gunpowder, Cannon, and Projectiles; Mordecai's Experiments on Gunpowder by means of the Gun and Ballistic Pendulum.

*Text-books in ordnance and gunnery.*—1859. Thiroux's Instruction Théorique et Pratique d'Artillerie; Ordnance Manual; Mordecai's Experiments on Gunpowder; Notes on Fabrication of Cannon and Projectiles.

1863 and 1864. Benton's Course of Ordnance and Gunnery.

1865 to 1870. Benton's Ordnance and Gunnery.

1870 to 1886. Benton's Ordnance and Gunnery; Mordecai's Notes and Pamphlets; Bruff's Exterior Ballistics.

1886 to 1896. Metcalfe's Ordnance and Gunnery; Metcalfe's Notes and Pamphlets.

1896 to ——. Bruff's Ordnance and Gunnery.

The development of the course of ordnance and gunnery has been as follows: First, the whole subject, under the head of artillery, was taught by the department of tactics. In the early days of the institution very little scientific knowledge on the subject of artillery and ordnance was in existence. Hence the subject was taught at first practically, great attention being given to drill and very little to the principles. As knowledge upon the subject increased more time was devoted to the theory of the subject, and somewhere between 1820 and 1826 this knowledge had increased so greatly that it was deemed proper to transfer instruction in it to another department, where more time could be given it. It was transferred back again, however, for reasons not given, and in 1839 the course as laid down deals extensively with the theory of artillery, the determination of initial velocity, proof of gunpowder, rifling, causes of deviation in firing, etc.

The greatest step in the development of the course was undoubtedly its division in 1857 into two parts, the one practical and belonging to the department of tactics, the other theoretical and belonging to ordnance proper, or the study of the theory of gunpowder, pressures, velocities, and the effect of these upon the building of guns and upon their projectiles; also the numerous questions relating to pointing, metal for guns, manufacture of ordnance stores, and many others of this class became for the first time the subject of a separate course.

The great ability of the first instructor of ordnance and gunnery, Col. (then Capt.) J. G. Benton, Ordnance Department, gave an organization and an impetus to the department that it has always felt. His text-book, Benton's Ordnance and Gunnery, is well-known almost to the present time as a model book, and it has furnished the basis of most of the subsequent revisions.

The first of these was made by Col. Alfred Mordecai, Ordnance Department, who published a series of pamphlets, taking up the different chapters of Benton in detail and correcting them to date. His intention was upon the completion of the work to publish it in book form, but unfortunately he was relieved from duty before this work was accomplished.

The course for some years after his tour of duty consisted of his pamphlets and those parts of Benton which still applied, supplemented by notes published by Maj. Clifton Comly, of the Ordnance Department, who succeeded him. It was during this time that the old system of exterior ballistics, Didion's, was replaced by a more modern one, Niven's.

Capt. Henry Metcalfe, who succeeded Major Comly, found that the course needed a thorough revision, and he proceeded with the work with untiring energy, and finally published his Ordnance and Gunnery, which remained a text-book up to the present year, 1896.

When Captain Metcalfe's book was written the artillery system of the United States was in embryo, and also the subject of small arms and some others. Shortly after his relief from duty, in 1891, all these factors in the ordnance problem assumed definite shape. The system of artillery, guns, and carriages became fixed, a new small arm was adopted, smokeless powders came into vogue, and many other minor changes were made.

These changes necessitated a revision of the course again, and resulted in the text-book at present adopted by the academic board and compiled by the present instructor of ordnance and gunnery.

The present course is contained in one text-book, entitled Ordnance and Gunnery, Bruff, and a ballistic table, compiled by Capt. James M. Ingalls, First Artillery, U. S. A., whose title is Ballistic Tables, Ingalls.

The list of subjects taught is as follows:

1. *Gunpowder and interior ballistics.*—Under this head is given the composition and manufacture of gunpowder, the laws of its burning in air and in a gun, formulas by which the velocity of a projectile and the pressure in the bore of a gun can be calculated, pressure curves in a gun, and a general outline of the characteristics of powder, such as is generally comprehended under the head of interior ballistics.

After the theory of powder is understood the practical methods of determining the velocity of projectiles and the pressure in the bore of a gun are taught, both theoretically and by practical use of the instruments themselves.

2. *High explosives and smokeless powders.*—This includes a description of the general properties of high explosives, and of each particular explosive used for military purposes, giving its preparation, properties, uses, etc. The manufacture of smokeless powder is explained, the reason why it is superior in ballistic properties to ordinary powder, and a description of the principal well-known smokeless powders is given. This is supplemented by the exhibition of samples of nearly all the known smokeless powders.

3. *Guns.*—This subject is quite extensive, and includes various subordinate subjects. First. Gun steel, the metal of which all modern guns is made, is described with regard to its properties, chemical and physical. Its manufacture is then explained in detail, together with the various modern processes of treatment, such as fluid compression, hydraulic forging, oil tempering and annealing, and the rationale of the process of hardening, tempering, and annealing.

Second. A general outline of the principles of machines is next given, with the various methods of transmitting and modifying power in use in shops; the general arrangement of machine shops, and a description of the various machines in common use, such as the lathe, planer, shaper, etc., and the tools used by them.

Third. Practical operations in the manufacture of guns, under which head are described the various operations at the gun factory in building a modern gun, including the preparation of the parts for assembling, the heating, shrinking, and cooling of the parts, thus forming the assembled gun, and the final operations of finish boring rifling, etc.

Fourth. After the manufacture of the gun is understood, the reasons for the processes are given under the head of "Elastic strength of guns."

This subject includes a discussion of the strains and stresses which act on a gun, the laws of their distribution through the metal composing it, and the methods by which the structure may be strengthened to best withstand the strains. It is an outline of the modern method of gun construction. Wire guns are also treated of, and their construction illustrated by examples.

Fifth. The discussion of the elastic strength of guns having shown the necessity for accurate measurements of all the parts, the subject of measurements in gun construction is next considered, and the instruments and methods employed are described.

Sixth. The student is now in condition to understand the completed gun, and under the next head are described all the guns in the United States service, with their breech mechanism. In this description, the reasons are given for the arrangement of the various parts, and their functions and action clearly explained. The foreign variations are also described here.

4. *Projectile and armor.*—Under this head are described the various field, siege, and sea-coast projectiles in use in the United States service; their methods of manufacture, inspection, and tests; the circumstances under which each is best employed; the laws with respect to bursting charges, and the use of high explosives in shell; the development and use of shrapnel; law of rotation of an oblong projectile, and its sectional density as affecting its accuracy and range; rifling, its use and laws, form of rifling curve, and kinds of twists employed; the history and development of rotating devices, both muzzle and breech loading; rule for determining the weight of oblong projectiles; the kinds of armor and their relative value; effect of projectiles on armor; backing and fastenings for armor plates, and the principal formulas for penetration of projectiles in armor.

5. *Fuses and primers.*—The various fuses used in projectiles, with their requisites, are explained here, and also the common or friction and the obturating primers.

6. *Exterior ballistics.*—The subject of this head is the motion of projectiles in air; and the formulas giving the laws of resistance of the air, and those by means of which the various elements of the trajectory may be calculated, are deduced, and their application to practice explained and illustrated by numerous examples. The problems which are most likely to be met with in practice are treated only, leaving the more extended application of the principles to be taught at the schools of application.

7. *Artillery carriages; theory of recoil.*—The modern artillery carriage is a very complex structure, and requires much study of the principles of recoil and of the stresses acting on it. The principles of wheeled carriages are described, and the various brakes used to diminish recoil, together with the draft of the horse, his mode of attachment, and the harness. A description of the various wheeled carriages for the field and siege services is then given, followed by a description of the sea-coast carriages for the guns and mortars, and also a brief mention of the older forms of carriage found in the service.

The principles governing the recoil of guns are then discussed, and the laws of recoil in the first and second periods deduced. This having shown the necessity for

brakes or buffers, they are next discussed, and formulas deduced by which the elements of a hydraulic brake may be calculated.

8. *Pointing; probability of fire.*—Under this head are considered the different cases which may arise in pointing, due to difference of level of target and trunnions of gun; the method of calculating the height of rear sight and the correction for drift is explained, and also the methods of indirect pointing. The causes of deviations in firing are then considered, and the methods of estimating distances to targets explained, together with the general principles of range finders. These principles are illustrated by a description of one of the best known instruments. The sights for the service guns, field, siege, and seacoast are then explained. The laws of deviation of projectiles are then discussed, and the methods of calculating their deviations explained and illustrated. The doctrine of "probability" is then briefly considered and applied to the case of firing, and the laws of accidental error deduced and applied to finding the probability of committing certain errors and of striking objects of given dimensions, and these laws are illustrated by examples.

9. *Portable arms.*—This subject includes, first, a description of the various hand arms, the sword, saber, bayonet, etc., together with the principles upon which they depend, and, second, a discussion of the modern small arm. This discussion explains first the reason for the reduction of the caliber of the modern rifle and the ballistic advantages obtained by it. A description in detail is then given of the various parts of the Springfield rifle and of the caliber .30 rifle recently adopted. In this connection the general principles of breech mechanism are discussed, and the requisites of a good mechanism given, so that each system described may be compared with the general conditions and the advantages and defects of each made evident. The sights for small arms are also described, together with the various minor parts which make up the gun. The magazine or repeating arms are then discussed, the reason for using a magazine arm being explained, and the conditions which a good magazine arm should fulfill are given. The different magazine systems are then described in detail, and the advantages and defects of each pointed out. Finally the magazine system of the United States rifle, caliber .30, is explained in detail, with the reasons for its adoption. Metallic ammunition for small arms is next explained, a general history of its development being given and the reasons for the various changes and improvements pointed out.

10. *Machine and rapid-fire guns.*—The principles upon which the various machine guns are built are here explained, and also their advantages and disadvantages in general, and their use and the requirements which a good machine gun should fulfill. The best known machine guns are then described in detail, with their working and peculiar advantages and disadvantages, and each gun is shown, and explained from the gun itself. After the guns have been studied and their working understood they are fired a number of rounds at targets, so that their actual working may be seen.

The same course is pursued with the rapid-fire guns, their general principles being first explained, then each gun is studied in detail, and the gun itself used to explain any doubtful points; and after being thoroughly studied they are fired to show their working.

All parts of the course except those purely descriptive are illustrated by problems which are solved as a test of the thoroughness with which the principles taught are understood. The total number of lessons in the course is as follows:

|                             |            |
|-----------------------------|------------|
| Advance .....               | 54         |
| Review .....                | 27         |
| Practical instruction ..... | 6          |
| General review .....        | 16         |
| <b>Total .....</b>          | <b>103</b> |

The average length of lessons is 12 pages advance, 24 pages review, 40 pages general review. The time allowed for the course is as follows: "From 11 to 1 o'clock every other week day from September 1 to June 1, alternating with riding, and during February with drill regulations, except Saturdays from September 1 to December 1 and from March 15 to June 1."

The class is divided for instruction in ordnance and gunnery into two halves. The first half attends riding or drill regulations, while the second half attends ordnance, and alternates next day with the first half. Thus one-half the class in any one week will recite either twice or three times, except during the time from December 1 to March 15, when each half recites three times. Each half class is divided into four sections, and the number in each section varies, of course, with the size of the class, being generally from five to ten men.

The department is organized as follows: The head of the department has the official title of "Instructor of ordnance and gunnery." He is generally a captain of Ordnance detailed by the Secretary of War for four years upon the recommendation

of the Chief of Ordnance. The detail is not limited to captains, as shown by the list of instructors. Two assistants have been for some years allowed to the department, one a lieutenant of Ordnance and the other detailed from the line of the army.

The lieutenant of Ordnance is the senior assistant instructor of ordnance and gunnery, and in addition to his duties as instructor he is attached to the ordnance detachment at the post and is required to assist in the duties pertaining to that detachment, such as the care and preservation of the batteries at the post, mounting and dismounting guns and carriages, etc.

The junior assistant is not attached to the detachment, and his duties are those of instruction only as a general rule, but he may be called upon to assist the senior assistant in the performance of any of his duties.

Each of the assistants instructs from 11 a. m. to 1 p. m. daily, except the Saturdays before mentioned, and his duties as instructor also require about two hours daily correcting problems and arranging models, drawings, and subjects for the next recitations. The necessary time must also be given to the preparation of the lesson for the daily recitations.

The duties of the head of the department are a close supervision of the instruction, explanations of models, and occasionally lectures, preparation of the new matter for the course to replace such as may become obsolete, procuring of models, and preparation of drawings for different parts of the course when required. In addition he has charge of all the ordnance and ordnance stores of the post, and is responsible for the condition of the batteries and their ammunition, for the care and preservation of the various stores used in mechanical maneuvers, and for the target supplies of cadets. He has command of the post ordnance detachment and regulates their duties.

The ordnance section rooms are located on the third floor of the new academic building in the curtain facing the area, and are numbered 311, 313, and 315. The two latter are section rooms, while 311 is the office where consultations are held, marks and standing arranged, models kept and exhibited, and books arranged for reference. The office and one of the section rooms, 313, have each a small fireplace of stone built into the wall and communicating with a flue for burning powder. Each room also contains a glass case filled with samples of gunpowder and of smokeless powder. These samples are kept in glass bottles, properly labeled.

The section on entering the section room finds the instructor seated at his desk, and after the members of the section have reached their seats and while they are still standing the section marcher places himself in front of the instructor, salutes, and reports "All are present, sir," or "Cadet Blank is absent, sir," etc. The members of the section then take their seats.

All absentees are noted and reported on the class reports at the end of the week. The section being seated, the instructor asks, "Are there any questions, gentlemen?" when any member of the section may ask for an explanation of any point in the lesson which may not be thoroughly understood by him. Very frequently there are models illustrating some subject in the lesson. In this case the model is explained by the head of the department or by the instructor before recitation begins. These explanations may occupy from five to fifteen minutes. The names of the members of the section are then called and subjects in the lesson assigned to them for recitation. These subjects are printed and numbered, and each subject is assigned by its number.

As a rule, not more than six recitations can be completed in the hour assigned to each section, and hence if there are more than six cadets in the section, as is generally the case, the seventh takes his place on the floor in front of the instructor and is questioned by him upon some subject in the lesson, and this questioning continues till one of the cadets at the blackboard is ready to recite. If there are more than seven members in the section, practical problems pertaining to the lesson or to some previous part of the course are given them, which they are required to work out at their seats, being furnished with pencil and paper for that purpose. These problems are folded and indorsed with the name of the cadet and his section and turned in to the instructor, by whom they are corrected and returned to the cadet at the next recitation.

The cadets at the blackboard write first their name in the upper right-hand corner, and also the number of the subject assigned them. They also write any mathematical formulas which may be given them to aid in their discussion and make such notes as may assist them in reciting. When prepared for recitation, the cadet takes his pointer in his right hand and faces the instructor. The instructor then calls him by name, upon which the cadet begins his recitation by stating "I am required to discuss the subject of ———." He then proceeds with his discussion. Any errors which he may make are noted by the instructor, and if they are not very grave he is allowed to proceed. Grave errors, however, which vitiate the reasoning or impair the clearness of the discussion are corrected at once. At the conclusion of the recitation the instructor calls the attention of the cadet to the errors he may have committed,

questions him upon the subject generally to bring out any points in which the knowledge of the cadet may have appeared defective, and endeavors to impress upon him the general principles underlying the subject and their connection with principles previously taught.

In the meantime those cadets who have prepared for recitation take their seats and attend to the recitation and the explanation going on.

As each cadet finishes his recitation, the next in order is called by name by the instructor, takes his place at the blackboard, and proceeds as explained above. In some cases a cadet who has had a subject assigned to him will state that he is unable to discuss the subject. In this case the reason is generally that he has mistaken the lesson or has had other duty such that he was unable to study that particular part of the lesson. In such case a second subject is given him, and his mark for the recitation divided by 2, as it is impossible to admit excuses of this kind without injustice to other members of the section who may have been equally circumstanced and who have prepared their lessons.

All recitations and problems are marked on the following scale: Thorough, 3; good, 2.5; indifferent, 2; bad, 1.5; very imperfect, 1; complete failure, 0. By using the various gradations of this scale the instructor is enabled to express very accurately the value of the cadet's performance in the section room.

At the end of each week the names of each section are written on a blank form prepared for the purpose, and opposite each name is written the mark made by the cadet at each recitation during the week. The maximum for the week is the greatest possible total that could be made by the cadet who has recited most frequently. For instance, if the section recites three times a week the maximum possible for any cadet is 9. This, then, is the maximum for the week, and if a cadet has recited three times, his maximum is the sum of his marks, as, for instance,  $2.3 + 2.8 + 2 = 7.1$ , maximum, while if he has recited twice and his marks are 2.4, 2.8, his maximum will be the average of these two marks multiplied by 3, or  $2.6 \times 3 = 7.8$ , maximum, and similarly for one recitation.

The marks thus written out for each section are transmitted by each instructor to the head of the department and by him handed to the Superintendent in person, when he makes any remarks or explanations upon the progress of the individual cadet for the week. The progress of the class is also noted on the report, as "from page — to page —," giving the name of the text-book, and whether it is advance, review, or general review.

The class reports above explained, after being handed to the Superintendent, are conspicuously posted in the halls of the academy building, where they are accessible to all the cadets. Any cadet who thinks his instructor may have erred in his mark upon any particular recitation has the privilege of requesting permission to speak about it, and to explain fully to the instructor his reasons for thinking the mark erroneous. If it appears to the instructor that his reasons are sound, the mark, with the consent of the head of the department and the permission of the Superintendent, is changed.

At the end of each week the total mark of each cadet is entered in a column opposite his name, and these marks are arranged in each section in the order of magnitude. Whenever the difference between the lowest man in an upper section and the highest man in the next lower section exceeds 1.5, a transfer is made of the cadet from the lower to the higher section, and vice versa. By this means the class is always arranged according to their marks.

The head of the department alternates in visiting sections. He endeavors to hear each section at least once a week, and more frequently if possible. The object of his visits is to become thoroughly acquainted with the cadets, and their methods of recitation, and mental habits; also to note the methods of the instructors, and to make such corrections or suggestions to them as may establish as nearly as possible a uniform method of instruction throughout the department.

To further this end the sections change their instructors every two weeks. This enables any inequality in the method of marking to be eliminated, and the sections also alternate every two weeks in hours of attendance, so that each cadet may have as far as possible the same advantages and disadvantages in this respect.

In studying the subject of ordnance and gunnery there are necessarily many objects described which are complicated and difficult to understand thoroughly without the use of models and drawings. Hence the department has endeavored to procure models of all the different machines, guns, carriages, etc., referred to in the text. These are kept in the section rooms during recitation upon the particular subject to which they refer, and the recitation is made from them.

Drawings of all the more difficult and complicated parts of the different objects are also prepared beforehand, and are used in the recitations.

After six advance lessons have been studied they are reviewed in three lessons, and at the end of each six months' course in December and May, the whole of the previous course is reviewed generally.

The examinations have so far been oral, owing to changing text-books and lack of facilities during the erection of the new academic building, but it is believed in future that at least one of the examinations should be written, and that frequent written recitations should be held during the course. The oral examinations are conducted in the presence of a committee of the academic board, and do not differ from an ordinary recitation in the section room. If a cadet fails upon the subject assigned him, or fails to establish his proficiency to the satisfaction of the committee, he is given a second subject, and his examination is continued until his proficiency or deficiency is established. In case he is proficient after such first failure, his standing is determined by the mark given him upon his first subject. In case he fails to establish his proficiency he is subjected to a written examination, the questions for which are approved by the committee. The result of this written examination fixes his proficiency or deficiency, and is reported to the academic board.

The oral examination has the weight of three recitations, or 9, and the final standing of the cadet is determined as follows: The sum of all the marks made by each cadet before general review is determined. To this is added the sum of the general review marks multiplied by two.

In the department of ordnance and gunnery, owing to the alteration of hours and of instructors as previously explained, and also to the fact that the whole class takes the same course, the cadets are arranged according to their total marks as given above, and this determines their standing before examination.

After examination, the mark made by each, multiplied by three, is added to his previous total before examination, and the cadets are then arranged according to this grand total, which fixes the standing after examination. This process is followed in January and June. For any cadet, the sum of his standing in January and June, properly weighted, gives his final standing.

In reviewing the present course in ordnance and gunnery and comparing it with former courses, it is thought that the following points have been kept in view:

1. It has been simplified. The mathematical parts of the course, though necessarily more extensive than formerly, have been worked out more in detail. Every equation is deduced plainly and nothing left to puzzle the student. Furthermore, as a general rule all the equations introduced have some direct practical use and bearing upon ordnance, and this use and bearing are pointed out.

In the recitations no memorizing of equations or of mathematical steps is required. Every equation which is to be used in a given discussion is printed with the subject which is given to the cadet, and in case equations are to be deduced from those given, the various steps in the process are given in the form of a synopsis, unless these steps are perfectly obvious. The reason for this is that the object of the course is to teach ordnance and not mathematics, and in order that all the time may be given to understanding and applying the principles taught. With the description of guns, carriages, small arms, etc., the object has been to confine the description to few objects and to make the description of each thorough and general, the idea being that it is more advantageous to understand one carriage or one gun thoroughly than to have a vague idea of many. The descriptions are illustrated by copious drawings and by models, so that there is no difficulty in thoroughly understanding what is taught.

2. It has been extended to cover generally the whole ordnance field. This statement may be regarded as somewhat rash, seeing that the ordnance field covers so much at the present day, but it is safe to assert that after going over the present course there is very little on the subject of ordnance that the graduate would feel ignorant of. Many subjects have been treated to a very limited extent, but the general principles of each have been given, and it is believed there is enough of each to build upon. Care has been taken that nothing shall be taught which must be unlearned, and especial attention has been given to our own systems. But as a general rule principles are taught rather than details, wherever possible, and in describing details the reasons for them and the principles on which they depend are pointed out.

3. The instruction is at present more thorough than formerly. This is entirely owing to the fact that the department has at present, and has had for some years, two instructors instead of one. This enables the head of the department to watch the instructors constantly, to criticise and correct defects wherever they may occur, and to assist in the instruction wherever he may deem it necessary. It virtually gives three instructors instead of two, with greatly increased efficiency.

When the class is small the sections are small, and the instruction all that could be asked. With large classes the sections become large, and the thoroughness necessarily diminishes, owing to lack of time to be given to each cadet. But the advantage of two assistants over one is maintained for all classes.

It is difficult to compare the instruction in this department with that in any other institution, as there is really no corresponding department in any other institution. The department of ordnance and gunnery at the Naval Academy is the nearest

approach to it, and that, it is understood, includes both the scientific instruction in ordnance and gunnery and practical instruction. In other words, it corresponds more nearly to the old department of artillery here. So far as the scientific part of the course goes, an examination of the text-books in use at the Naval Academy indicates that the two courses are very nearly alike. In general the same subjects are taught, and to the same extent at both places, with the exception that field artillery and small arms are taught at the Military Academy in the place of torpedoes and some other subjects exclusively naval at the latter academy.

In conclusion it may be said that the object of the course in ordnance and gunnery, like that of other courses at the Academy, is to teach general principles and their application in this country to our service, so that the cadet upon graduation will be enabled to take his place as an officer, with the practical knowledge which an officer should possess of the weapons he is called upon to handle, and beyond this, with a broad foundation upon which future knowledge of the subject may rest.

### O.

UNITED STATES MILITARY ACADEMY,  
*West Point, N. Y., August 31, 1896.*

SIR: I have the honor to submit the following report in accordance with the provisions of Circular No. 35, Headquarters United States Military Academy, West Point, N. Y., August 3, 1896:

The growth of the library during the year ending August 31, 1896, is shown in the following statement:

|  |         |
|--|---------|
| Number of volumes in library September 1, 1895.....  | 38, 203 |
| Number of volumes purchased up to August 31, 1896 .....  | 630     |
| Number of volumes presented to the library up to August 31, 1896.....  | 779     |
| .....  | .....   |
| Making a total of .....  | 39, 612 |
| Returned to the War Records Office, by direction of the War Department,<br>duplicates in excess of two copies of the Records of the Rebellion .... | 347     |
| Transferred one complete set to the department of engineering.....   | 99      |
| Transferred to philosophical department duplicate philosophical works..  | 9       |
| Transferred to Mr. John S. Pierson, in exchange.....   | 16      |
| .....  | .....   |
| Total loss.....  | 471     |
| .....  | .....   |
| Total volumes in library September 1, 1896 .....   | 39, 141 |

Of the 779 volumes donated to the library during the year, Mr. John S. Pierson, of New York, presented 169 volumes, which related mainly to the war of the rebellion. He also contributed 34 pamphlets of the same class of literature.

There have been added to the library during the year 218 pamphlets, which make a total of 6,132 pamphlets at present in the library. The card cataloguing of the books and pamphlets of the library has been continued, and at present the most important branches of literature have been completed.

I most earnestly urge that application be made for an increased compensation to the assistant librarian, Dr. Otto Plate, so that he may receive \$1,500 per annum. His services and ability are such that this compensation is the least that should be given him, and his value to the Military Academy is much beyond that which he receives at present. His predecessor, who was not a man of culture or training in the conduct of a library, received for many years over \$1,400 per annum, and it is certain that Dr. Plate is entitled to at least the same compensation.

The library building is in exceedingly bad repair, but it is hoped that provision will be made at the next session of Congress to renovate it in accordance with the plans which have been prepared by the architect.

Very respectfully, your obedient servant,

P. S. MICHIE,  
*Professor, U. S. M. A., Librarian.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

P.

UNITED STATES MILITARY ACADEMY,  
SURGEON'S OFFICE, CADET HOSPITAL,  
*West Point, N. Y., August 31, 1896.*

SIR: In compliance with the requirements of Circular No. 35, dated United States Military Academy, August 3, 1896, I have respectfully to submit the following statement of the work done in the medical department of the post of West Point, N. Y., during the fiscal year ending June 30, 1896.

The mean strength of the command for the year is shown in the following table:

|   |        |
|---|--------|
| Officers .....                                    | 50.83  |
| Cadets .....                                      | 296.77 |
| Enlisted men .....                                | 330.78 |
| Civilians—officers' families, etc .....           | 300    |
| Civilians—soldiers' and employees' families ..... | 481.60 |

The number of sick treated during the year was as follows:

|  |       |
|--|-------|
| Officers .....   | 35    |
| Cadets in hospital .....   | 1,011 |
| Cadets in quarters .....   | 3,504 |
| Enlisted men treated in hospital and quarters .....  | 488   |
| Civilians and officers' families who have received treatment from the cadet hospital .....     | 3,209 |
| Civilians and soldiers' families who have received treatment from the soldiers' hospital ..... | 1,416 |
| Number of recruits examined .....  | 117   |
| Accepted .....   | 81    |
| Rejected .....   | 36    |
| Births .....   | 23    |
| Discharged for disability .....  | 4     |

The number of deaths was as follows:

|                    |   |
|--------------------|---|
| Officers .....     | 2 |
| Cadet .....        | 1 |
| Enlisted men ..... | 0 |
| Civilians .....    | 2 |

One officer, not included in this statement, died at Fort Monroe, Va., while absent on sick leave.

Besides the cases of sickness in the above statement, there were many others of minor importance which do not appear of record except in the form of a prescription entry in one of the dispensaries of the post.

The health of the garrison during the past year must be regarded as unsatisfactory, whether the number of admissions to the sick report be considered, the number constantly sick, or the number of deaths, as the rates which represent these are higher than those of the previous year and the corresponding rates for the previous decade.

The principal causes of admission were malarial diseases, ephemeral fever, epidemic influenza, acute pharyngitis, acute tonsillitis, and injuries, the larger proportion of which consisted of contusions and sprains.

One case of typhoid fever was admitted to the cadet hospital for treatment.

During the winter months measles prevailed as an epidemic among the civilians residing at the post. This disease was almost immediately followed in the spring by an epidemic of whooping cough, which also affected the same class of patients. Fortunately there was no extension of either of these diseases to the members of the Corps of Cadets.

The epidemic of malarial fever, which has added such a large percentage to the sick rate of the post for the year, began in July, 1895, increased in severity and numbers in August and September, and declined in November. During the winter months the post was free from this disease. In December, March, and April a large number of cases were admitted to the sick report suffering from ephemeral fever. In January and February the majority of admissions were due to epidemic influenza.

The ephemeral fever of the spring months yielded to malarial fever in April, when this disease again became epidemic, continuing as such to this date.

The management of these epidemics did not interfere with the ordinary routine work of the medical department of the post.

There has been no change during the year in the personnel of the medical officers on duty at West Point.

Very respectfully,

GEO. H. TORNEY,  
*Major and Surgeon, U. S. A.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

Q.

HEADQUARTERS UNITED STATES MILITARY ACADEMY,  
OFFICE TREASURER, QUARTERMASTER AND COMMISSARY OF CADETS,  
*West Point, N. Y., August 10, 1896.*

SIR: I have the honor to submit the following relative to my duties as treasurer of the United States Military Academy, quartermaster and commissary of cadets, for the fiscal year ending June 30, 1896, referring to each duty under its heading, viz:

## TREASURER OF THE UNITED STATES MILITARY ACADEMY.

The business of the treasurer's office during the year necessitated the keeping of 28 separate accounts, which were settled and inspected every two months, and which are enumerated in Statement No. 2 of this paper. The following statement, No. 1, was the last one made in this office prior to the expiration of the fiscal year 1894-95, and shows the treasurer's assets and liabilities at date when made, viz, May 21, 1895:

| ASSETS.                           |             | LIABILITIES.                     |           |
|-----------------------------------|-------------|----------------------------------|-----------|
| Assistant treasurer United States | \$32,130.83 | Athletic Association             | \$226.93  |
| Cadet cash                        | 19.50       | Cadet hospital                   | 232.66    |
| Dentist                           | 115.00      | Cadet laundry                    | 1,749.10  |
| Bonds                             | 20,000.00   | Cadet quartermaster's department | 10,885.93 |
| Cash on hand                      | 1,176.94    | Cadet subsistence department     | 355.15    |
|                                   |             | Corps of Cadets                  | 8,618.05  |
|                                   |             | Deposits                         | 100.00    |
|                                   |             | Equipment fund                   | 31,040.00 |
|                                   |             | Y. M. C. A.                      | 50.49     |
|                                   |             | Dialectic Society                | 149.92    |
|                                   |             | Miscellaneous fund               | 33.74     |
| Total                             | 53,441.97   | Total                            | 53,441.97 |

The following statement, No. 2, enumerates the 28 separate accounts, exhibits the total receipts and disbursements under each between date of Statement No. 1, above given, and Statement No. 3, that of date May 21, 1896, the last one made prior to the end of the fiscal year 1895-96, and shows fully the financial work of the office, viz:

| No. | Designation.                     | Receipts.    | Disbursements. |
|-----|----------------------------------|--------------|----------------|
| 1   | Assistant treasurer              | \$167,335.38 | \$169,750.92   |
| 2   | Athletic Association             | 1,355.50     | 1,488.86       |
| 3   | Balances paid                    | 17,543.18    | 17,543.18      |
| 4   | Barber                           | 600.30       | 600.30         |
| 5   | Cadet cash                       | 10,168.08    | 10,156.03      |
| 6   | Cadet hospital                   | 2,282.07     | 2,514.73       |
| 7   | Cadet laundry                    | 10,270.95    | 10,763.03      |
| 8   | Cadet quartermaster's department | 71,744.08    | 73,735.29      |
| 9   | Cadet subsistence department     | 61,694.83    | 61,269.01      |
| 10  | Confectioner                     | 136.00       | 136.00         |
| 11  | Corps of Cadets                  | 194,509.65   | 193,126.27     |
| 12  | Damages, ordnance                | 11.58        | 11.58          |
| 13  | Dancing                          | 526.22       | 526.22         |
| 14  | Dentist                          | 840.00       | 855.00         |
| 15  | Deposits                         | 16,872.20    | 16,872.20      |
| 16  | Y. M. C. A.                      | 114.00       | 152.94         |
| 17  | Equipment fund                   | 14,432.00    | 11,500.00      |
| 18  | Dialectic Society                | 483.71       | 469.74         |
| 19  | Expressage                       | 37.30        | 37.30          |
| 20  | Gas                              | 1,054.56     | 1,266.86       |
| 21  | Hops and german                  | 1,443.77     | 1,443.77       |
| 22  | Miscellaneous funds              | 23.27        | 76.32          |
| 23  | Miscellaneous items              | 857.91       | 857.91         |
| 24  | Oaths                            | 53.50        | 53.50          |
| 25  | Paymaster                        | 169,756.92   | 169,756.92     |
| 26  | Periodicals                      | 8.15         | 8.15           |
| 27  | Photographer                     | 90.00        | 90.00          |
| 28  | Policing barracks                | 5,592.41     | 5,592.41       |

The foregoing disbursements under accounts 2, 4, 6, 7, 8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 21, 23, 24, 26, 27, and 28 exhibit the purposes for which the pay of the cadets is expended for their support, and the total amount expended under each account during the year.

The following statement, No. 3, dated May 21, 1896, was the last one made during the fiscal year ending June 30 last, and exhibits the assets and liabilities of the treasurer, Military Academy, at the date given, viz:

| ASSETS.                  |                  | LIABILITIES.                          |                  |
|--------------------------|------------------|---------------------------------------|------------------|
| Assistant treasurer..... | \$34,546.37      | Athletic Association.....             | \$93.57          |
| Cadet cash.....          | 7.50             | Cadet laundry.....                    | 1,257.02         |
| Dentist.....             | 130.00           | Cadet quartermaster's department..... | 8,894.72         |
| Miscellaneous fund.....  | 19.31            | Cadet subsistence department.....     | 780.97           |
| Bonds.....               | 20,000.00        | Corps of Cadets.....                  | 10,001.43        |
| Cash on hand.....        | 784.37           | Deposits.....                         | 100.00           |
|                          |                  | Y. M. C. A.....                       | 11.55            |
|                          |                  | Equipment fund.....                   | 33,972.00        |
|                          |                  | Dialectic Society.....                | 163.99           |
|                          |                  | Gas fund.....                         | 212.30           |
| <b>Total.....</b>        | <b>55,487.55</b> | <b>Total.....</b>                     | <b>55,487.55</b> |

The graduates of this year, 73 members, received on final settlement of their accounts \$17,731.63, an average per man of \$227.83.

Sixty-nine furlough men received \$7,668, an average of \$111.13.

The 109 new cadets who entered this year deposited \$10,256.29, an average per man of \$94.09.

The expense to the Corps of Cadets on account of the cadet hospital for the year ending April 30, 1896, was \$2,514.73, an annual cost to each cadet of \$7.21, or an average monthly cost of 60.8 cents per man.

CADET QUARTERMASTER'S DEPARTMENT.

The following exhibits the work of the department in reference to the manufacture and repair of clothing, viz:

| Articles.               | Number manufactured. | Number repaired. | Articles.                       | Number manufactured. | Number repaired. |
|-------------------------|----------------------|------------------|---------------------------------|----------------------|------------------|
| Dress coats.....        | 304                  | 333              | Officers' dress coats.....      | 1                    | .....            |
| Overcoats.....          | 153                  | 233              | Officers' capes.....            | 4                    | 11               |
| Fatigue coats.....      | 496                  | 704              | Trousers, civilian.....         | 4                    | 169              |
| White jackets.....      | 214                  | 49               | Coats, civilian.....            | 3                    | 169              |
| Gray trousers.....      | 504                  | 943              | Vests, civilian.....            | 3                    | 169              |
| White trousers.....     | 924                  | 1,310            | Waiver jackets.....             | 34                   | 40               |
| Flannel trousers.....   | 112                  | .....            | Socks, pairs of.....            | .....                | 2,335            |
| Riding trousers.....    | 67                   | .....            | Gloves, pairs of.....           | .....                | 153              |
| Officers' trousers..... | 63                   | .....            | Crape, pieces of, sewed on..... | .....                | 656              |
| Officers' blouses.....  | 43                   | .....            | Shoes, pairs of.....            | .....                | 1,986            |

CADET SUBSISTENCE DEPARTMENT.

Prior to November 1, 1887, the cost of subsistence of cadets in the cadets' mess included the cost of cadets sick in hospital. Since that date the two accounts have been kept separate, the cost of the subsistence of sick cadets, after the accounts of the surgeon have been audited by the board of inspectors of supplies and have been approved by the Superintendent, being paid by the treasurer of the Academy, who divides the expense each settlement, pro rata, against all cadets on the rolls of the Academy, whether they are present or absent. The following exhibits the annual and daily cost of subsistence per cadet of subsisting cadets in both mess and hospital for the period July 1, 1870, to June 30, 1887, the end of the last fiscal year prior to the commencement of keeping the two accounts separately, a period of seventeen years, viz:

| Fiscal year. | Annual cost per cadet, mess and hospital. | Average daily cost per cadet, 365 days. | Fiscal year. | Annual cost per cadet, mess and hospital. | Average daily cost per cadet, 365 days. |
|--------------|---|---|--------------|---|---|
| 1870-71..... | \$243.81                                  | \$0.668+                                | 1879-80..... | \$183.50                                  | \$0.503-                                |
| 1871-72..... | 227.00                                    | 622-                                    | 1880-81..... | 188.50                                    | .516+                                   |
| 1872-73..... | 238.30                                    | 653-                                    | 1881-82..... | 215.00                                    | .589+                                   |
| 1873-74..... | 270.40                                    | 741-                                    | 1882-83..... | 215.00                                    | .589+                                   |
| 1874-75..... | 243.00                                    | 680                                     | 1883-84..... | 210.00                                    | .575+                                   |
| 1875-76..... | 233.00                                    | 638+                                    | 1884-85..... | 196.00                                    | .537-                                   |
| 1876-77..... | 199.00                                    | 545+                                    | 1885-86..... | 192.00                                    | .526+                                   |
| 1877-78..... | 195.50                                    | 535+                                    | 1886-87..... | 197.00                                    | .539+                                   |
| 1878-79..... | 182.00                                    | 499-                                    |              |   |   |

The following shows the annual and daily cost of subsistence in both mess and hospital for the fiscal year 1887-88, during the first four months of which the hospital expenses were merged with the mess expenses, and for the last eight months of the year were separate, viz: Annual charge, \$195.96; average daily charge, 53.7 cents.

The following exhibits separately the annual charge per cadet for subsistence in the cadet mess, the annual charge against each cadet in the corps for the subsistence of sick cadets in the hospital, the totals of both, and the average daily charge per cadet for both for the period, fiscal years 1888-89 to 1895-96, inclusive, a period of eight years, viz:

| Fiscal year. | Annual charge, mess. | Annual charge, hospital. | Total charge. | Average daily charge. |
|--------------|----------------------|--------------------------|---------------|-----------------------|
| 1888-89..... | \$192.06             | \$5.25                   | \$197.31      | \$0.540+              |
| 1889-90..... | 190.30               | 9.54                     | 199.84        | .547+                 |
| 1890-91..... | 183.35               | 8.39                     | 191.74        | .525+                 |
| 1891-92..... | 181.03               | 7.34                     | 188.37        | .516+                 |
| 1892-93..... | 190.70               | 7.24                     | 197.94        | .542+                 |
| 1893-94..... | 189.20               | 7.79                     | 197.09        | .539+                 |
| 1894-95..... | 184.40               | 8.63                     | 192.93        | .528+                 |
| 1895-96..... | 186.50               | 7.57                     | 194.07        | .531+                 |

From the foregoing the following facts of interest are evident:

During the twenty-six years last past the highest charge for subsistence, including cost of sick cadets in hospital, was, per cadet per day, 68 cents. The lowest similar charge was 49.9 cents. The average similar charge was 56.8 cents. The average similar charge for the last eight years prior to July 1, 1887, was 54.6 cents. The average similar charge for the last past eight years was 53.2 cents.

The variation in the annual cost of subsistence in the cadet mess from year to year is due chiefly to the variation in the number of cadets present and in the variations of the cost of provisions.

A Pasteur-Chamberland filter of 40-tube power has been placed in the mess, and so connected that an abundant supply of filtered water, chilled, is furnished at each meal.

The variety, quality, and character of food supplied is essentially the same as that heretofore furnished, with the exception of milk, which article, for sanitary reasons, has been discontinued as a potable article of diet. Coffee, chocolate, and water are furnished at breakfast; water at dinner; coffee, tea, and water at supper, with boiled milk for the coffee and tea.

#### CADET LAUNDRY.

The following exhibits the work done at the laundry during the year for individuals, viz:

|                       |        |                      |         |
|-----------------------|--------|----------------------|---------|
| Bathing suits.....    | 34     | Jackets, white.....  | 1,947   |
| Belts, shoulder.....  | 17,723 | Pillowcases.....     | 13,189  |
| Belts, sword.....     | 2,550  | Sheets.....          | 21,936  |
| Belts, waist.....     | 20,597 | Shirts, white.....   | 26,993  |
| Blankets, single..... | 276    | Shirts, night.....   | 11,848  |
| Clothes bags.....     | 2,627  | Shirts, under.....   | 34,263  |
| Collars.....          | 97,939 | Socks, pairs of..... | 39,315  |
| Comfortables.....     | 107    | Towels.....          | 64,922  |
| Cuffs, pairs of.....  | 64,039 | Trousers, gray.....  | 153     |
| Drawers.....          | 34,170 | Trousers, white..... | 31,360  |
| Fatigue coats.....    | 30     |                      |         |
| Gloves, pairs of..... | 32,442 | Total.....           | 582,728 |
| Handkerchiefs.....    | 64,268 |                      |         |

During the same period there was laundered for the cadet hospital—

|                       |       |                       |        |
|-----------------------|-------|-----------------------|--------|
| Bandages.....         | 6     | Sheets.....           | 2,956  |
| Bedspreads.....       | 320   | Shirts, hospital..... | 30     |
| Blankets, single..... | 1     | Tablecloths.....      | 257    |
| Mattress covers.....  | 13    | Towels.....           | 3,363  |
| Napkins.....          | 1,484 |                       |        |
| Pillowcases.....      | 2,243 | Total.....            | 10,673 |

The five washers now in the laundry are brass, of the latest and most improved pattern, and an effort is being made to produce first-class work.

Very respectfully, your obedient servant,

WM. F. SPURGIN,  
*Captain, Twenty-first Infantry, Treasurer U. S. M. A.,  
 Quartermaster and Commissary of Cadets.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

## R.

WEST POINT, N. Y., *August 18, 1896.*

SIR: In accordance with instructions I have the honor to submit the following report of the principal operations in the department of ordnance and gunnery at the United States Military Academy during the fiscal year ending June 30, 1896:

## LABORATORY.

The routine work at the laboratory includes the care and preservation of two light batteries, the seacoast battery, and battery Knox, and the siege and mortar batteries. The guns and carriages belonging to these batteries have been painted, lacquered, and kept in repair during the year. It has been found necessary to dismount the mechanism of the 8-inch steel B. L. rifle and the 12-inch mortar, as they were constantly interfered with by unauthorized persons. The rapid-fire and machine guns have been placed in the ordnance museum, where they can be exhibited and used for cadet instruction, and where they can be kept in better condition.

The ammunition for gallery practice and the necessary targets for cadet practice have been prepared and attendance upon the same furnished, and also the care and repairs of the implements used in mechanical maneuvers, repairs of cadet arms and equipments, and the care and preservation of the trophy guns have received due attention. The skidding of guns on Trophy Point will be continued.

A model lathe one-fourth size has been made for use in cadet instruction and for exhibition in the museum. The cuts for the text-book of ordnance and gunnery have been completed, and the book has been published and is now ready for use by the present first class. Pamphlets containing lists of subjects and practical problems for the course and also the lessons for the entire year have been prepared and published.

Considerable work has been done upon the new museum in fitting up the various models, and all the varnishing of the woodwork has been done by the members of the ordnance detachment.

## MUSEUM.

The models, flags, etc., belonging to the museum have been arranged during the year in proper cases and upon stands and the room opened to the public. This has been the principal work of the year. The models had been stored for nearly four years in various places, and it was impossible to have access to them for the purpose of cleaning them. It was found, consequently, that many of them were in bad condition, and they have all been thoroughly overhauled, cleaned, and placed in proper condition. Four handsome cases of plate glass contain most of the battle and trophy flags, hermetically sealed and numbered, and the remaining trophy flags will be placed in a large case of sufficient length to contain them. All models have been mounted on oak stands provided with friction rollers, and they can be moved readily and used for purposes of instruction. The model Mexican mine has been thoroughly repaired and placed in proper condition. The work in the museum is still incomplete and has been suspended during the summer. It is the intention to continue the work during the fall and winter.

## SMALL ARMS, ETC., RECEIVED.

During the year the following additions to the small arms have been received: One Spanish Mauser rifle, caliber .276; one cadet rifle, caliber .45; one cadet rifle, caliber .30; one carbine, service, model 1895, caliber .30; one rifle, service, model 1895, caliber .30; two rifles, service, model 1893, caliber .30.

These are used in cadet instruction and also for exhibition in the museum.

The ordnance department has also furnished one Gatling gun, caliber .30, model 1895; one carriage and limber for same; one 8-inch steel armor-piercing shot.

## MODELS.

The following models have been received during the year: One 5-inch siege carriage, one-tenth size; one 7-inch siege howitzer carriage, one-tenth size; one 8-inch Buffington-Crozier disappearing carriage, one-tenth size.

These models are exact reproductions of the service carriages, and are very useful in cadet instruction. Work is in progress upon other models, and at the conclusion of the present year the department will have a working model of every service gun and carriage.

There have also been received from the Ordnance Department a number of sample boards containing fuses and primers, a number of samples of shrapnel, showing their manufacture, and from Messrs. E. I. Du Pont De Nemours & Co., of Wilmington,

Del., a handsome case containing samples of the different kinds of gunpowder and smokeless powder manufactured by them. This case was presented to the department through the kindness of the above firm.

Very respectfully, your obedient servant,

LAWRENCE L. BRUFF,

*Captain, Ordnance Department, U. S. A., Instructor Ordnance and Gunnery.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

## S.

WEST POINT, N. Y., *September 7, 1896.*

SIR: I have the honor to report as follows upon the different branches of work assigned to me for the year from September 1, 1895, to August 31, 1896:

### PRACTICAL MILITARY ENGINEERING.

During October, 1895, and April, 1896, the classes of 1896 and 1897 were under instruction, and during July and August, 1896, the classes of 1897 and 1899.

The class of 1896 received instruction in bridge by successive pontoons, fascine, hurdle, hoop-iron gabion, brush gabion, gabion revetment, sand-bag revetment, barrel revetment, wire entanglement, simple trench (one-sixth scale), simple trench (full scale), flying trench (one-sixth scale), flying trench (full scale), shelter trenches (various types), Russian gun pit, full sap, making palisading, planting vertical palisading, planting inclined palisading, planting fraises in scarp, planting fraises in counterscarp, gun platform, mortar platform, signaling with telegraph, explaining model bridge train, use of reconnoissance instruments, mounted reconnoissance.

The class of 1897 received instruction in school of the boat, making knots and lashings, bridge by successive pontoons, assembling and launching canvas pontoons, trestle bridge on land, single lock spar bridge, double lock spar bridge, single sling spar bridge, fascine, hurdle, hoop-iron gabion, brush gabion, gabion revetment, sand-bag revetment, barrel revetment, wire entanglement, simple trench (one-sixth scale), simple trench (full scale), flying trench (one-sixth scale), flying trench (full scale), shelter trenches (various types), Russian gun pit, single full sap (one-sixth scale), double full sap (one-sixth scale), epaulement for breech-loading gun (one-sixth scale), making palisading, planting vertical palisading, planting inclined palisading, planting fraises in scarp, planting fraises in counterscarp, gun platform, mortar platform, profiling, defilading, signaling with flag, signaling with heliograph, signaling with telegraph, and use of explosives.

One member of the class of 1898 attended instruction with the class of 1897 during part of last July.

The class of 1899 received instruction in school of the boat, bridge by successive pontoons, assembling and launching canvas pontoons, trestle bridge on land, fascine, hurdle, hoop-iron gabion, brush gabion, fascine revetment, gabion revetment, wire entanglement, signaling with flag (sending and receiving), and use of explosives.

### COMPANY E, BATTALION OF ENGINEERS.

This company has furnished throughout the year a daily guard detail of from ten to twelve men; has kept its barrack and barrack ground in repair and police; cultivated its garden; kept the two pontoon trains and the cadet boats in repair; completed two new pontoon boats, and has kept the sacoast, siege, and mortar batteries, with Fort Clinton and Battery Knox, in order. It has assisted in the instruction of the cadets in practical military engineering, preparing the bridge and siege material. In connection with the extension of the waterworks, it has also furnished field parties for the survey and construction, and from one to three noncommissioned officers at a time as overseers of working parties. It has also furnished from two to three teachers for the post school for soldiers' children, and a like number for the post school for enlisted men.

The company is now eight below its allotted strength. Four desertions occurred during the year, the company in each case being the gainer. The physical condition of the men has continued excellent, and the discipline of the company good.

Attention is invited to the accompanying table, which contains a résumé of the company's duties by months.

### WATER SUPPLY AND PIPE LINE.

The summer of 1895 was a rather favorable one for the water supply, but on account of a dry September the level of Round Pond was reduced to 7.45 feet by October 22,

the last day of drawing for 1895. Last spring this pond failed to fill by 1.6 feet, an unfortunate feature, accentuated by dry weather in April and May, which resulted in drawing upon the pond at the unusually early date of May 25. The drought has since continued with practically no intermission, until the stage of about 9 feet was recorded on August 31, ultimo. The stage on the corresponding day last year was 14.5 feet, and as low a stage for that day has not been recorded since 1886.

The consumption of water has apparently increased since the inauguration of the new swimming pool and the new cadet bathrooms. The attendant at the filter house is positive that the increase is considerable. An opportunity to test the matter arose during the latter part of August, when the siphon from Round Pond was temporarily out of service. During six days Delafield Pond lost water at an average rate of 417,000 United States gallons daily, the greatest loss being nearly 436,000 gallons on the day ending at 5 p. m., August 24 (Monday). A small percentage of this loss is possibly due to leakage, which it is impracticable to recover, but the fact remains that the daily consumption or loss of water at this post is much greater than it should be, and to meet it without inconvenience the new reservoir must be made to hold the greatest practicable volume.

The deficiency of rainfall during last July and August, coupled with the failure of Round Pond to fill last winter and spring, may possibly require a closer restriction than usual of the daily consumption, until the brooks begin to run their customary fall volume.

The pipe line has fulfilled all demands upon it without trouble, except in a recent instance, when temporary repairs were required in the siphon at Round Pond. In this portion of the line several joints have been distorted, apparently by the action of ice upon the cribs last winter. Further repairs will be needed as soon as the siphon can be put out of service for the purpose of making them.

#### NEW RESERVOIR.

Work on the north dam was suspended for the winter on December 14, 1895, the core wall having been carried up to the level of the temporary roadway (about 318 M. L. W.). The 6-inch pipe connection had previously been completed between the new reservoir and the Round Pond pipe line, intersecting the Delafield pond-filter house and Cro' Nest pond-filter house pipe lines en route. This new pipe line is laid through the core wall of the north dam at about the elevation of 309 M. L. W. At the same elevation four lengths of 12-inch pipe are laid, also piercing the core wall, and allowing a future connection of larger size to be made between the new reservoir and the Cro' Nest ridge without breaking through the core wall. I believe that the said larger connection will undoubtedly be necessary in the near future.

Work on the main dam was suspended on December 28, 1895, the body of the structure having been completed and somewhat more than half the coping set. Stonecutting was suspended for the winter on January 8, 1896, but was again renewed on April 20 following, and completed about June 6, 1896. The north and south faces of this dam were thoroughly cleaned and pointed during May, June, and July, 1896. The work yet to be done upon this structure includes parapet walls, the paving of the carriageway on top, the building of the overflow and spillway, and the road connections at the ends.

During last March and April the water in the new reservoir rose to the elevation of about 317 M. L. W., fairly testing the tightness of the main dam, which was then in an unpointed state. The structure appeared to be entirely free from leaks.

#### REMOVAL OF SOIL AND PEAT.

Under the appropriation for this purpose work was commenced by day labor July 1, ultimo, and on August 31 about one-third of the entire marsh had been stripped of the objectionable material. The commencement of this work was expensive, a deep drainage ditch having to be driven through a deposit of bowlders, and plank roads having to be provided to support the teams and vehicles used in hauling. The work is now proceeding at a fairly satisfactory rate, and it is hoped to have the reservoir in condition for storing water by December 1 next.

#### FILTERS.

My last annual estimates included an item of \$35,000 for covered filter beds, of capacity sufficient to filter the entire consumption at any season of the year.

This item did not reach Congress, and thus no appropriation was made. The item was not presented by me until several years' study and observation had satisfied me that thorough filtration was necessary. During the summer just closed an examination into the sanitary condition of the water supply by Maj. Charles Smart, Medical

Department, United States Army, resulted in a strong recommendation of filtration upon the lines previously covered by the estimates and recommendations above referred to. This item will appear in my estimates for the coming fiscal year.

## NEW SUPPLY MAIN.

No appropriation was made for this work by Congress at its last session. The estimate will be renewed this fall.

## MEMORIAL HALL.

The supervision of certain features of the work on this structure was committed to me last April. The work progressed rapidly until about August 1, since which time there has been some delay, apparently without sufficient justification.

The character of the work done seems to be entirely satisfactory.

Very respectfully, your obedient servant,

JAS. L. LUSK,

*Captain, Corps of Engineers, Instructor Practical Military Engineering.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

|                                       | 1895. |      |      |      | 1896. |      |      |      |      |       |       |      |
|---------------------------------------|-------|------|------|------|-------|------|------|------|------|-------|-------|------|
|                                       | Sept. | Oct. | Nov. | Dec. | Jan.  | Feb. | Mar. | Apr. | May. | June. | July. | Aug. |
| Average strength of company.....      | 88    | 87   | 89   | 91   | 94    | 96   | 96   | 93   | 92   | 91    | 92    | 92   |
| Average strength of guard detail..... | 12    | 12   | 12   | 12   | 12    | 12   | 12   | 12   | 12   | 12    | 12    | 12   |
| Fatigue days.....                     | 25    | 27   | 26   | 26   | 27    | 25   | 26   | 26   | 25   | 26    | 27    | 27   |
| Infantry drills.....                  | 2     | 10   | 3    | 4    | 4     | 4    | 4    | 4    | 14   | 2     | 13    | 6    |
| Signal drills.....                    | 1     | 10   | 3    | 4    | 4     | 4    | 4    | 3    | 1    | 2     | 14    | 5    |
| Engineering drills.....               | 2     | 9    | 3    | 5    | 5     | 4    | 5    | 3    | 1    | 4     | 6     | 7    |
| Gymnasium drills.....                 | 0     | 6    | 5    | 9    | 9     | 8    | 9    | 7    | 1    | 3     | 0     | 0    |
| Average attendance at drills.....     | 38    | 35   | 33   | 38   | 36    | 43   | 44   | 37   | 43   | 42    | 36    | 34   |
| Target practice, days....             | 12    | 0    | 0    | 0    | 0     | 0    | 0    | 0    | 0    | 0     | 0     | 0    |
| School days.....                      | 0     | 9    | 18   | 21   | 20    | 20   | 22   | 0    | 0    | 0     | 0     | 0    |
| Average attendance at school.....     | 0     | 0    | 17   | 21   | 18    | 20   | 19   | 0    | 0    | 0     | 0     | 0    |

## T.

QUARTERMASTER'S OFFICE, U. S. MILITARY ACADEMY,  
West Point, N. Y., August 31, 1896.

SIR: I have the honor to submit herewith the following report of the operations of the quartermaster's department at West Point, N. Y., for the fiscal year ending June 30, 1896, prepared in accordance with instructions from your office, dated August 3, 1896:

## QUARTERMASTER'S DEPARTMENT, UNITED STATES ARMY.

The duties pertaining to this department are enumerated in paragraph 972, Army Regulations, 1895. The amounts received, disbursed, etc., under the various heads of appropriation are shown in accompanying statement, marked A.

The following contracts for furnishing fuel, forage, and straw were entered into and were satisfactorily fulfilled:

Clark & Wilkins: 200 cords hard wood, 20 cords soft wood.

Dickson & Eddy: 600 tons egg coal, 1,100 tons stove coal, 300 tons chestnut coal.

William E. Dante: 600,000 pounds oats.

John Moonan: 20,000 pounds middlings, 40,000 pounds bran, 400 tons hay.

Charles L. Rickerson: 95 tons straw.

William McMeekin: Flagstaff.

It is imperative that the number of quartermaster's animals at this post be increased by at least six. In connection with this I desire to call attention to the increased demands on the transportation by the increased size of the post, and the corresponding increase of work and special attention to the increased work on the transportation during nearly four months of the busiest season by the use of the range at this post by troops from the harbor. No allowance whatsoever has been made for the necessary work which must be done for these troops in hauling their property, camp and range equipage.

QUARTERMASTER'S DEPARTMENT OF THE UNITED STATES MILITARY ACADEMY.

My duties in this branch are defined in paragraph 15 of the United States Military Academy Regulations, 1894.

Contracts entered into during the year and made in previous years and remaining in force in the fiscal year to which this report relates were as follows:

| No. | Contractor.                             | Date.          | Purpose.                      |
|-----|---|----------------|-------------------------------|
| 1   | Thomas J. Gilroy .....                  | June 26, 1894  | Unmarried officers' quarters. |
| 2   | John Fox .....                          | May 21, 1895   | 8-inch gas pipe.              |
| 3   | Davis, Reed & Alexander .....           | May 25, 1895   | Tile floor, cadet mess.       |
| 4   | Warren Foundry and Machine Co. ....     | June 11, 1895  | 6-inch water pipe.            |
| 5   | Westmoreland Coal Co. ....              | June 27, 1895  | 1,700 tons gas coal.          |
| 6   | Dickson & Eddy .....                    | June 28, 1895  | 4,600 tons coal.              |
| 7   | Warren Foundry and Machine Co. ....     | July 23, 1895  | 12-inch water pipe.           |
| 8   | Empire Paving and Construction Co. .... | Sept. 23, 1895 | Granolithic pavement.         |
| 9   | The Mason & Risch Vocalion Co. ....     | Sept. 7, 1895  | Organ for chapel.             |
| 10  | Probst Construction Co. ....            | Jan. 22, 1896  | Memorial Hall.                |

The contract with Thomas J. Gilroy, deceased, for unmarried officers' quarters has been closed, final payment having been made to the administrators by the Treasury Department.

The following buildings have been repaired, either by special appropriation therefor or from the appropriation for repairs and improvements: Cadet mess building, cadet laundry, cadet quartermaster's department, gymnasium, cadet guardhouse, cadet barracks, cadet hospital, soldiers' hospital, band barracks, quartermaster's stable and barn, Company E, engineer barracks. The barracks of army service detachment was completed sufficient for occupancy about April 1, 1896. Some minor details of work on outside of building remain to be completed with the appropriation available for fiscal year ending June 30, 1897. All officers' quarters given such repairs as were necessary, new organ placed in the chapel, granolithic pavement laid around the new Academy building, and the roads in that vicinity regraded and macadamized. The picket line at the cavalry stables was also macadamized. Iron fence was built around the soldiers' hospital. A new gas main laid below the present south gate. Stone wall on west side of road from the crossroads to Highland Falls was built by the men of the army service detachment, some 1,000 linear feet.

During the past fiscal year the post has suffered severely from storms, and much unforeseen work has been necessitated. The retaining wall of road east of cemetery was undermined and fell down. This amounted to some 3,600 cubic feet of stone wall to rebuild. The retaining wall of road to east of Fort Clinton was undermined and required rebuilding. This amounted to some 1,500 cubic feet of stone wall. The roof of the quartermaster's stables was twice blown partially off. All roads were badly eroded and many trees blown down and uprooted. Two sets of married soldiers' quarters in Logtown were pulled down, having been condemned as uninhabitable.

Attention is invited to the present method of paying civilian employees which was adopted July 1. The duty of paying the additional pay to officers, the extra-duty pay to enlisted men, and the pay of civilians provided for by the act making appropriations for the support of the Military Academy was then transferred to the pay department. The transfer of the first two appears desirable, as it relieves this office of the necessary clerical work of preparing the rolls and vouchers and does not materially increase the clerical work of the companies, requiring only the additional note on the muster and pay rolls to cover the payment of the extra-duty pay. The transfer of the payment of the civilian employees is not, in my opinion, advisable, as it unnecessarily increases the work both of this office and that of the paymaster designated to make the payment without corresponding advantage.

Prior to this year all the regular civilian employees were paid on the monthly rolls with those temporarily hired, such as painters, carpenters, and mechanics of all kinds, as well as the laborers. The money was drawn from the Treasury at the same time and one pay day answered for all, the 27 permanent employees entailing very little additional work over the several hundred men paid. Under the present arrangement rolls (in triplicate) must be prepared by this office and the signatures thereon be obtained as before. These are then forwarded by the Superintendent to the paymaster, who is obliged under the regulations to put each man's pay in a separate envelope, marking the envelope with the man's name and its contents, etc., and then forward same to the Superintendent. He transmits the package to the disbursing officer, who distributes the envelopes to the employees, seeing that each envelope is correct.

This system, it will be seen, makes the work performed by the pay department entirely additional and unnecessary, and at the same time increasing the work of this office.

I would recommend that the matter be brought to the attention of the Adjutant-General, with a view of having the civilian employees paid, as heretofore, by this office.

Statement of the receipts and disbursements for the fiscal year ending June 30, 1896, accompanies this report, marked B.

GAS WORKS, UNITED STATES MILITARY ACADEMY.

As director of the gas works, I am charged with providing the necessary illuminating gas for the needs of the post. In order to properly light the buildings and grounds of the Academy, Congress appropriated for the last fiscal year the sum of \$5,000 for the purchase of gas coal, oil, candles, lanterns, matches, chimneys, and wicking for lighting the Academy chapel, library, cadet barracks, mess hall, shops, hospital, offices, stables and riding hall, sidewalks, camp, and wharves. As the gas consumed costs more than the amount appropriated, all that which is consumed at places not enumerated in the act is sold at actual cost of manufacture with a small increase for contingencies, which includes a portion of the deficiency above named, and also provides for contingent repairs, which experience has shown to be necessary from time to time. The remainder of the deficiency is charged to cadets, who pay for gas at the rate of 35 cents per month for the time they are actually present. The sale of gas as above, of coke, coal tar, etc., constitutes a fund known as the "contingent fund," which is expended under the direction of the Superintendent of the Academy in the purchase of additional gas coal when necessary, retorts, gas fixtures, and repairs of same, pay of labor employed in making gas, and such other expenditures as pertain to the gas-making plant of the Academy.

The receipts and disbursements are shown in the statement of the contingent fund herewith, marked C.

SPECIAL CONTINGENT FUND, UNITED STATES MILITARY ACADEMY.

This fund is derived from the rent of certain buildings on the post and from the sales of gas, coke, coal tar, etc.

Statement of the receipts and disbursements under this head accompanies this report and is marked C.

Respectfully submitted.

J. B. BELLINGER,

*Captain and Assistant Quartermaster, United States Army,  
Disbursing Officer, United States Military Academy.*

The ADJUTANT UNITED STATES MILITARY ACADEMY.

A.—Statement of funds pertaining to the Quartermaster's Department, United States Army,  
for the fiscal year ending June 30, 1896.

|                                    |              |
|------------------------------------|--------------|
| Balance on hand July 1, 1895.....  | \$1, 259. 82 |
| Received since:                    |              |
| Regular supplies.....              | 25, 965. 86  |
| Incidental expenses.....           | 12, 545. 71  |
| Army transportation.....           | 4, 874. 82   |
| Clothing and equipage.....         | 2. 00        |
| Sales to officers.....             | 4, 281. 78   |
| Sales at auction.....              | 582. 63      |
| Total to be accounted for.....     | 49, 512. 62  |
| Disbursed:                         |              |
| Regular supplies.....              | 25, 930. 58  |
| Incidental expenses.....           | 12, 446. 23  |
| Army transportation.....           | 4, 761. 49   |
| Clothing and equipage.....         | 2. 00        |
| Deposited.....                     | 5, 072. 87   |
| Balance on hand June 30, 1896..... | 1, 299. 45   |
| Total.....                         | 49, 512. 62  |

**B.—Statement showing receipts and disbursements, etc., pertaining to the appropriations for the support of the United States Military Academy for the fiscal year ending June 30, 1896.**

| Date.         |                                 | Current and ordinary expenses. | Miscellaneous items and incidental expenses. | Buildings and grounds. | New academic building. | Memorial Hall.   | Total.            |
|---------------|---------------------------------|--------------------------------|--|------------------------|------------------------|------------------|-------------------|
|               | <b>Cr.</b>                      |                                |  |                        |                        |                  |                   |
|               | By balance on hand fiscal year— |                                |  |                        |                        |                  |                   |
| July 1, 1895  | 1889                            |                                |  |                        | \$59,055.20            |                  | \$59,055.20       |
| Do.           | 1894                            | \$4,856.19                     | \$53.15                                      | \$3,519.20             |                        |                  | 8,428.54          |
| Do.           | 1895                            | 16,864.04                      | 5,276.50                                     | 20,950.58              |                        |                  | 43,091.12         |
| Do.           | 1895-96                         | 600.00                         |  | 8,124.49               |                        |                  | 8,724.49          |
| Do.           | Memorial Hall                   |                                |  |                        |                        | \$5,000.00       | 5,000.00          |
|               | Received since fiscal year—     |                                |  |                        |                        |                  |                   |
| June 30, 1896 | 1889                            |                                |  |                        | 153.33                 |                  | 153.33            |
| Do.           | 1895                            | 3,000.00                       |  | 8,000.00               |                        |                  | 11,000.00         |
| Do.           | 1896                            | 79,867.10                      | 29,310.00                                    | 50,451.25              |                        |                  | 159,628.35        |
| Do.           | 1895-96                         |                                |  | 97.50                  |                        |                  | 97.50             |
| Do.           | Memorial Hall                   |                                |  |                        |                        | 35,000.00        | 35,000.00         |
|               | <b>Total</b>                    | <b>105,187.33</b>              | <b>34,639.65</b>                             | <b>91,143.02</b>       | <b>59,208.53</b>       | <b>40,000.00</b> | <b>330,178.53</b> |
|               | <b>Dr.</b>                      |                                |  |                        |                        |                  |                   |
|               | Disbursed fiscal year—          |                                |  |                        |                        |                  |                   |
| June 30, 1896 | 1889                            |                                |  |                        | 59,208.53              |                  | 59,208.53         |
| Do.           | 1894                            | 1,413.87                       | 3.12   | 447.47                 |                        |                  | 1,864.46          |
| Do.           | 1895                            | 14,263.08                      | 4,426.28                                     | 25,961.26              |                        |                  | 44,670.62         |
| Do.           | 1896                            | 62,178.46                      | 25,531.79                                    | 47,168.50              |                        |                  | 134,878.75        |
| Do.           | 1895-96                         | 600.00                         |  | 8,221.99               |                        |                  | 8,821.99          |
| Do.           | Memorial Hall                   |                                |  |                        |                        | 8,366.75         | 8,366.75          |
|               | Deposited fiscal year—          |                                |  |                        |                        |                  |                   |
| Do.           | 1894                            | 3,442.32                       | 50.03  | 3,071.73               |                        |                  | 6,564.08          |
| Do.           | 1895                            | 5,600.96                       | 850.22                                       |                        |                        |                  | 6,451.18          |
| Do.           | 1896                            | 1,293.19                       |  |                        |                        |                  | 1,293.19          |
|               | Balance on hand fiscal year—    |                                |  |                        |                        |                  |                   |
| Do.           | 1895                            |                                |  | 2,969.32               |                        |                  | 2,969.32          |
| Do.           | 1896                            | 16,395.45                      | 3,778.21                                     | 3,282.75               |                        |                  | 23,456.41         |
| Do.           | Memorial Hall                   |                                |  |                        |                        | 31,633.25        | 31,633.25         |
|               | <b>Total</b>                    | <b>105,187.33</b>              | <b>34,639.65</b>                             | <b>91,143.02</b>       | <b>59,208.53</b>       | <b>40,000.00</b> | <b>330,178.53</b> |

**C.—Statement of receipts and expenditures pertaining to the special contingent fund, United States Military Academy, from July 1, 1895, to June 30, 1896.**

|                                  | Gas works.      | Rents, etc.     | Total.           |
|----------------------------------|-----------------|-----------------|------------------|
| Balance on hand July 1, 1895     | \$2,182.72      | \$810.18        | \$2,992.90       |
| Received since:                  |                 |                 |                  |
| By rent of—                      |                 |                 |                  |
| West Point Hotel                 |                 | 2,000.00        |                  |
| Post-office                      |                 | 150.00          |                  |
| Stables                          |                 | 75.00           |                  |
| Store (retiring house)           |                 | 350.00          |                  |
| By sale of—                      |                 |                 |                  |
| Gas                              | 5,185.11        |                 |                  |
| Coke                             | 817.50          |                 |                  |
| Coal tar                         | 442.74          |                 |                  |
| Junk                             |                 | 123.50          |                  |
| Miscellaneous                    |                 | 196.24          |                  |
|                                  | <b>6,445.35</b> | <b>2,894.74</b> | <b>9,340.09</b>  |
| <b>Total to be accounted for</b> |                 |                 | <b>12,332.99</b> |
| Disbursed                        | 8,041.82        | 2,865.65        | 10,907.47        |
| On hand June 30, 1896            | 905.99          | 519.53          | 1,425.52         |
| <b>Total accounted for</b>       |                 |                 | <b>12,332.99</b> |

