THE SERVICES OF GRADUATES AS EXPLORERS, BUILDERS OF RAILWAYS, CANALS, BRIDGES, LIGHT-HOUSES, HARBORS, AND THE LIKE.

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OFFICER OF ENGINEERS, 1821.

IN THE systematic teaching of the sciences to qualify students for the engineering profession West Point led the way during the first half century of its existence. When the Military Academy was founded it was even more true than now that our people hesitated at expenditures for purely military purposes, and proposed to employ their officers in time of peace in various useful undertakings. In the beginning, through the personal efforts of President Jefferson, who was "no great lover of military affairs, but a warm friend of science," such a teacher as Jared Mansfield was secured, and we know that Mr. Jefferson, when he signed the act establishing the Military Academy, contemplated an institution which would supply the country with engineers for civil as well as military purposes, an institution which would serve as a model for training in the practical sciences.

Our technical schools are now the admiration of the world, but West Point antedated the Rensselaer Polytechnic School by twenty-three years, and there was no third institution in the same field prior to 1847, when the Sheffield Scientific School was established. While many engineering achievements may be claimed as the immediate work of West Point graduates, we must not forget the profound influence of the Academy as an example, and of many of its graduates as teachers, which have helped to make the American civil engineer

the most capable practical man in the world to-day, and the American nation, in consequence, the envy of Europe in all that pertains to manufacture and construction.

President Gilman, in an address delivered on the occasion of the semicentennial celebration of the founding of Sheffield Scientific School, remarks:

> The opportunities, the honors, the pleasures, and the rewards of a liberal education were opened during the first half of this century to those only who had been disciplined, by the preparatory schools, in the ancient languages, and this discipline was continued through the greater part of the subsequent collegiate curriculum. To verify this remark it is only necessary to examine the catalogues of the leading colleges of the country during the first five decades of this century. * * * Spasmodic efforts were made for the founding of new courses, but virtually West Point and Troy were the only established places in this country for good technical instruction so late as 1847.

As illustrating the character and influence of her many graduates whom the Military Academy gave as teachers to the institutions which followed her, we may again quote the words of President Gilman:

> Norton (the first professor of civil engineering at Sheffield Scientific School) was an admirable teacher, well trained at West Point, painstaking, accurate, thorough, well acquainted with the progress of his favorite science, and always commanding students of ability. * * * In later days another West Pointer (Professor Trowbridge), who is said to have been the first to suggest the cantilever bridge, was distinguished for his work upon steam generators and other prime motors.

Not only their scientific attainments, but we are proud to believe the well-known and lofty standards of honor and integrity inculcated by their Alma Mater fitted graduates to play no inconsiderable part in the wonderful processes of our national growth. It is proposed to outline the story of these services in this chapter.

EXPLORATIONS.

Maps compiled in largest part from the routes pursued by graduates through previously unknown lands between the Mississippi and the Pacific first delineated the great West, showing the plains and valleys susceptible of cultivation

and the streams watering them; the mountains barring the way to communication, and the passes by which they might be traversed. Every march of a column or scouting party added to the stock of human knowledge that was to direct the movements of an unequaled immigration. Mention can be made here of important expeditions only.

In the years following 1807 our country was much involved in foreign complications. Systematic exploration of the West languished during this period, but its resumption in 1819 found an increasing body of graduates to pursue the work in a scientific manner.

Long's expedition, in the year last mentioned, set out from Pittsburg in the steamer *Western Engineer*. By way of the Ohio, Mississippi, and Missouri, the party proceeded to old Council Bluff, which served as a base of operations. By the close of 1820 the courses of the Platte, Arkansas, and Canadian rivers had been traced, their sources in the Rocky Mountains examined, and Pike's Peak had been ascended for the first time. With Long were John R. Bell ('12), J. D. Graham ('17), and W. H. Swift ('19), the last two doing most of the astronomical work.

James Allen ('29) first explored the source of the Mississippi in 1832.

Capt. B. L. E. Bonneville ('15), born in France during the Reign of Terror, was a worthy successor of Marquette and La Salle. Of adventurous and romantic temperament, he sought leave of absence and permission, at his own expense, to investigate the topography and resources of the far West. In the spring of 1832, Bonneville proceeded up the Platte and established a rendezvous upon Green River in the present State of Wyoming. Thence his parties explored Great Salt Lake, and the Green, Snake, and Salmon river countries. One detachment crossed the Sierra Nevadas, proceeded as far westward as the Sacramento, and rejoined the main body by way of the Santa Fe trail. Other parties explored the headwaters of the Yellowstone, the Big Horn range, and the Wind River Mountains.

During the winter of 1833–34, and subsequently in the summer of 1834, Captain Bonneville visited the Columbia

River, and in 1835 returned to the "States" by way of the Platte.

There is barely room in this plain story of Bonneville's travels to allude to the hardships and the dangers he encountered. Amid perils of Indian warfare and of flood and cold and hunger, most of his companions savages, he was traversing a wilderness that was literally trackless. The romance of his adventures has been preserved in the work of Washington Irving.[a] The practical results were maps which first correctly portrayed the hydrography of the region west of the Rocky Mountains.

The work of exploration went on, gradually losing something of its picturesqueness as route crossed route, but the hardships and dangers remained. W. H. Warner ('36) was killed by hostile Indians while exploring the California Mountains, and M. P. Harrison ('47) met the same fate while accompanying Marcy to the Red River country.

In the early fifties the attention of Congress was directed toward the transcontinental railroad problem. It was felt that prospect of future profit would not alone suffice to bring about the gigantic combination of capital that such an undertaking required. Nevertheless opinion was wisely formed that military, political, and economical considerations demanded the construction of one or more lines, and the Government, among other aids, extended the services of its officers, who at that time possessed almost a monopoly of the requisite engineering knowledge and training. Engaged upon the survey of routes near the forty-seventh and forty-eighth parallels, near the thirty-eighth and thirty-ninth parallels, near the forty-first, thirty-fifth, and thirty-second parallels, through the Sierra Nevada and Coast Range, and from the Sacramento to the Columbia River, were score upon score of graduates of the Military Academy. With no intention to ignore others, many of whom rendered equally or perhaps more valuable service, the names may be mentioned of a few graduates, now otherwise known to fame, who did their part in these great and systematic pioneer surveys: George B. McClellan, commander

[a] Irving: Adventures of Captain Bonneville, U. S. A., in the Rocky Mountains and the far West N. Y. 1851. 12 mo.

of the Army of the Potomac; Henry L. Abbot, prominent in connection with our present splendid system of coast defense; Philip H. Sheridan, the hero of the Shenandoah campaign; John B. Hood, Confederate leader; Parke and Humphreys, the former a superintendent of the Military Academy, and both distinguished corps commanders. Of those graduates, bearing the sextant in one hand and the rifle in the other, not the only one giving his life for his country was Gunnison ('37), who was cruelly massacred and mutilated near Sewell Lake in 1853.

It is very interesting to-day to compare a modern railroad map of the West with the "Map of routes for a Pacific railroad" accompanying the report of the Secretary of War to the House of Representatives.[a] No further evidence is needed that graduates most intelligently blazed the way for the steam locomotive which, like a mighty shuttle, has spun the wonderful fabric of our country.

There is not space in this chapter to detail the work of Marcy ('32), who mapped the Red River country in 1852, 1853, and 1854, nor of Warren ('50), whom years of hazardous topographical studies in the Dakotas and Nebraska may have trained to see the value of Little Round Top and so save the day at Gettysburg. From the Yukon to the Rio Grande, in every extreme of climate, the work went on to an extent that may be gathered from the following paragraph in a letter addressed to the Secretary of War by General Humphreys on May 10, 1878:

> In addition to the foregoing it may be stated that the officers of Engineers and officers on engineer duty attached to the headquarters of the military divisions of the Missouri and the Pacific, at the headquarters of the military departments of Dakota, the Platte, the Missouri, Texas, California, Arizona, and the Columbia, and at the headquarters of the military district of New Mexico, together with other officers of the Army, have surveyed within the last ten years an aggregate of more than 175,000 miles of routes, lines, and marches, besides an aggregate of more than 40,000 miles of area, and the results of these surveys are mainly to be found on the maps in use by the Army and the country.

Before passing to the more exact and refined surveys undertaken by graduates, it is proper to mention the fact that

[a] Ex. Doc. 129, Thirty-third Congress, first session.

explorations are still progressing in the icy mountains of Alaska and in the matted jungles of the Philippines. No more than three years ago Herron ('95) was seeking an all-American route from Cook Inlet to the Yukon, beset by imminent peril of flood and starvation. At the same time Alstaetter ('97), captured while reconnoitering for a road, lingered a prisoner in the hands of the Filipinos.

BOUNDARY SURVEYS.

In the six great international boundary surveys which have fixed the northern and southern limits of the United States, the most refined astronomical methods have been developed and pursued by graduates of the Military Academy.

Capt. Andrew Talcott ('18), while determining the northern boundary of the State of Ohio in 1834, invented the zenith telescope and the method of determining latitude by observing the difference of meridional zenith distances of two stars on opposite sides of the zenith.[a] The Talcott method has long been recognized as the most accurate practical one for the determination of latitude.

THE LAKE SURVEY.

One of the great refined geodetic surveys of the world, inaugurated in 1841, had for its object the production of reliable charts as well for vessels navigating the Great Lakes and upper St. Lawrence River as for determining the improvements needed for the prosperity of lake commerce. This great work was substantially completed in 1885, with a total expenditure of nearly $3,000,000. The primary triangulation was of the greatest precision, so that it might serve to determine the form and dimensions of the earth. Over 6,000 miles of shore line were mapped. The triangulation embraced an area of nearly 17,000 square miles, and the hydrography covered nearly 10,000 square miles. Mainly the work of graduates, this work will stand as a monument to Cyrus B. Comstock ('55), who was long its superintending engineer. To this last-named graduate, whose conscientiousness almost

[a] See Journal of the Franklin Institute, 1838, p. 217.

reached the point of eccentricity, and whose scientific attainments have been recognized the world over, it is related that President Grant offered promotion from the rank of major to that of brigadier-general. In these days it is hard to believe that Comstock resolutely declined the honor on the ground that it belonged of right to a distinguished senior officer. It is to be regretted that Comstock never subsequently attained the rank he had so honorably declined.

THE COAST AND GEODETIC SURVEY.

While the work of determining the hydrography of our coast waters and the exact topography of our shores has never been a War Department enterprise, nevertheless it was Alexander Dallas Bache, grandson of Benjamin Franklin and a graduate of the class of 1825, who, in 1843, upon the recommendation of the principal national scientific societies, was called upon to reorganize the Survey. He served as its Superintendent for twenty-four years, and when, in 1867, the Secretary of the Treasury announced his death, he used these words:

> No man within the present generation was more widely known in the walks of practical science; none has been so closely identified with collateral service in the various public departments. * * * Under his direction that great work [the Coast Survey] has been eminent no less for its abundant results than for its high scientific character, which has won the approbation of the leading learned bodies of the world, among whom his name has long been held in honor.

THE WHEELER SURVEYS.

While on reconnoissance work in 1869 Lieut. George M. Wheeler ('66) conceived the idea of a systematic topographical survey of the area of the United States west of the one hundredth meridian. He estimated that the total cost of covering this area (1,443,360 square miles) would be $2,500,000. The work was approved by Congress and was inaugurated in 1872 under the War Department—graduates performing most of the skilled work of observation. When it is stated that detailed topographical surveys have cost $65 per square mile in Prussia and $190 per square mile in the

case of the ordnance survey of England, it can readily be understood that Lieutenant Wheeler contemplated some sacrifice of extreme accuracy and the abandonment of unnecessary detail.

When appropriations for the work ceased in 1878 nearly 350,000 square miles had been mapped at a cost of about $1.48 per square mile, and data had been obtained for the preparation of elaborate reports on mineralogy and mining, geology, botany, and the like.

* * * * * * *

Surveys of the Mississippi and Missouri rivers, for an intercontinental railway, for an isthmian canal, for many hundred works of river and harbor improvements, and for roads and military defenses, have engaged the attention of graduates from time to time, but a mere list of them would pass the bounds assigned to this chapter.

In concluding this account of the services of graduates as explorers and surveyors, it seems fitting to quote from a letter of General H. G. Wright ('41), addressed to the Secretary of War, October 29, 1878, wherein it is truthfully claimed—

> that refined methods of topographical survey were first used in the United States by officers of the Army in the performance of their varied duties under the Government; that they were among the first to apply the refined methods of geodetic surveys; that from the time the Government had territories to explore, the exploration has been mainly made by them; that a large portion of the information contained in all of the maps of the United States west of the Mississippi River is due to their labors; * * * that the officers of the War Department, from the earlier years of this century, from the days of Pike and Long, and Lewis and Clarke, and Bonneville, have borne the hardships and exposure of the preliminary examinations and surveys when the region was an unknown wilderness, and have gone on improving their surveys from time to time by more accurate methods as the improvement in instruments and means of their transportation have increased.

RAILROADS.

It is difficult to believe that as recently as 1827 there could have prevailed a discussion wherein, speaking editorially of the project of one Hale to join Boston with Connecticut by

means of a railroad, the North American Review would use the words:

and we think Mr. Hale is perfectly right in forming his estimates on the supposition that the use of horsepower is best adapted to our circumstances. It certainly is so at present, and we can foresee no change or improvement which shall reverse this condition.

It is much easier to believe the assertion that he who first conceived the idea of a railroad, a Frenchman of the seventeenth century, should have cried out in the madhouse in which he was incarcerated, "I am not mad! I have made an invention!"

The railroad was born in England with the successful opening of the Stockton and Darlington line by Stephenson in 1825. A fever for railroads immediately attacked this country. Of men competent through experience to locate and construct them of course there were none. Of men competent through education there were a few, and these were almost all graduates of the Military Academy, or their associates in the Army. In accordance with a liberal policy, the Government lent its officers for this purpose, and if the phenomenal growth of our country may in a great degree be attributed to railroads, then are graduates of West Point entitled to much credit for that growth, for it was due to their skill and diligence that in the second quarter of the last century railroads sprang into existence so rapidly and so extensively throughout the country.

The Baltimore and Ohio was the earliest important railroad enterprise undertaken in the United States. S. H. Long, William Howard, and William Gibbs McNeill, all officers of Engineers, and the latter a graduate of the class of 1817, were chosen as a board to select a proper route to the Ohio. To quote from good authority:[a]

Their report is elaborate and able, and is probably the most interesting document of its day on the subject of railways in America.

Engaged in the construction of the Baltimore and Ohio, besides McNeill, were Joshua Barney ('20), Isaac Trimble ('22), Richard E. Haggard ('24), William Cook ('22), Walter Gwynn ('22), John Dillahunty ('24), and George W. Whistler

[a] Van Nostrand's Engineering Magazine, v. 7, p. 502.

('19). Upon the rails, definitely located by McNeill, ran (for the first time in America) a steam locomotive.

In 1828 the railroad company sent to England a commission of three, including McNeill and Whistler, who were cordially received by such men as Stephenson and Telford, and learned what they could from the railroad builders of that country.

McNeill and Whistler soon forged to the front of the civil engineering profession.

These two engineers exercised an influence throughout the country for many years, much greater than any others. Indeed, there are few works of importance undertaken at that time in connection with which their names do not appear.[a]

Before McNeill resigned in 1837 he had surveyed the summit division of the Chesapeake and Ohio Canal, and had acted as chief engineer of the Baltimore and Susquehanna, Paterson and Hudson River, Boston and Providence, Providence and Stonington, Taunton and New Bedford, Fayetteville and Yadkin, Long Island, and other railroads scattered from New England to Florida and Alabama. After he resigned, for the remaining sixteen years of his life, he acted as chief or consulting engineer upon many railroad and other public enterprises in the United States and Cuba, completing the Western Railroad of Massachusetts, planning and practically constructing the first large dry docks at the Brooklyn Navy-Yard, and acting as president of the Chesapeake and Ohio Canal.

Probably greater than McNeill was his junior, Whistler. The two were associated in the construction of many railroads, including the Baltimore and Susquehanna (now Northern Central), the Paterson and Hudson (now Erie), the Western of Massachusetts (now Boston and Albany), and the Providence and Stonington. It was upon Whistler that most of the details devolved.

These pioneers were not simply "following the best practice." They were creating methods and inventing means to apply them. At Lowell, Mass., in 1836, Whistler was

[a] Life and Works of George W. Whistler, by George L. Vose, president Boston Society of Civil Engineers.

personally designing and constructing locomotives that were preferred to all others in this country. He had even to invent the locomotive whistle, as it is said he had previously invented the method of showing elevations upon topographic maps by means of contours.

Conditions in the United States varied extremely from conditions in England. The former was a country of magnificent distances and a meager population. Railroads were often built to develop the country rather than to care for an established traffic. The first study of the engineer was economy in first cost, and the second study was economy in operation. The use of extreme grades and extreme curvature reduced the items of excavation and embankment. The line often departed many miles from its natural location to seek an easy river crossing or a low pass through the mountains. Steam excavators and other labor-saving machinery were demanded and produced. The character of the line compelled improvements in the rolling stock.

In 1835 the Russian Government determined to build a line from St. Petersburg to Moscow. A Russian commissioner visited the countries of Europe and the United States and pronounced the American systems of construction and operation to be the most fitted to the needs of Russia. Later a committee of Russian engineers reported that "of all persons with whom they had communicated, no one had given them such full and satisfactory information upon all points, or had so impressed them as possessing extraordinary ability, as Major Whistler." Whistler, in accepting a very flattering offer from St. Petersburg in 1842, became the precursor of that American invasion of brains, products, and methods which is now exciting the fear as well as the admiration of European countries. Whistler's title was consulting engineer, but the road and its equipment were planned by him in detail. He had to overcome not merely physical obstacles, but also the natural opposition of his jealous associates. His report upon the gauge to be selected has been pronounced "one of the finest models of any engineering document ever written." It prevented the adoption of a wide gauge, which afterwards and in other locations has caused untold expense

and trouble. Plans were completed in 1843, and the manufacture of rolling stock began in 1844 under contract between the Russian Government and the American firm of which Ross Winans was a well-known member.

In the building of engines all parts were made interchangeable, a feature which beyond all other things has since made American machinery supreme.

The freight cars were 30 feet long and supported upon 8 truck wheels. If this practice had been universally adopted upon the Continent and in England, amounts almost fabulous would have been saved in cost of transportation during the past sixty years. To-day the English railroad companies are investigating whether they may not yet, with economy, throw aside their little "goods-wagons" and face the immediate losses in rolling stock, terminal investments, etc.

Having so great an engineer in their midst, the Russians utilized his judgment in many undertakings, such as bridging the Neva, constructing docks and fortifications at Cronstadt, etc.

Worn out by extraordinary labors, Whistler died in 1849. At this time his railroad was nearly completed, and his plans were retained to the smallest detail. Another graduate of West Point, T. S. Brown ('25), was invited to succeed him.

"As an engineer, Whistler's works speak for him. He was eminently a practical man, remarkable for steadiness of judgment and for sound business sense. Whatever he did was so well done that he was naturally followed as a model by those who were seeking a high standard. Others may have excelled in extraordinary boldness or in some remarkable specialty; but in all that rounds out the perfect engineer, whether natural characteristics, professional training, or the well-digested results of long and valuable experience, we look in vain for his superior."[a]

If McNeill and Whistler were the greatest American railroad engineers of their generation, there were many other graduates who approached them closely. In a hasty inspection of the records I have been able to count 49 graduates

[a] Life and Works of George W. Whistler, by George L. Vose.

who have been chief engineers and 22 who have been presidents of railroads. Many have acted in one of these capacities upon several roads, and the list would be long, indeed, of those who have served as resident or assistant engineers.

The Central Railroad of Georgia in 1859 appropriated $5,000 for the erection of a monument to William H. Gordon ('15), who, as president of the company, had devoted his life to its upbuilding with a success that covered his State with a network of railroads. Of this same railroad and other important lines in the South, E. P. Alexander ('57), the distinguished Confederate artillery commander, was later president.

George W. Cass ('32) was a great organizer and administrator of railroads. He was president of the Pittsburgh, Fort Wayne and Chicago and of the Northern Pacific railways. He was also the first president of the Adams Express Company, the pioneer in that branch of transportation.

Thompson S. Brown ('25), before he was engaged by the Russian Government to complete the work of Whistler, built the Lake Shore and parts of the Erie Railroad.

The Mobile and Ohio was largely constructed by graduates, among them Andrew Talcott ('18), John Childe ('27), and O. McK. Mitchell ('29). Mitchell was better known later as a distinguished astronomer, author, and inventor, and as the director of the Cincinnati Observatory.

Daniel Tyler ('19), who in 1835 erected the first coke hot-blast furnace in America, was a very eminent engineer, with a special gift for the upbuilding of wrecked or failing corporations. His work of construction and reconstruction was scattered from Maine to Alabama. He was president or chief engineer of many railroads, including the Cumberland Valley and the Mobile and Montgomery.

The first railroad in Cuba was built by Benjamin H. Wright ('22).

Talcott built the first railroad in Mexico, and Albert M. Lee ('31) and R. A. Petrikin ('65) added hundreds of miles to the lines of that country.

The Panama Railroad has been largely built and operated by graduates, among them William C. Young ('22), A. J. Center ('27), William H. Sidell ('33), and John Newton ('42).

Before the civil war George B. McClellan was chief engineer of the Illinois Central and president of the St. Louis and Cincinnati; Halleck was president of the Pacific and Atlantic; Abraham Buford was president of the Richmond and Danville, and Lloyd Tilghman, afterward killed at the head of a Confederate division, was chief engineer of several southern railroads.

After the civil war Braxton Bragg ('37) was chief engineer of the Gulf, Colorado and Santa Fe; Burnside ('47) was president of several western roads; Horace Porter ('60), now ambassador to France, was president of the West Shore, and James H. Wilson ('60) was president of the New York and New England.

During the civil war the highly efficient chief of construction and transportation on military railroads was Herman Haupt, of the class of '35.

The oldest living graduate to-day is Thomas A. Morris ('34), who built many of the earlier roads in his adopted State of Indiana, and administered others as president or receiver.

Unfortunately the limits of this chapter do not permit accounts of the work of Swift ('19), Joshua Barney ('20), Cook ('22), Gwynn ('22), Isaac Trimble ('22), James Barnes ('29); these last, with those mentioned before, constituted a large and important part of the body of civil engineers of their day. I shall be satisfied should it appear that the pioneer railroad work in our country has reflected great credit upon our Alma Mater, who furnished so many of her sons for skillful, honorable, and important services.

MUNICIPAL ENGINEERING.

Little has been written of graduates as municipal engineers, but the record is a splendid one.

The work of George S. Greene ('23) in connection with the Croton water supply of New York City is well known. The same distinguished engineer was employed by the city of New York to report on plans for elevated railway structures; was chief engineer of public works of the city of Washington to devise a sewerage system for that city, and was consulting

engineer upon many important municipal enterprises throughout the country. Greene served his country well in war as well as in peace, for it was his brigade that saved the Union right on the second day of Gettysburg.

The Philadelphia water department was reorganized (1883 to 1886) by William Ludlow ('64). Finding corruption and carelessness the rule, and a plant inadequate and in a state of deterioration, Ludlow inaugurated many reforms and vastly extended the service of his department. His administration has been praised by all lovers of honesty and efficiency in municipal affairs.

Egbert L. Viele ('47) was engineer in chief of Central Park, New York, and of Prospect Park, Brooklyn. General Viele was a recognized authority in matters of municipal engineering.

The city of Washington illustrates in many of its public works and in the success of its present form of government the ability of graduates to handle with fidelity and skill all varieties of municipal works.

Montgomery C. Meigs ('36), nearly fifty years ago, located a system of water supply admitting of easy expansion to care for the population of a hundred years hence. Meigs was much criticized at the time for building upon so large a scale, but the community is now congratulating itself upon his large ideas. The Washington Aqueduct crosses two creeks flowing through deep ravines, one by means of Cabin John Bridge, whose magnificent span of 228 feet was for nearly fifty years the maximum for masonry arches, and the other by means of arches formed of the iron water pipes themselves, which are utilized to support a bridge for wagon traffic. The methods used in crossing these creeks well illustrate the daring originality of the constructor. Meigs was one of the greatest builders and organizers of work of his generation, and was a lovable man and a great student besides. Before he was chosen for the most important post of Quartermaster-General during the civil war, he had been connected with other great works that are mentioned elsewhere in this chapter.

In 1878 Congress placed the executive and a part of the

legislative functions of government of the District of Columbia in the hands of a board of three Commissioners, one of whom is, by law, an engineer officer of the Army. The first Engineer Commissioner was Twining ('63), whom people called a "benevolent despot" and regarded as an ideal municipal executive. The Commissioners are supposedly coordinate, but the Engineer Commissioner is the principal executive officer of the Board. With two engineer officers as principal assistants he is charged with the construction and repair of streets and bridges, water distribution, sewage disposal, and the like. It is a matter of common remark that Washington has the best government of any city in the world. Much credit for this is due to graduates.

In the broadest sense of the phrase F. V. Greene ('70) and Eugene Griffin ('75) have been great municipal engineers, each along an important special line. Greene made a name for himself by writing an account of the Turko-Russian war that has become standard the world over. He resigned from the Corps of Engineers in 1887 to become chief engineer, and later chief executive, of the Barber Asphalt Paving Company. Greene compelled a general recognition of the superior advantages of asphalt paving for city streets, but not before he had perfected the materials and methods of laying, adapting both to the severe climatic conditions of our American cities.

Griffin, while assistant to the Engineer Commissioner of the District of Columbia, in 1888, wrote an epoch-making report upon the subject of the propulsion of city street cars. Published by the Government, this report was circulated everywhere, and added great impetus to the building of electric street railways throughout the country. As a result of his studies along these lines Griffin is to-day the general manager, as he has been largely the creator, of the great General Electric Company, the operations of which have helped greatly to swell the total of manufactured exports from the United States to foreign countries and to create that marvelous balance of trade that has alarmed European economists.

In our insular possessions, since 1898, a vast amount of municipal engineering and the like has fallen upon graduates. The whole story of this work would—nay, probably

will—fill volumes. It is most satisfactory that our officers have everywhere demonstrated to their countrymen a high capacity for honest and skillful direction of work.

If as Americans we congratulate ourselves upon the noble and unselfish policy which was recently consummated in the evacuation of Cuba, we find no less cause for satisfaction in the details of our four years of stewardship; so common upon the pages of our magazines and in the columns of our newspapers is the comparison between Cuba of yesterday and Cuba of to-day that I hesitate to introduce so trite a subject. When Ludlow was appointed governor of Habana that city was the plague spot of America; streets and buildings were festering with corruption, and the noisome odors afflicting the senses were but fit accompaniments of political and administrative conditions. As at Habana, so it was at Santiago and the other cities.

Under the immediate direction of Ludlow ('64), Black ('77), Geary ('74), Barden ('94), Hanna ('97), Hamilton ('91), and many other graduates the work of renovation and improvement was vigorously prosecuted. Sewers were planned and constructed; streets cleaned and paved; parks, waterworks, roads, and bridges constructed, and public buildings, including hospitals and prisons, were made sanitary; but more far-reaching than all this, a people being trained for independent national existence was afforded an object lesson in faithful public service that may be the salvation of Cuba.

Similar duties have fallen to graduates in Porto Rico and the Philippines, but the reader must not be wearied with more details.

PUBLIC BUILDINGS, ETC.

In Washington stand many testimonials to the skill of graduates as builders of beautiful and enduring structures.

The wings and Dome of the Capitol itself were built under the superintendence of Meigs ('36), of Washington Aqueduct fame. A great architect, Thomas W. Walter, was associated with Meigs in this work, but the beauty of the structure was largely due to Meigs, and all the details of what was then difficult construction were of his devising.

In connection with this work Meigs was the first to turn

stone columns in a lathe, notwithstanding predictions of failure and the opposition of "practical" stonecutters.

Under the auspices of the Washington National Monument Association there was begun in 1848, with funds derived from public subscription, the magnificent obelisk that commemorates the life and work of George Washington.

Incredible as it may appear the original foundation consisted of a rubble masonry footing, laid in lime mortar, 80 feet square at the base, 58 feet 6 inches square at the top, 23 feet 4 inches in thickness, set only 7 feet 8 inches below the original surface of the sandy clay alluvium soil.

On the top of this footing, 55 feet 1½ inches square at the base, rested the shaft, with a white marble facing in 2-foot courses and a rubble masonry backing of blue gneiss rock. In 1856 the shaft had reached a height of 156 feet 4⅛ inches, when, owing to lack of funds and other unfavorable conditions, work was suspended. The weight of the incomplete structure was 35,000 tons, or nearly 5½ tons to the square foot. It seems apparent to us now that if a becoming liberality among the people had enabled the Monument Association to complete its work upon the foundation it had established something startling must have happened, for the weight per square foot would have been doubled. Indeed the soil had already been loaded to the limit of prudence, if not of safety.

In 1876 Congress assumed the task of completing the work. In 1878 the work was placed in charge of Thomas Lincoln Casey ('52), who was confronted by the then unique problem of building a suitable foundation under an existing heavy structure 156 feet in height.

Although Casey's solution of this problem is well known to all civil engineers, yet detailed accounts of it are hard to discover, a fact that may justify the following description in the words of Bernard Greene, who was Casey's able assistant and lifelong friend:

A much firmer stratum of gravel, sand, and small bowlders existed at 13 feet 6 inches below the old foundation, which was underpinned with Portland cement concrete blocks 4 feet wide, 13 feet 6 inches deep, 41 feet 3 inches long, 18 feet of which extended underneath. These were

put in singly or in pairs, one on each opposite side, as the tendency of the monument to lean toward the respective cuts appeared, and this was constant until a number of the blocks has been inserted. Frequent level observations were kept up on brass benches at the four corners of the shaft, which showed an extreme sensitiveness to the least disturbance of the earth underneath the old foundation. Finally, the underpinning was completed, leaving, as will be noted, a block of untouched earth 44 feet square in the center. Jackscrews were used freely to retain the side pressure of the earth in the trenches, and the concrete was forced up under the old footing masonry with a swinging horizontal battering-ram timber. Then the old rubblework was quarried out around the sides in sections of about 10 feet wide, and concrete buttresses were inserted 2 to 3 feet under the edge of the shaft and extending well out onto the projecting underpinning. When all were in they formed a continuous buttress all around. In this way 70 per cent of the original earth bed was cut away and substitued by the concrete underpinning, 51 per cent of the rubble footing was torn out, and 48 per cent of the bed area of the shaft itself undermined and filled with concrete.

During this operation the total settlement of the structure was 2½ inches, the greatest difference between any two corners being one-half inch, which nearly corrected an original inclination of about 1½ inches in the old shaft at 156 feet high.

This accomplished, the continuation of the shaft was resumed on August 7, 1880, and the capstone set on December 6, 1884. The facing is marble, in 2-foot courses of 2-foot bed, in alternate leaders and stretchers, backed up with cut granite, all laid in Portland cement mortar.

The total weight of the monument, including the foundation and interior ironwork is 90,854 tons, loading the foundation not over 10 tons per foot in the center, nor less than 3½ tons at the outer edges of the foundation. The construction of the shaft produced a further settlement of the foundation, making a total of about 4⅓ inches, but no material change has occurred since.

Neither winds nor changes of temperature produce any appreciable effects on the monument. The pressure of wind on one flat face of the structure requisite to overturn it is 200 pounds per square foot, and then it would break off at the junction of the old and new sections of the shaft, leaving the lower one standing.

The dimensions of the monument are: Total height, 555 feet 5⅛ inches; shaft proper, 500 feet 5⅛ inches; base, 55 feet 1½ inches; top, 34 feet 5½ inches; pyramidion, 55 feet high; interior well, 25 feet square up to 150 feet, splaying out to 31 feet 5½ inches at 160 feet, and thus continuing to top of shaft; batter of exterior, one-fourth inch to 1 foot; thickness of walls at base, 15 feet; at top, 1 foot 6 inches; foundation, 126 feet 6 inches square and 36 feet 10 inches deep.

As the original was built 15 feet 8 inches above the then natural surface and subsequently buried by artificially raising the mound about the Monument, the total height of structure actually built is 555 feet 5⅛ inches plus 15 feet 8 inches = 571 feet 1⅛ inches, but the present visible obelisk alone is still the highest masonry structure built by man by some 20 feet.

From 1877 to 1888 Casey was in charge of construction of the State, War, and Navy Department building. For many years this was the largest and perhaps the most imposing office building in the world, and to-day remains a fit neighbor to the beautiful White House.

The construction of the Library of Congress occupied Casey during the latter years of his life. This great edifice was completed within the limits of time and money set forth in the estimate, and promises long to remain the most commodious, the most convenient, and the handsomest library building in the world. The plan is rectangular, with four interior courts and a central octagonal rotunda 140 feet in diameter containing the main reading room. The exterior of the building is 470 feet long by 340 feet wide. Between the courts are three special book stacks, each nine tiers high above the cellar, capable of shelving 1,800,000 volumes, while other convenient portions of the building may be shelved for as many more. The book stacks are wholly of masonry, iron, marble, and plate glass. Excepting in three rooms, all door and window frames, casings, and baseboards are of cast-iron or marble, and the floors generally are surfaced with marble or mosaics. The exterior is of Concord granite. Two thousand two hundred windows give ample light by day, and at night the building is brilliantly illuminated from its own power plant. Pneumatic tubes and endless sprocket chains connect the delivery desk with the main book stacks, and an endless chain cable with auxiliary pneumatic tubes passes through a tunnel to the Capitol.

In a work of such magnitude all details can not be the care of the master mind; but as Casey, by special act of Congress, was given the greatest latitude and responsibility, his would have been the blame if the whole conception had been faulty or the details inadequate. Casey was a man upon whom

Congress came to rely absolutely. His estimates and his opinions were accepted without question, and he was very proud that there was never a disappointment. Casey was a great man, of wonderful integrity and administrative capacity. His work has added materially to the fame of the Military Academy.

LIGHT-HOUSES.

In 1851, recognizing the shortcomings and general inefficiency of the Light-house Service prior to that date, Congress caused the creation of a Board whose duty it was to investigate conditions then existing and to suggest appropriate legislation. This Board consisted of two naval officers, and three others, two of whom, Totten ('05) and Bache ('25), were graduates of West Point.

As a result of the studies and recommendations of this Board, an act was passed creating the permanent Light-house Board, which has, since 1852, been charged with all matters relating to the location, construction, repair, and operation of light-houses and similar aids to navigation throughout the United States. Of this Board, which consists of two naval officers, two officers of the Corps of Engineers of the Army, and two civilians of high scientific attainments, together with a naval and an engineer secretary, many graduates have been members, often constituting a full half of the Board. All plans, drawings, specifications, and projects for construction are proposed by the engineer secretary of the Board, or by other engineer officers. Each of the 16 light-house districts into which the country is divided is, for purposes of construction and maintenance, in immediate charge of an engineer officer. Before the organization of the Light-house Board the construction of a number of light-houses presenting special difficulties was intrusted to the topographical engineers of the Army.

The construction of light-houses, by reason of the almost insurmountable difficulties sometimes imposed by the sea and because of the beneficent service they render to mankind, possesses a romantic as well as a strictly technical engineering interest. Perhaps the best known English engineers are

men like Smeaton and the Stevensons, who risked reputation and sometimes life itself to found among the waves structures that would bear aloft their warning torches through every jealous fury of the elements.

Naturally enough, upon the coasts of the United States, built by our graduates, are many light-house structures of equal interest with, if less well known than, Skerryvore or Eddystone.

The first iron skeleton light-house structure in the United States was a beacon, designed and erected by W. H. Swift ('19), at the entrance to Black Rock Harbor, Connecticut, in 1847. In this locality three masonry beacons, costing $21,000 in all, were successively demolished within a period of twelve years. Swift's beacon, costing but $4,600, is still in service.

In 1848 Hartman Bache ('18) began in Delaware Bay the construction of Brandywine Shoal light-house, the first in the United States to use screw piles.

Proper foundation for heavy masonry structures is often lacking, especially upon our southern coasts, and the result has been numerous improvements in the skeleton form of construction and its adoption in connection with iron or steel piles, screw piles, plates, grillage, or other foundation for a great number of United States structures upon sites both submerged and dry. Of this type is Sombrero Key light-house, built by George G. Meade ('35) a short six years before he was to defeat Lee's army at Gettysburg. Sombrero light is situated 50 miles east of Key West. Standing in 8 feet of water it shows a light 140 feet above mean low tide. Twelve-inch wrought-iron foundation piles rest their shoulders centrally upon cast-iron disks 8 feet in diameter, penetrating the coral rock 10 feet below the plates. The piles stand at the angles and center of an octagon 56 feet across. The well braced frame rises pyramidal in shape, tapering to a diameter of 15 feet at the top. The entire structure cost $120,000 and still stands in good condition.

Another skeleton tower light is that on Fowey Rocks, at the extreme northern point of the Florida reefs, completed in 1878.

The light-houses that have been previously described are of little weight, but oppose no great surface to the action of

wind or waves, and may be constructed with comparative rapidity. Many of the great sea-rock light-houses of the world, particularly those exposed to great wave action, are constructed of the best masonry that man can devise, and given great weight to resist the stress of storm waves.

Of this latter type is the light-house now standing on Minots Ledge. The site was previously occupied by an iron skeleton tower that was carried away, with both keepers, in the great storm of 1851.

Engaged in the erection of this light-house which, in the words of General Barnard, "ranks by the engineering difficulties surrounding its erection, and by the skill and science shown in its construction, among the chief of the great sea-rock light-houses of the world," were J. G. Totten ('05), who made the plans, and B. S. Alexander ('42), who built the structure. The only authentic account of this great work is found in a modest memoir prepared by Alexander, from which the following is quoted:[a]

* * * We could not land, even in the summer season, for weeks together; and when we could effect a landing, a part of the ledge was at all times under water, and the remainder only bare for one or two hours at low water of spring tides. The space was contracted, and the sea broke with such violence during easterly weather that no cofferdam was possible. How were we to begin? What should be the process? Where were the workmen to live, and what were they to do while waiting for an opportunity to land on the ledge? * * *

In the year 1855 we worked on the rock one hundred and thirty hours. * * *

In 1856 we worked on the rock one hundred and fifty-seven hours. * * *

On the 19th of January, 1857, the bark *New Empire*, loaded with cotton, was thrown against our scaffold during a violent northeast gale, and swept it from the rock, breaking off the iron posts very much as those of the iron light-house had broken when it was carried away, and shattering the top of the rock in some places, so that a portion of our labor during the preceding year had to be done over again.

1857 was a very unfavorable season for work; the whole working time on the ledge being only one hundred and thirty hours. Nevertheless, the foundation pit was nearly completed and four stones of the foundation were laid.

[a] Trans. American Society of Civil Engineers, Vol. VIII, p. 85.

1858 was a much more favorable season. The foundation was finished, and the masonry of the tower was carried up to the sixth course (inclusive). * * *

We worked on the rock this year two hundred and eight hours.

In 1859 the masonry of the tower was carried up to the top of the thirty-second course, being 62 feet above low water.

Working time on the tower this year, three hundred and seventy-seven hours.

The light-house was completed in 1860. The last stone was laid on the 29th day of June, which was just five years, lacking one day, from the time the workmen landed on the ledge.

No life was lost in building this light-house, nor was any person seriously injured.

When this work was completed there remained unexpended $30,000 of the original appropriation. The Government, in the interest of science, proposed to devote this sum to a complete account of the work, but the civil war came on before anything of the kind could be done, and perhaps designer and builder have secured less fame than their great achievement warranted.

Another sea-rock light-house of great engineering interest is founded upon Spectacle Reef, at the northern end of Lake Huron. The fetch of the waves from a southerly direction is 170 miles. In winter heavy ice flows are borne against the structure by strong currents, and often the ice piles up from 30 to 40 feet high, forcing the keepers to cut their way to the entrance in the spring when the light is to be reestablished. As at Minots Ledge, the main difficulty lay in the preparation of the foundation. The focal plane is 97¼ feet above the water. The cost was $375,000. The crib and cofferdam above described were designed by W. F. Reynolds ('43), and the light-house structure was designed and built by Orlando M. Poe ('56), who was Sherman's chief engineer in his march to the sea.

On Stannards Rock, 28 miles from shore in Lake Superior, stands a light-house very similar to that on Spectacle Reef.

Both of these structures are specimens of monolithic rock masonry that can not, perhaps, be equaled the world over.

Another light-house illustrating in its construction the difficulties often confronting the light-house engineer is

Tillamook Rock, about 20 miles south of the mouth of the Columbia River, on the coast of Oregon.

The site was a precipitous rock, much frequented by sea lions, but untouched by the foot of man, for the wet and slippery slopes were continually washed by the great waves of the Pacific. The designer and builder of this light-house was G. L. Gillespie ('62). The first attempt at landing to effect a survey of the rock was by a most capable man, one John Trewavas, who had at one time been employed in the construction of the great Wolf Rock light, in England. Trewavas succeeding in reaching the eastern slope of the rock when he slipped, was dragged down by a receding wave, and his body was never recovered. With great difficulty and danger a few men were landed more than a month later, and communication was established with the attending vessel by means of a cable attached to a mast of the latter and to a projecting ledge of rock. Men were now transported along the cable in a breeches buoy, but the rocking of the vessel introduced such violent motions upward and downward that at least one traveler refused to make the return journey and spent the many remaining years of his life on Tillamook. This structure is one of the most exposed in the world. Despite many perilous incidents it was completed in the remarkably short space of sixteen months, and at a cost of but $124,000.

Fourteen-Foot Bank light, between the capes of the Delaware, and 20 miles from the nearest harbor, is founded upon a caisson sunk 23 feet into a submerged sand shoal by the pneumatic process.

Race Rock light, lying off the southwest point of Fishers Island, is founded upon a submerged bed of bowlders compacted with gravel and sand, in depths of 12 to 15 feet of water. The tide ebbs and flows with great violence, and waves from the Atlantic find no barrier save Block Island. To solve the problem of construction, a riprap breakwater was first built around the site. With the aid of divers the foundation was then built up of concrete, in stepped layers, each layer being confined by bands of sheet iron.

In our light-house service for more than fifty years none but graduates have had the responsible charge of construction. The annual expenditures of the Light-House Board have increased gradually from about $700,000, in 1852, to over $4,000,000 in 1900, while the number of lights (exclusive of buoys, port lights, and light-ships) has meantime increased from about 300 to 1,243. In 1900, 17 engineer officers of the Army, all graduates of West Point, were connected with this service.

It is to the credit of West Point that the most difficult engineering and administrative problems have been ably solved as they have arisen; no taint of corruption has grown into the service; and an adequate and most efficient system of lights has been established for our enormous coastwise and lake traffic.

RIVER AND HARBOR IMPROVEMENTS.

In the early days of the Republic there was much animated debate upon the constitutional right of the Federal Government to appropriate for internal improvements. The first need of the country was for roads, and in 1806 President Jefferson appointed commissioners to lay out the Cumberland or "National" road, a work for which Congress appropriated in all nearly $7,000,000 and which engaged the services of many graduates of the Military Academy. In 1817, mainly through the efforts of Calhoun, Congress passed a bill proposing to expend the bonus and dividends derived from the national bank in "constructing roads and canals and improving the navigation of water courses." Upon constitutional grounds this bill was vetoed by President Madison, who stated, nevertheless, that he was "not unaware of the great importance of roads and canals and the improved navigation of water courses, and that a power in the National Legislature to provide for them might be exercised with signal advantage to the general prosperity."

The people were not satisfied with this action. Under the leadership of Clay and his friends, in 1818, the House of Representatives passed a resolution declaring that the Federal Government had the power which three successive

Presidents denied. Although Monroe's views upon this subject so far coincided with Madison's that he vetoed a bill for the repair of the National road, yet the general demand for internal improvements was so great that practically the first appropriations for rivers and harbors were made during the Administration of Monroe, and a President was chosen to succeed him who was committed to such appropriations.

In his inaugural address President John Quincy Adams in one and the same sentence adheres to policies "to provide and sustain a school of military science" and "to proceed in the great system of internal improvements within the limits of the constitutional power of the Union."

In his first annual message President Adams used these words:

> The Military Academy at West Point, under the restrictions of a severe but paternal superintendence, recommends itself more and more to the patronage of the nation, and the number of meritorious officers which it forms and introduces to the public service furnishes the means of multiplying the undertakings of public improvements to which their acquirements at that institution are peculiarly adapted.

If there is a tendency on the part of any graduate to depreciate the civil work of a number of his associates and to believe that strictly military matters should monopolize the attention of all, let him think what support the Academy drew through a long and critical period from the sentiment expressed above.

Perhaps the average citizen, whether or not he be a graduate of West Point, has informed himself upon the subject of river and harbor improvement, largely through the perusal of editorials denunciatory of governmental extravagance. There has been little effort systematically to describe the vast extent and almost inestimable value of the improvements already made or now underway.

Before improvement many of our coast harbors were unsuited even to the light-draft vessels and relatively small commerce of fifty or seventy years ago.

At Portland, Me., but 8 feet draft could be carried to the inner harbor, and along the wharf front vessels were much exposed to wave action.

At Boston 16 feet was the ruling depth and the channels were narrow and tortuous.

At New York there was generally 23 feet off Sandy Hook, but the East River entrance, obstructed by rocky shoals and violent currents, was precarious in the extreme.

Philadelphia and Baltimore were good harbors in the early days, each with 17-foot channels, but at Wilmington, N. C., Charleston, and Savannah the depths varied between 9 and 12 feet. Pensacola with 19 feet and New Orleans with 14 feet were long in satisfactory condition, but Mobile and Galveston, with 5 and 9 foot channels, respectively, were much hampered in their business.

Upon the Pacific coast were but few natural harbors. Among them, however, were the magnificent Golden Gate, Puget Sound, and the Columbia River.

Upon the Great Lakes there was a singular absence of harbors except for the smallest vessels. With very few exceptions existing harbors were the mouths of rivers or creeks, which were obstructed by bars showing but from 2 to 4 foot depths of water. There was an 11-foot channel connecting Lakes Erie and Huron, but no navigation was possible between Lakes Superior and Huron.

Many of our great rivers were indeed in many respects as suitable for navigation as now. Before the forests were cut and the banks cultivated, water falling as rain was held by the roots of trees and undergrowth, so that it entered the streams gradually and was not surcharged with silt from plowed fields. The banks were in some degree protected from erosion by rank growths of vegetation. Under such circumstances the rivers did not reach the present extremes either of high or of low water. But the Ohio was originally interrupted at low stages by the falls opposite Louisville, Ky., and the Mississippi by the Des Moines Rapids, near Keokuk, and by the Rock Island Rapids, near the town of the same name.

For the improvement or construction of waterways there has been appropriated in all approximately $424,000,000. Of this amount very nearly $392,000,000 had been expended on June 30, 1902, and of this amount approximately

$383,000,000 was under the direct supervision and in accordance with the plans of graduates of the Military Academy, mostly of the Corps of Engineers.

The following table shows the average annual appropriation for river and harbor work for each decade since 1820, and illustrates the growing magnitude of the work:

1820 to 1830	$353, 163. 24
1830 to 1840	817, 200. 94
1840 to 1850	137, 147. 47
1850 to 1860	331, 220. 06
1860 to 1870	1, 306, 680. 27
1870 to 1880	6, 260, 759. 02
1880 to 1890	9, 487, 177. 81
1890 to 1902 [a]	19, 659, 298. 17

While absolutely the increase has been great, yet Mr. Theodore E. Burton, the present very able chairman of the House Committee on Rivers and Harbors, recently showed that since 1879 the rate of increase for rivers and harbors had been less than for the support of any one of six other important departments of the Government.

Let us see in a general way what these large appropriations have accomplished.

The average available depth at fourteen of our most important Atlantic and Gulf harbors, including Portland, Boston, Providence, New York (both entrances), Philadelphia, Baltimore, Norfolk, Wilmington, Charleston, Savannah, Pensacola, Mobile, New Orleans, and Galveston has been increased from 12.4 feet to 25.1 feet.

Upon the Pacific the destruction of San Diego Harbor has been prevented by the diversion of a river; Los Angeles has been provided with a harbor at Wilmington, and soon the great San Pedro breakwater will furnish a protected area of deep water suited for a great commerce with the East. The channel to Oakland, on the eastern side of San Francisco

[a] The last period has been extended to include the elapsed portion of the current year. The average for this period would be increased about $100,000 if the total expenditures for 1902 under certain permanent appropriations could be included. On the other hand, the average for this period is unduly large, inasmuch as the two river and harbor acts carrying the largest totals passed in 1890 and 1902. It is probable that the next river and harbor bill will not be reported before 1904, although approximately $38,586,160 may be appropriated within the next four years in deficiency and sundry civil acts to cover work which the last river and harbor act authorized. Of course most of the $26,521,442 appropriated under the last act, together with other balances from previous acts, is still unexpended.

Bay, has been deepened from 2 feet to 20 feet, permitting the establishment there of great railway terminals. Protected harbors have been formed where practically none existed at Humboldt Bay, California, and Coos Bay, Oregon, with channels 28 and 20 feet deep, respectively.

As to our rivers, the Hudson has been improved to a depth of 12 feet as far up as Troy. Originally there was but 4 feet between Troy and Albany, and but 7½ feet between Albany and New Baltimore.

A canal with locks has been built around the Falls of the Ohio at Louisville. The Davis Island lock and dam, 5½ miles below Pittsburg, form a commodious harbor for that city. A start has been made upon a system of locks and movable dams designed to afford a 6-foot low-water channel throughout the course of the Ohio.

Upon the Mississippi the Des Moines Rapids have been overcome by means of a canal with locks, and the Rock Island Rapids by means of wing dams and extensive rock excavation. A great levee system has been built to protect from floods the low land adjacent to the Mississippi in its lower courses, and a vastly improved and reliable channel has been obtained for nearly a thousand miles below St. Paul.

Upon the Columbia River the canal and locks at the Cascades permit steamers drawing 8 feet to ascend to The Dalles, about 210 miles from the Pacific.

The James River below Richmond has been deepened from 7 feet to 16½ feet.

Many of our rivers have been maintained in a navigable condition by the annual removal of snags, and many works not mentioned above have improved our rivers, to the great advantage of commerce.

It may be admitted frankly that the changed conditions of commerce incident to the construction and reduced cost of operation of railways has diminished in some cases (and for the present) the value of a light-draft navigation either by river or canal; that the clearing of the banks and adjacent areas, with resulting influx of sediment and increased range from high to low water, has operated against the improvement

of a number of alluvial streams, and that a thorough improvement of some rivers has been sought with insufficient means.

Upon the Great Lakes there have been wonderful accomplishments.

I have prepared a table contrasting the original with the present condition of 41 important lake harbors, and it is to be regretted that the result can be presented here only as a summary. The average available depth of channel to or in 37 of these harbors was originally 2.1 feet. To-day it is 17.8 feet. At 15 important localities extensive breakwaters have been built to form harbors where none existed, or to add to the capacity of harbors formed in the mouths of creeks and rivers.

A great through waterway has been created between Buffalo and Duluth, navigable by vessels drawing 20 feet. By dredging and blasting in the Detroit and St. Clair rivers this part of the through channel has been deepened from 11 feet. At Sault Ste. Marie, which completely blocked navigation between Lakes Huron and Superior, a canal has been excavated and two locks constructed side by side, each with an 18-foot lift; one of them among the largest and most perfect masonry structures of the world.

It is now proposed to describe briefly a few of the individual works of improvement.

Harbors of refuge, Delaware Bay.—Inside of Cape Henlopen, about equally distant from Philadelphia or New York and the Capes of Chesapeake Bay (the sea entrance to the ports of Baltimore, Norfolk, and Newport News) and convenient to a great portion of our coastwise trade, was begun in 1829 the Delaware Breakwater, behind which, annually, several thousand vessels find shelter while awaiting orders or in stress of weather. The work, as originally designed, was a rubble mound, with the larger stones on the sides and top, in two parts, of which the breakwater proper was 2,556 feet long and the ice breaker 1,359 feet long. So much was completed in 1869. The work of closing the interval between breakwater and ice breaker, 1,350 feet in length, was finished in 1898. The structure is now 5,265 feet in length, rising 14

feet above low water, and its average width at the base is 160 feet. The amount of stone used was approximately 1,100,000 tons.

Since the work was begun, in 1829, there has been such an increase in the draft of vessels that the sheltered area can no longer accommodate the largest ships.

To meet the new demands of commerce a second harbor of refuge has been constructed in the same general locality. Although started in 1896, a breakwater 8,035 feet long and 10 ice piers have been completed for about 50 per cent of the original estimate. Approximately 1,600,000 tons of stone have been placed in the work. The subaqueous portion of the breakwater is a rubble mound; the superstructure is formed by laying large blocks of stone as headers upon the sea and harbor sides, with slopes of 1 on 7. Sheltered behind this breakwater more than 1,000 vessels may anchor at once; and of the anchorage area nearly a square mile has a minimum low-water depth of 30 feet. Vessels of any draft, bound from northern to southern or from southern to northern ports, may now go to sea in doubtful weather with the assurance of finding ample protection at the Delaware capes if overtaken by storm.

Since 1833 the old breakwater has given shelter to about 450,000 vessels, and the two harbors are now annually sought by some 5,000 vessels, not counting tugs, fishing boats, and other small craft.

There is great contrast between the legislative policies which extended the work on the original breakwater over a period of seventy years and that which completed the second and much larger work in five years, and with a less expenditure. Some account will be given later of the gradual improvement in the legislative policies and processes, until to-day, when river and harbor bills are no longer a reproach to Congress nor a mortification to those who must disburse the appropriations.

Galveston Harbor, Texas.—From the Mississippi westward to the Rio Grande, as late as 1890, there was no harbor with entrance deeper than 13½ feet. Galveston was the only port provided with ample interior harbor facilities, and a great

commerce was there carried on under most expensive conditions. By means of lighters the lading of all larger vessels was completed upon the seaward side of the bar, 5 miles from shore. In heavy weather the vessels thus loading in the open Gulf were compelled to put to sea to obtain a safe offing. The cost of lighterage and the increased cost of freight and insurance were borne in largest part by the cotton growers of Texas. Conditions permitted no grain to be handled.

In a desultory way, as irregular and inadequate appropriations became available, the improvement of Galveston Harbor progressed from 1870 to 1890. During this period the average annual expenditure was about one-eightieth part of the sum required for the completion of the work. Considering the rapid deterioration to which incomplete work of this character is subjected and the financial losses due to uncertainty and irregularity of appropriation, it was remarkable that so much was accomplished, the south jetty being completed for a length of nearly 4 miles.

In 1890 Congress adopted the continuous-contract system and provided for a tenfold increase of annual expenditure. From this date the work progressed rapidly to completion in 1897.

The top of the jetties is 5 feet above low water and gently rounded to permit waves to pass over it with least resistance. The side slopes are about 1 on 1.75. The exterior is composed of granite blocks carefully laid in a single layer by means of huge floating derricks. At the outer ends the granite blocks weigh each from 10 to 15 tons. The core of the jetties is of sandstone riprap, deposited from a railway trestle which was extended gradually seaward in advance of the enrockment. The aggregate length of the jetties is 12 miles. Over 2,000,000 tons of material were employed in the work, and the average length of haul from the quarries was about 210 miles. Probably no other work constructed by the hand of man has involved the transportation of such a mass of material such a distance.

The cost of the Galveston jetties was approximately equal to that of the jetties at the mouth of the Mississippi, although

the former are three times as long, and embody within themselves far greater quantities of imperishable material.

The physical result of the Galveston improvement has been the scour from between the jetties of some 20,000,000 cubic yards of sand, compared with the scour of about 3,000,000 cubic yards of material by the Mississippi jetties.

In both localities supplementary dredging has been resorted to, and the demands of commerce have been satisfied with channels from 26 to 30 feet deep.

The canalization of the Great Kanawha.—The Great Kanawha River traverses a region rich in deposits of coal of a superior quality. In low water the river was originally obstructed by gravel shoals which prevented navigation. Since 1875 this river has been canalized by the construction of ten locks and dams. The two upper dams are fixed and are of timber cribs filled with stone. The remaining dams are movable and of the chanoine-wicket type, operated from trestle bridges. When the river is at a sufficiently high stage, the movable dams are lowered, and an open-river navigation is carried on. The upper four locks have clear widths of 50 feet and lengths between quoins varying from 300 to 311 feet. The lower six locks are 55 feet wide and 342 feet long. At low water there is now a 6-foot channel throughout the improved portion of the river, and a great commerce is carried on in coal and lumber.

New York Harbor.—By the dredging of nearly 5,000,000 cubic yards of material in the five years preceding 1892 the main entrance has been deepened from 22½ feet to 30 feet. The removal of 40,000,000 cubic yards of mud and sand will soon result in the completion of a more direct channel 40 feet deep and 2,000 feet wide.

The East River entrance, now safely used by an enormous coasting fleet, was originally obstructed in many places, especially at Hell Gate, where 10-mile tidal currents rushed over and around Hallets Point, Flood Rock, and other lesser obstructions, causing the wreck of many vessels.

The meager results of surface blasting led to the formation

of plans to attack the larger reefs in an entirely original manner. From the bottom of vertical shafts galleries were run in all directions beneath the overlying rock. The simultaneous explosion of numerous mines within the galleries shattered each reef at a single blast. In this manner Hallets Reef was disrupted in 1869–1876, and Flood Rock in 1875–1885. At Hallets Reef over 100,000 pounds of high explosive were used, and at Flood Rock over 250,000 pounds. In these two reefs nearly 6 miles of gallery were driven, and the amount of rock mined or shattered was 461,544 cubic yards. The method employed in this work has become famous in the annals of engineering.

Nothing but the limitations of this chapter prevent recital of other great achievements of graduates in river and harbor engineering. I wish I could tell in detail of the great locks at Sault Ste. Marie and at the Cascades, of the magnificent harbor that has been created at Duluth, of the investigations of Humphreys ('31), and Abbot ('54), upon the subject of the hydraulics of the Mississippi River, 1850–1860. Of the work last mentioned, the results of which have been published and studied all over the civilized world, the following extract illustrates present professional opinion:

> When the entire novelty of the problem set before them is considered, the want of any precedents to guide them, the magnitude of the task, the imperfect means at their command, the short time allowed for the work, and the rapidity with which it was performed, and the results matured and announced, their achievements seem little short of herculean. * * * The work must always stand as a monument of original research, of colossal labor, and of engineering genius. All the work done since has been based on the model set by them. Engineers of the present day owe them an everlasting debt of gratitude. Used with discrimination, their work is still of great value.[a]

Prior to 1890 it was the practice of Congress, in providing for a particular item of river and harbor work, to appropriate biennially a small percentage of the amount needed for its completion. A great handicap was thus placed upon those executing the work. That this condition was finally recognized in Congress may be gathered from the following extracts

[a] William Starling, M. Am. Soc. C. E., in Transactions of the American Society of Civil Engineers, November, 1895.

from an article[a] by the Hon. N. C. Blanchard, once chairman of the House Committee on Rivers and Harbors:

Our method of making appropriations for river and harbor work has been faulty in the extreme. * * * With us an order of survey of the stream or harbor proposed to be improved is made by Congress, and this order is executed by the War Department through the Engineer Corps. Inquiry is then made relative to the present and prospective commerce to be benefited by the contemplated improvement with a view of determining what public necessity exists for the proposed expenditure; and an opinion is required of the officer making the survey and of the War Department, through the Chief of Engineers, as to whether the locality is worthy of improvement or not. If worthy, a plan of improvement is formulated and estimates of the cost figured. All this is submitted in a detailed report to Congress. So far so good. Then, if it be the judgment of Congress that the project is worthy and the improvement be entered upon, the plan is formally adopted and a small appropriation, frequently not more than 10, 15, or 30 per cent of the estimate, is made to begin the work.

* * * There is always uncertainty when the next appropriation to continue the work will be made, and how much it will be. Thus the officer charged with the work of construction is compelled to limit his contracts to the amount actually appropriated. This is soon exhausted, and the work is stopped until the period comes around for the passage of another river and harbor bill. * * * Stoppage of the work for want of funds, as above indicated, not only postpones the period when results will be realized by the completion of the work, but it is wasteful in the last degree by deterioration of the work already done and left in an incomplete condition, and by the plant and working force engaged upon it becoming scattered and removed. * * * Sometimes the results of one year's work are destroyed or become valueless from one cause or another before the next appropriation can be had. Sometimes the engineer, as a matter of economy, or from force of circumstances, withholds the expenditure until more money is appropriated and becomes available for the work. * * * This slow, sporadic, intermittent, uncertain method of providing the means to carry on public works has operated greatly to our disadvantage.

In many instances the final cost of securing desired results has been greatly increased over what would have been required had the estimated cost been made available at once. The fault of our system lies in not appropriating the amount needed to complete public work when it is ordered to be commenced, or in not authorizing the making of contracts to complete it. * * * The officers of the Engineer Corps protested from the beginning against a policy of partial appropriations. * * * Those

[a] North American Review, March, 1894.

of us in Congress who are intimately identified with this branch of public service saw and recognized this; but reforms are of slow growth and it took years to educate popular sentiment in and out of Congress to the point of departure from the old, wasteful system, and the adoption of the new, or what is now called the "Contract or continuous work system."

The "continuous-contract" system was introduced in 1890, and the principle has been extended in successive river and harbor acts until it reached its highest development in the act approved June 13, 1902, which provided for the completion of every great project involving a less expenditure than $1,000,000, and for several years' work on a large and economical scale in the case of more costly enterprises. The last act was marked by the elimination of a number of projects of doubtful utility, and was by no means a "log-rolling" measure. "We have pursued no plan of compromise; we have considered no plan of dividing appropriations according to States, or localities, or membership of this House. We have endeavored to consider every project according to its merits, and made that the sole criterion as to whether it should be included in this bill or not."[a]

But perhaps the most promising feature of the last act was a clause providing for a board of review, composed of five engineer officers, through which the Corps of Engineers is hereafter to be made responsible to a large extent for the general policy of the Government with regard to public works.

When all has been said on the subject of the execution of river and harbor works, there may remain doubt as to the value of the improvements to the country at large. It would not be well if the efforts of so many graduates had not been fruitful of great benefits to the people.

Due to our interior waterways, the maintenance of which is no less necessary to the traffic borne than is the maintenance of railroads and roads, and of which many have been created (as well as maintained) by graduates of the Military Academy, it has recently been stated by the statistician of the Interstate Commerce Commission that the saving to the United States reaches annually the sum of $342,000,000.

[a] Remarks of Hon. Theodore E. Burton, chairman River and Harbor Committee, in the House of Representatives, March 17, 1902.

Upon the Great Lakes, in 1901, not counting shipments to or from foreign ports, there was transported 46,065,288 tons of freight,[a] which may be compared with 26,426,412 tons hauled by the 12,552.35 miles of railroad in the State of Texas during the fiscal year ending June 30, 1902.[b] Upon the Great Lakes the cost of carriage per ton-mile was .99 mill, as compared with 8.58 mills per ton-mile in Texas. If carried by rail at the Texas rate the cost of transporting lake freights during 1901 alone would have exceeded the actual cost by the sum of $178,004,467.87.

The value of the craft engaged in lake transportation during 1901 was approximately $60,000,000. The value of the railroad properties of Texas was in excess of $200,000,000. What, then, would represent the value to the community of the deep channels and harbors, and the locks, that have made possible so great and inexpensive a commerce? It is an indeterminate problem, but no one in possession of the facts would place this value at less than a great multiple of the total expenditures of the United States for river and harbor improvements.

Again let us consider the effect upon commerce of the improvement of Galveston Harbor, Tex., another typical instance of river and harbor improvement.

Between 1840 and 1900 the burden of the largest ocean-going ships increased from 1,155 tons to 15,500 tons. The average draft, loaded, of the 20 largest steamships of each period increased from 19 feet in 1848 to 29 feet in 1898. As a consequence of economies that resulted largely from increases of depth in terminal harbors, with consequent increase of size in ocean carriers, the cost of moving a ton of wheat from New York to Liverpool decreased from $5.75 in 1868 to $1.90 in 1900.

Other conditions being equal, navigable channels are said to compare in value as the cubes of their controlling depths, where the latter are less than the greatest draft of vessels.

If Manchester, England, has found it advisable to expend over $80,000,000 to become a seaport, if Glasgow has profitably

[a] Commerce on the Great Lakes, 1901, Bureau of Statistics, Treasury Department.
[b] Report of Railroad Commission of State of Texas for fiscal year 1902.

expended something like $60,000,000 to secure a deep-water harbor, then certainly there seems no a priori case of extravagance on the part of the United States in expending less than $9,000,000 to secure a deep and capacious port upon the Gulf of Mexico at Galveston.

Nearly equal distances separate the grain fields of Kansas from Chicago and Galveston. Export grain at Chicago is almost 1,000 miles from tide water, while at Galveston it may be loaded directly into the holds of deep-draft ships. In order to compete with prevailing rates from Kansas City to the Gulf other lines terminating at Kansas City and their connections to eastern ports must reduce their rates to a minimum. It has been testified before the Interstate Commerce Commission at meetings held in 1901 and 1902 that to meet rates of from 10 to 15 cents per hundred pounds to the Gulf grain has been hauled from Kansas City to Chicago at as low as 6 cents; and that "* * * in the past six years the price of grain at Kansas City was a great deal higher than the price in Chicago or any other market, figuring on the regular rate of freight."

Although the details would weary the reader, it may easily be proven that, due to the existence of the port of Galveston the farmers of Nebraska, Kansas, Colorado, Texas, Oklahoma, and Indian Territory receive at least $6,000,000 per annum additional for their grain. The farmers of Texas alone receive $2,000,000 per annum more for their cotton crop, which often exceeds 3,000,000 bales, and another $2,000,000 is a small estimate for savings in the handling, through Galveston, of cotton-seed products, lumber, and general merchandise. Thus it is seen that the annual saving to the community due to the work at Galveston amounts to a fair interest upon all expenditures throughout the country for river and harbor improvements from 1820 to the present day.

CONCLUSION.

There must be engineers in war, and much of the needed training of engineers would fail if undertaken in peace as a part of the routine of drill, for the destruction of materials

involved would cause great and immediately unprofitable expenditures which would never be provided for.

That training upon civil works, as supplemental to peace training of a military character, may produce soldiers of the highest type would seem to be proved by statistics of the civil war. From the relatively small number of officers who had served in the Corps of Engineers at least 41 were appointed general officers in command of Federal or Confederate troops. The names may be mentioned of at least ten who commanded armies in the field: Lee ('29) and Meade ('35), who commanded the opposing hosts at Gettysburg; Joseph E. Johnston ('29), McPherson ('53), and the great corps commanders, Humphreys ('31), Newton ('42), Wright ('41), and Warren ('50.)

In addition to their military duties, and at times in place of them, a number of graduates to-day find in river and harbor work and the like a field of great usefulness to their country. Thus is afforded a school of great value in time of peace for the development of administrative talent, knowledge of men and of materials, the habit of industry, and ability to meet emergencies and surmount difficulties.

THE SERVICES OF GRADUATES IN CIVIL LIFE, 1802–1902.

By WINFIELD SCOTT CHAPLIN,

Chancellor of Washington University, St. Louis—U. S. Military Academy, 1870.

WHEN the Military Academy was founded in 1802 scientific schools of all kinds were lacking in our country. There were colleges which were primarily intended for the education of men for the ministry, but did educate incidentally many who became lawyers and physicians; and these colleges taught, besides the ancient classic languages, mathematics and philosophy, which were considered the essentials of their course, the elements of physics, chemistry, and some or all the branches of natural history. Such beginnings of science seem never to have been sufficient to serve as a basis for a professional training. The young country had not reached the point in its development where the trained engineer and scientific man were needed. The Academy at the outset gave but little promise of usefulness in developing trained men of any kind; its course was short; the attendance of the cadets was irregular; the standard of admission was low; and the conduct of its affairs was unsympathetic and discouraging. It was only in 1817, when Colonel Thayer became Superintendent, that the institution took on its characteristic form, and that it could be expected to produce graduates who would show the effects of a thorough course in pure mathematics and in the physical and engineering branches which are founded on mathematics. Since that date, as will appear, the number who have resigned their commissions and betaken themselves to engineering and other work in civil life has been considerable.

The first school of engineering established in the United

States was the Rensselaer Polytechnic Institute of Troy, N. Y., which opened in 1824; but for about twenty years its course of instruction was but little if any better than that of the Military Academy in its earliest days, and accordingly the Military Academy had practically this field of education to itself up to about 1845, since which time the numerous schools of engineering which have sprung up in all the States have competed with the Academy in supplying the demand for educated engineers. The course of study at the Academy in all except the strictly military branches has always been highly theoretical; there has been but little practical application. Especially has this been the case in mechanics, which has always been studied to an extent not equaled in the regular course of any other institution. When engineering was reached by the student it was assumed that he had pure mathematics and mechanics so thoroughly at his command that most mathematical demonstrations could be omitted and the instruction in engineering limited to a description of engineering materials and works. It would be interesting, though perhaps difficult, to institute a comparison between the graduates of the Academy and those of schools where the instruction is of a different kind, where the course is made as practical as possible and application keeps even pace with the development of theory.

Of the first 100 graduates (1802–1814) we find that 55 resigned their commissions after longer or shorter terms of service, of whom only 4 became engineers, and of these 2 did not resign till many years after graduation, when there was a great demand for educated engineers; 10 devoted themselves to agriculture; 7 entered mercantile pursuits; 4 became sutlers; 5 became teachers; 5 entered non-military public employment, and 4 became lawyers. Of 16 the occupation in civil life is unknown. This showing may, I think, be taken as fairly representative of the demands at that time for educated men in the various callings which the training of these graduates fitted them to enter. Agriculture was of course the great business of the country. Teachers were in great demand. To enter the practice of law required but

scanty preparation. The number who became sutlers is indicative of a social sentiment widely different from that which prevails today.

Up to the time of the civil war the percentage of resignations continued to be large. This fact was due mainly, I think, to the unsettled policy in reference to the Regular Army and to the absence of any system of retirement for disability or age. The army officer could not hope, on the small pay he was allowed, to accumulate enough money to provide for old age or to care for himself and family should disease break down his health. Indeed, the records show many cases where resignation was closely followed by death, showing probably that officers who had become incapacitated had no choice but resignation.

Taking the 100 graduates, numbered from 392 to 492, who graduated in 1825, 1826, and 1827, we find that 48 resigned, of whom 5 became teachers or scientists, 10 became lawyers, 14 became engineers, 2 became farmers, 7 entered mercantile pursuits, 5 became clergymen, 1 became a Government clerk, 2 resigned to join the Southern army in the civil war, and of 2 nothing is known after resignation.

Since the civil war, with higher pay and a regular system of retirement on account of old age or disability and a fair provision for the remaining years of life, there has been a marked decrease in the percentage of resignations. For example, of the 100 graduates, numbered from 2312 to 2412, who graduated in the classes of 1870, 1871, and 1872, only 24 have resigned, and 2 of these have returned to the Army. Of these, 5 became manufacturers, 4 entered commercial pursuits, 3 became engineers, 3 became lawyers, 2 devoted themselves to scientific work, 1 became a teacher, and of 6 the occupation is unknown. The difference in occupation between these graduates and the first hundred graduates is marked.

There seems to be no way of exhibiting the work of the graduates of the Academy in civil pursuits except to give accounts of the achievements of those who have been most prominent and successful in each of the departments into which the work of the graduates may be roughly divided.

The accounts must of necessity be very succinct and their number limited. Yet we may hope in this way to give an impression as to the work of the graduates in civil life. The table of the civil occupations of graduates, 1802–1902, should also be consulted. (See page 483.)

ENGINEERS.

As has already been said the Academy had for many years almost a monopoly of engineering education. The first graduate of the institution, General Joseph G. Swift (1), had a distinguished civil career embracing all the branches of civil engineering which were practiced in his time. He built railroads, making the first use of the T-rail in America. He was in charge of important harbor improvements. He also held important civil appointments. He was surveyor of customs for the port of New York for eight years.

Major-General William Gibbs McNeill (172), of the class of 1814, who resigned his commission in 1837, had had a wide and successful experience as a builder of canals and railroads before his resignation, the authorities at Washington having assigned him to these civil duties. His work before and after his resignation from the Army extended into nearly every coast State from Massachusetts to Florida.

Captain Andrew Talcott (181), of the class of 1818, who, while in the Army, had devised the method of determining latitude by means of the zenith telescope now in general use, resigned after a service of eighteen years and devoted himself to geodetic and engineering work. He had a part in the building of the first railroad in Mexico—that from Vera Cruz to the City of Mexico—and was largely instrumental in developing the railroads of the Southern States.

Major George Washington Whistler (214), of the class of 1819, resigned in 1833. After considerable experience, both before and after his resignation, on the largest railroad undertakings of this country, an experience which gave him wide knowledge in civil as well as mechanical engineering, he became, in 1842, by appointment of the Russian Government, consulting engineer of the St. Petersburg and Moscow Railroad. In this capacity he had to undertake the construction

of 400 miles of railroad and the establishment of all the shops and the training of all the men necessary to his great task. He gained the entire confidence of the Czar, and was consulted by him on the most varied kinds of engineering problems. When he died, in Russia in 1849, his work was not completed, but it had advanced so far that, all the great questions decided, it could be carried through by others.

Daniel Tyler (216) graduated in the class in 1819 and served in the Army until 1834. He was connected with many railroad enterprises both in the northern and southern States as an engineer and as a manager. While he was best known in the latter capacity, he had a high standing as an engineer. He founded the city of Anniston, Alabama, where he built extensive factories. His experience included civil, mechanical, and mining engineering, and in all these branches he was very successful. He died in 1882.

William H. Swift (231), of the class of 1819, remained in the Army thirty years and like other engineer officers of his time was, before his resignation, employed on many works of a non-military character, the Illinois and Michigan Canal and the Boston and Albany Railroad, west of Worcester, among the number. His connection with the canal continued for many years after his resignation. He was in turn president of the Philadelphia, Wilmington and Baltimore Railroad, of the Massachusetts and Western Railroad (now part of the Boston and Albany Railroad), chairman of the board of trustees of the Hannibal and St. Joseph Railroad, and a director of the St. Louis, Iron Mountain and Southern Railroad. He died in 1884.

Isaac R. Trimble (302), of the class of 1822, resigned in 1832. He was chief engineer of several railroads in the Middle States and a consulting engineer of extensive experience. He died in 1888.

George S. Greene (327), of the class of 1823, resigned in 1836. After a wide experience in railroad engineering he became connected with the Croton waterworks of New York City as engineer in charge, chief engineer, and commissioner, and held a very prominent place among the leading engineers of waterworks, sewers, canals, and docks. He died in 1899.

John Childe (471), of the class of 1827, resigned in 1835. Until his death in 1858 he was engaged in engineering work on railroads as chief engineer and on large public works, among them the improvement of the St. Lawrence River.

Thompson S. Brown (395), of the class of 1825, resigned in 1836, and after experience in various branches of engineering in the United States became consulting engineer on the St. Petersburg and Moscow Railroad in succession to Whistler (214). He died in 1855.

The lack of space forbids a full notice of the many who from this time onward have been engaged in engineering. We must be content to name those who have been mainly engaged in that profession: Alexander J. Center (491), class of 1827, who was connected with the Panama Railroad; James Barnes (545), class of 1829, a railroad engineer of high reputation; George W. Cass (665), class of 1832, president of the Pittsburgh, Fort Wayne and Chicago Railroad and the Northern Pacific Railroad; William H. Sidell (712), class of 1833, connected with trans-isthmian railroads; Thomas A. Morris (753), class of 1834, chief engineer and president of several railroads of the middle Western States; Hermann Haupt (816), class of 1835, who devoted a long life to engineering and management of railroads, and who wrote valuable treatises on engineering subjects; Montgomery C. Meigs (846), class of 1836, who, after retirement, planned and erected Government buildings in Washington with remarkable success and economy; Lloyd Tilghman (887), class of 1836, a railroad engineer; George B. McClellan (1273), class of 1846, who was before the civil war chief engineer and vice-president of the Illinois Central Railroad, and after this war engineer in chief of the department of docks of New York City; Egbert L. Viele (1360), class of 1847, an engineer of parks and of railroads; James H. Wilson (1852), class of 1860, railroad engineer, manager, and president; Reuben W. Petrikin (2058), class of 1865, chief engineer of the International Railroad from Laredo to the City of Mexico; Lewis M. Haupt (2162), class of 1867, who, after a long service as professor of engineering, became a specialist on various branches of hydraulic engineering; Russell Thayer (2525), class of 1874, the chief

engineer and superintendent of Fairmount Park, Philadelphia.

It seems clear that, relatively speaking, the Military Academy has lost the preeminence which it once held in the civil-engineering work of the country, which fact is easily accounted for by the establishment and development of schools of engineering all over the country in which much more attention is given to engineering than can be given to it at the Military Academy. To attain the greatest success in engineering a man must have not only the scientific training, knowledge, and aptitude, but a grasp of the methods of business. It is a question whether the training at the Military Academy gives the last of these requisites. The civil-engineering works of the United States Engineer Department, river improvement and harbor works, conducted as they are wholly by graduates of the Military Academy, will always be a monument of the civil engineering knowledge and ability of its alumni. What other country can show works of such magnitude, planned so skillfully and carried on so honestly? Others will speak of these works in detail as they have been executed by army officers still holding commissions. I note their prominent qualities here in order to bring together into one view all the civil-engineering work of West Point graduates.

TEACHERS AND EDUCATORS.

The first graduate who became a teacher was Capt. Alden Partridge (15), class of 1806, who, having been professor of mathematics and engineering at the Academy, resigned in 1818. He was the founder of various successful private military schools and of Norwich University.

His first school was founded at Norwich, Vermont, in 1820, which was removed to Middletown, Connecticut, in 1825, and back to Norwich again, where it was incorporated as Norwich University in 1834. In 1840 he founded a military school at Portsmouth, Virginia, and subsequently Jefferson Military College in Mississippi, a school at Pembroke, New Hampshire, in 1847 another at Harrisburg, Pennsylvania, and another, in 1853, at Brandywine Springs, Delaware. In all

these institutions he combined military training with teaching of rather a scientific turn. He died in 1854.

Charles Davies (157), class of 1815, after filling the professorship of mathematics in the Military Academy, resigned in 1837 to accept the professorship of mathematics in Trinity College, Hartford, Conn. He was reappointed into the Army and again resigned in 1845 to become professor of mathematics and philosophy in the University of New York. In 1857 he became professor of higher mathematics in Columbia College, New York City, with which institution he remained connected until his death in 1876. He was the author of numerous mathematical text-books which for many years were the best of their kind. His earliest books were translations from French authors. In this way he was instrumental in giving to our mathematical text-books a decidedly French form, rather than an English form, which it would have been reasonable to expect, a peculiarity which has been maintained until our time.

Horace Webster (183), class of 1818, resigned in 1825 and was for twenty-three years professor of mathematics at Geneva College, Geneva, N. Y. Then for eighteen years he was principal of the Free Academy, New York City, and president of the same institution under the name of the "College of the City of New York" for three years, until 1869. During his connection with this institution he held the professorship of philosopy. He died in 1871.

Edward H. Courtenay (262), class of 1821, after serving for five years as professor of natural and experimental philosophy, resigned in 1834 to become professor of mathematics in the University of Pennsylvania, which position he held two years. In 1842 he became professor of mathematics in the University of Virginia, where he remained until his death in 1843. He was the author of a treatise on the Calculus, which was in use as a text-book in colleges and scientific schools for many years.

Alexander Dallas Bache (392) was graduated in 1825 and resigned in 1829 to become professor of natural philosopy and chemistry in the University of Pennsylvania (1828–1836

and again 1842–43). He was president of Girard College 1836–1841, principal of the Philadelphia High School 1841–42, and superintendent of the public schools of the city. His greatest service was as the reorganizer of the United States Coast and Geodetic Survey, of which he was the chief from 1843 to 1867. He was president of the National Academy of Sciences from its foundation in 1863 to 1867.

James Clark (574), class of 1829, resigned in 1830 and became professor of mathematics in Mount St. Mary's College, Maryland. He later held other professorships in the same institution. In 1844 he became a member of the Society of Jesus, and until his death in 1885 he held positions in colleges of that society as professor or treasurer or vice-president or president.

Roswell Park (629), class of 1831, resigned in 1836 and became professor of natural philosophy and chemistry in the University of Pennsylvania. In 1843 he became a priest of the Protestant Episcopal Church, and thereafter until his death in 1869 he was employed in educational institutions connected with that church. He was for eleven years either president or chancellor of Racine College, Wisconsin.

William A. Norton (635), class of 1831, resigned in 1833. After holding a professorship in the University of the City of New York, in Delaware College, and in Brown University, he became in 1852 professor of civil engineering in the Sheffield Scientific School of Yale University, where he remained until his death in 1883. He was a member of the National Academy of Sciences.

Francis H. Smith (711), class of 1833, resigned in 1836. In 1839 he became superintendent of the Virginia Military Institute, Lexington, Va., which office he held, except when the institute was closed on account of the civil war, until his death in 1890. He was a translator and an author of textbooks on mathematics.

Richard S. Smith (779), class of 1834, resigned in 1856 and became professor of mathematics, engineering and drawing in the Brooklyn Collegiate and Polytechnic Institute, which position he held until 1859, when he became director of the Cooper Institute, New York City. He was president

of Girard College from 1863 to 1867 and a professor in the U. S. Naval Academy from 1870 to 1877.

Henry H. Lockwood (863), class of 1836, resigned in 1837. In 1841 he became a professor of mathematics in the U. S. Navy, which position he held, except during the civil war, until he retired in 1876. He held at various times the professorships of mechanics, of gunnery, of tactics, of natural and experimental philosophy at the U. S. Naval Academy, and was engaged in astronomical calculation at the United States Naval Observatory, Washington, in the later years of his service.

Bushrod R. Johnson (1039), class of 1840, resigned in 1847 and became a professor in the Western Military Institute, Georgetown, Ky. He was connected with this institute as superintendent or professor, except during the civil war, until his death in 1880.

Henry L. Eustis (1111), class of 1842, resigned in 1849 to become professor of engineering in the Lawrence Scientific School of Harvard University. He was also dean of the Lawrence Scientific School until his death in 1885.

Alexander P. Stewart (1122), class of 1842, resigned in 1845 and after holding the professorships of mathematics and natural and experimental philosophy in several universities in the South became, in 1874, chancellor of the University of Mississippi. He died in 1891.

William G. Peck (1206), class of 1844, resigned in 1855. After serving as professor for two years in the University of Michigan, he became connected with Columbia College, New York City, as professor of mathematics, mechanics, and astronomy. He was a prolific author of mathematical textbooks, the translator of Ganot's Physics, and the author of a Mathematical Dictionary and Encyclopedia. He remained in the School of Mines of Columbia College until his death in 1892.

Henry Coppée (1241), class of 1845, resigned in 1855 and became professor of English literature and history in the University of Pennsylvania. Here he remained until 1866, when he became president of Lehigh University, Bethlehem, Pennsylvania. In 1875 he resigned the presidency but

retained the professorship of English literature and history which he had filled since he became president, and served in that capacity until his death in 1895. He was the author of many works and the editor of many compilations, and he wrote numerous articles which appeared in reviews and magazines.

William P. Trowbridge (1369), class of 1848, resigned in 1856. He served one year as professor of mathematics in the University of Michigan, four years in the United States Coast Survey, four years in the civil war. After a practical experience of five years in mechanical engineering, he was appointed professor of dynamic engineering in the Sheffield Scientific School of Yale University. Here he remained until 1877, when he became professor of engineering in the School of Mines of Columbia University, New York City. He died in 1892.

G. W. Custis Lee (1631), class of 1854, after resigning became, in 1865, professor of civil and military engineering in the Virginia Military Institute. Since 1871 he has been president of the Washington and Lee University.

Alexander S. Webb (1689), class of 1855, resigned in 1870. From 1869 until 1903 he has been president of the College of the City of New York, in succession to Horace Webster, of the class of 1818.

Frank Soulé (2125), class of 1866, resigned in 1870 and became professor of mathematics in the University of California. In 1872 he was transferred to the chair of engineering, which he has since held.

Robert Fletcher (2230), class of 1868, resigned in 1870 and became professor of civil engineering in the Thayer School of Civil Engineering (a graduate school) of Dartmouth College, New Hampshire.

Winfield S. Chaplin (2313), class of 1870, resigned in 1872. After practice as a civil engineer, three years as professor of mechanics at the Maine State College, five years as professor of civil engineering at the Imperial University of Japan, three years at Union College, New York, he became professor of engineering in and dean of the Lawrence Scientific School of Harvard University in succession to Eustis (1111). In 1891

he became chancellor of Washington University, St. Louis, Mo., which position he now holds.

Edward S. Holden (2314), class of 1870, resigned in 1873 to become professor of mathematics in the U. S. Naval Observatory at Washington. From 1881 to 1885 he was professor of astronomy in the University of Wisconsin; from 1885 to 1888, president of the University of California, and director of the Lick Observatory to 1898. Besides scientific writings he is the author of a number of books for colleges and schools.

Although this chapter is devoted to the work of graduates in civil life, it will not be complete without a mention, at least, of the distinguished teachers, members of the Academic Board of the U. S. Military Academy itself. Through their textbooks, which have been used in other institutions; through other writings and by their personal weight and influence, many of them have left a distinct mark on the educational history of the country. Including only the names of the most distinguished among those no longer living we have Davies (157), Mahan (361), Bartlett (429), Church (508), Bailey (666), and Michie (1996).

The number of graduates who have for longer or shorter terms held positions as teachers is quite large. From the few specially named above it appears that graduates of the Academy have reached high positions in the educational world. The greater number of them have entered the departments of mathematics or civil engineering. Yet others have succeeded in subjects as remote from mathematics as English and philosophy.

The course of study at the Academy is certainly not designed to develop literary production among its graduates. The time of a cadet is too fully occupied to allow even of an extensive acquaintance with literature, and the study of English composition has never been given an important place in its curriculum. Yet in the writings of its graduates, whether in the form of autobiographies, such of those of Grant and Sherman, or in its reports of services, there has always been the simplicity, directness, and clearness which are second nature to the soldier and which go far to make good English. Of the publications of the graduates another writer is to treat. Here

it is appropriate that I should speak only of some of those who have, after leaving the Army, taken up writing as a regular occupation.

Ethan A. Hitchcock (177), class of 1817, resigned in 1855. He devoted himself to philosophical and metaphysical study and writing. He published seven volumes.

Edward D. Mansfield (206), class of 1819, resigned in 1819. He published several books on various subjects, the most valuable of which is his "Memories." He held a high position as a contributor to the press.

Albert T. Bledsoe (602), class of 1830, who resigned in 1832, wrote several books on a wide range of subjects and was a successful editor of the Southern Review.

Roswell W. Park (629), class of 1831, resigned in 1836. He published several works, mostly compilations.

Charles King (2136), class of 1866, retired in 1879; the author of many novels of military life.

Richard H. Savage (2236), class of 1868, resigned in 1870; author of several novels.

Arthur S. Hardy (2282), class of 1869, resigned in 1870; author of several very successful novels.

MINISTERS OF THE GOSPEL.

To the ministry the Academy has contributed over 20 of its graduates, the great majority of whom have entered the Protestant Episcopal Church, in which Polk (477), class of 1827, became a bishop, and Woodbridge (442), class of 1826, rector in Richmond, Virginia; Parks (449), of the class of 1826, who declined a bishopric and served as chaplain of the Military Academy, and Vinton (590), class of 1830, for many years a rector in New York, were the most prominent.

Culbertson (991), class of 1839, and Garst (2631), class of 1876, were missionaries, and both died at their posts in eastern lands. Deshon (1168), class of 1843, became a Roman Catholic priest, and is now Superior-General of the Paulists.

PHYSICIANS.

Twelve graduates have become physicians, of whom probably the best known are Picton (372), class of 1824; Brush (680), class of 1832, and Metcalfe (947), class of 1838.

LAWYERS.

About 200 graduates have, after resigning, become lawyers. We find records of them in judicial positions and in positions of trust, but it is impossible to obtain such details of their careers as would enable us to speak as to their general success.

PUBLIC POSITIONS.

In our country the successful soldier is a favorite candidate for high public office. It, therefore, is not strange that the graduates of the Academy have held many such positions. It would occupy too much space to give a list of all who have been favored in this way, but we may name a few of the most prominent.

Grant (1187), class of 1843, was President of the United States for two terms. McClellan (1273), class of 1846, and Hancock (1223), class of 1844, were unsuccessful candidates of great parties for the same office. Donaldson (233), class of 1820, afterwards an unsuccessful candidate for the Vice-Presidency, was envoy extraordinary and minister plenipotentiary to Prussia from 1846 to 1849. McLane (927), class of 1837, was minister to China from 1853 to 1856, envoy to Mexico in 1859–60, envoy extraordinary and minister plenipotentiary to France from 1885 to 1889. Lawson (998), class of 1839, was minister plenipotentiary to Austria-Hungary from 1887 to 1889. Rosecrans (1115), class of 1842, was envoy and minister plenipotentiary to Mexico in 1868–69. Longstreet (1164), class of 1842, was minister resident to Turkey in 1880–81. Maury (1308), class of 1846, was minister to the United States of Colombia from 1887 to 1889. Torbert (1697), class of 1855, was minister resident to the Central American States from 1869 to 1871. Kilpatrick (1904), class of 1861, was envoy extraordinary and minister plenipotentiary to Chile from 1865 to 1868. Porter (1849), class of

1860, has been envoy extraordinary and ambassador plenipotentiary to France since 1897. Grant (2406), class of 1871, was envoy extraordinary and minister plenipotentiary to Austro-Hungary from 1889 to 1893. Hardy (2282), class of 1869, has been minister to Persia, minister to Switzerland, and since 1902 envoy extraordinary and minister plenipotentiary to Spain.

The following have been governors of States:

Wallace	(270), class of 1821, of Indiana, 1837–1840.
Allston	(271), class of 1821, of South Carolina, 1856–1858.
McLane	(927), class of 1837, of Maryland, 1885.
Buckner	(1216), class of 1844, of Kentucky, 1887–1891.
McClellan	(1273), class of 1846, of New Jersey, 1878–1881.
Stoneman	(1304), class of 1846, of California, 1883–1887.
Burnside	(1348), class of 1847, of Rhode Island, 1866–1868.
Nicholls	(1688), class of 1855, of Louisiana, 1877–1880 and 1888–1892.
Lee	(1755), class of 1856, of Virginia, 1886–1889.
Marmaduke	(1789), class of 1857, of Missouri, 1885–1887.
Ames	(1892), class of 1861, of Mississippi, 1874–1876.

The Academy has been well represented in the United States Senate and House of Representatives as well as in the Cabinet, but space does not allow of the introduction of the names of the graduates who have held these positions.

SCIENTISTS.

Among the graduates who have made names in scientific pursuits outside the Army, we should mention the astronomers Mitchell (555), class of 1829, and Holden (2314), class of 1870, both practical astronomers in charge of the largest telescopes of their time, and writers on and popularizers of astronomy; Mather (522), class of 1828, and Whittlesey (660), class of 1831, geologists who have added greatly to the knowledge of the geology and mineral wealth of the country; and Bache (392), class of 1825, Superintendent of the United States Coast Survey for twenty-four years. The following graduates have been members of the National Academy of Sciences—the highest American distinction of an American man of science. The Academy was founded in 1863.

Graduates who have been members of the National Academy of Sciences.

H. L. Abbot (1632), A. D. Bache (392), J. G. Barnard (708), W. H. C. Bartlett (429), T. L. Casey (1536), Comstock (1677), Holden (2314), A. A. Humphreys (641), E. B. Hunt (1232), D. H. Mahan (361), M. C. Meigs (846), J. Newton (1112), W. A. Norton (635), J. G. Totten (10), Trowbridge (1369), G. K. Warren (1451).

MANUFACTURERS.

Many of the graduates who have entered civil life have devoted themselves to manufacture or to commercial pursuits. Of these the following have attained unusual success:

Robert R. Parrott (363), class of 1824, resigned in 1836. He was the superintendent of the West Point Iron and Cannon Foundry at Cold Spring, New York, for thirty-one years. He manufactured the rifled cast-iron cannon which went by his name.

Henry Du Pont (727), class of 1833, resigned in 1834. He became director and proprietor of extensive powder works at Wilmington, Delaware.

Joseph R. Anderson (845), class of 1836, resigned in 1837. He was president of the Tradegar Iron Works at Richmond, Virginia, from 1841 until his death in 1892.

William B. Franklin (1167), class of 1843, resigned in 1866. He was vice-president and general agent of the Colt's Fire Arms Manufacturing Company at Hartford, Connecticut, until 1888.

Ambrose E. Burnside (1348), class of 1847, resigned in 1865. He became president or director of several railroads, and was president of the Rhode Island Locomotive Works until his death in 1881.

John C. Palfrey (1760), class of 1857, resigned in 1866; treasurer of the Merrimack Manufacturing Company at Lowell, Massachusetts, until 1874; and since that year, of Manchester Mills, New Hampshire.

Horace Porter (1849), class of 1860, resigned in 1873; vice-president of the Pullman Car Company since 1873.

Henry A. Du Pont (1888), class of 1861, resigned in 1875; son and successor of Henry Du Pont (727), powder manufacturer, Wilmington, Delaware.

H. B. Ledyard (2064), class of 1865, resigned in 1870; president of the Michigan Central Railroad since 1883.

George A. Garretson (2195), class of 1867, resigned in 1870; banker at Cleveland, Ohio.

Leander T. Homes (2198), class of 1867, resigned in 1869; banker, New York City.

Francis V. Greene (2312), class of 1870, resigned in 1886; president of Barber Asphalt Paving Company.

William R. Quinan (2319), class of 1870, resigned in 1881; an authority on explosives and their manufacture; now in charge of a manufactory of dynamite in South Africa.

Charles W. Burrows (2328), class of 1870, resigned in 1872; president of Burrows Brothers Company, extensive booksellers, Cleveland, Ohio.

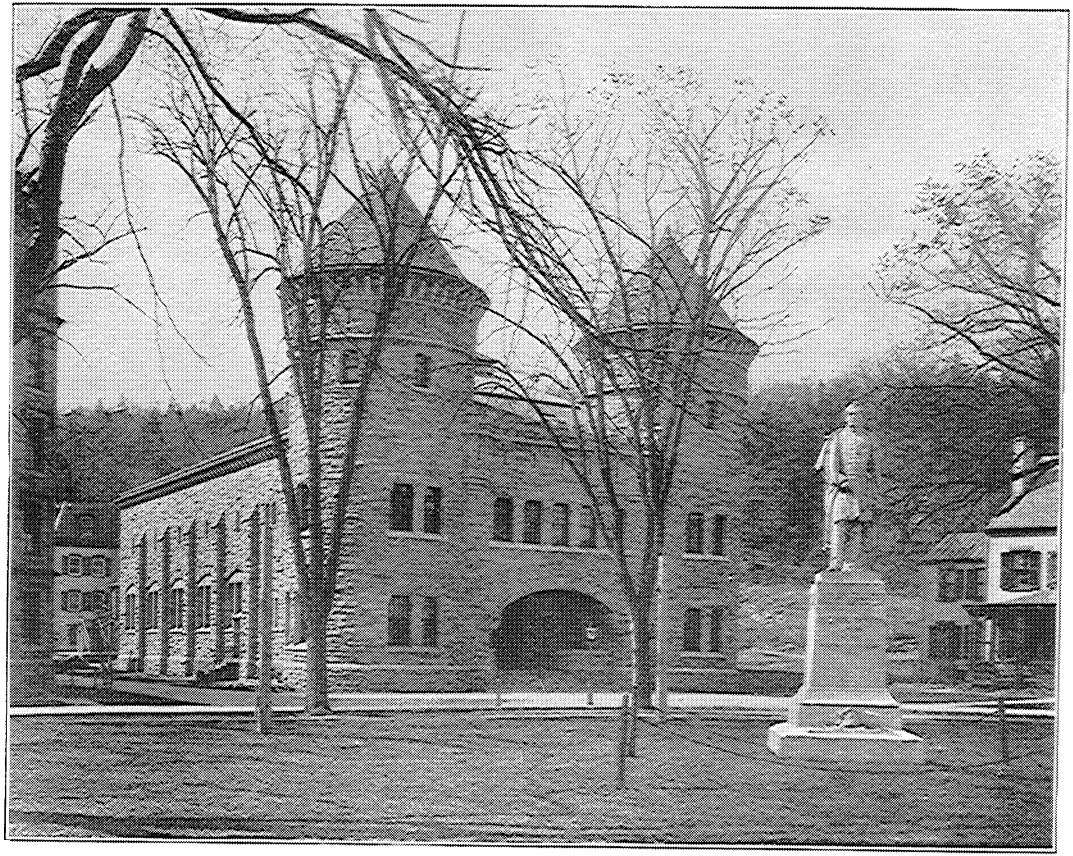
Dexter W. Parker (2350), class of 1870, resigned in 1871; president of the Charles Parker Company, manufacturers of hardware and shotguns, Meriden, Connecticut.

Frank O. Briggs (2416), class of 1872, resigned in 1877; manufacturer of wire rope, Trenton, New Jersey.

Eugene Griffin (2552), class of 1875, resigned in 1889; vice-president of the General Electric Company in 1892 and president of the Thomson-Houston Electrical Company in 1893, and is a director of the European branches of these companies.

It is to be expected, naturally, that the Military Academy will stand or fall with the achievements and records of its graduates in strictly military matters, and judged on this basis its success is secure; but it is extremely gratifying to see, as we must from the foregoing facts, that its graduates succeed remarkably in the non-military callings of civil life. To those of us who hold that the main object of education is rather the training of the mind than the acquisition of a body of facts, the success of the graduates in civil life comes as a confirmation of our views. The teaching at the Academy since the time of Colonel Thayer has laid more and more stress on

thoroughness of understanding. There has been little patience with displays of general knowledge. The cadet must know that a statement is or is not correct and why. Criticise the extent and distribution of the studies as we may, regret as some of us do that all students are obliged to go along together over the same curriculum, whatever their individual powers and tastes may be, yet we must admit that the mental training which the cadets receive does enable them not only to perform their military duties in a manner creditable to themselves and their country, but also to meet the requirements of civil life in its widest variation in a manner of which we may all feel proud.



CADET GYMNASIUM (BUILT 1893) AND STATUE OF COLONEL THAYER (DEDICATED 1883).

THE PHYSICAL TRAINING OF CADETS, 1802–1902.

By Lieut. H. J. KOEHLER, U. S. Army.

OWING to the lack of authentic data the place given to bodily exercise in the curriculum of the Academy during the first years of its existence is wrapped in comparative obscurity. Enough has been gleaned from various sources to establish beyond conjecture that efforts were made at the beginning to train the physical as well as the mental side of the cadet. From what can now be discovered it is difficult to establish by what means this was accomplished—whether by purely military drills or by a course of crude gymnastics. Doctor Hartwell, in his report on the Physical Training in American colleges, is inclined to believe that it was the former. He states:

> Bodily training, under the heads of Military Instruction and Sword Exercises, received marked attention from the first.

In appendix to his report, published by the Commissioner of Education in 1899, the following reference is made to the training at West Point:

> Excepting the Military Academy at West Point, in whose curriculum bodily exercises have figured more or less largely since 1817, the "American Literary, Scientific, and Military Academy," founded at Norwich, Vt., in 1820, by Capt. Alden Partridge, formerly Superintendent at West Point, seems to have been the first educational institution of note in America to attempt to connect "mental improvement with a regular course of bodily exercise and the full development of physical powers." The example of the West Point and Norwich academies proved mildly stimulating and led to the establishment of perhaps a score of select military schools for boys, etc.

This extract is of more than passing interest to graduates of the Academy, as it not only credits their alma mater with being the first American educational institution to adopt a system of rational physical education, but also ranks one of its officers among the first exponents of rational training in America.

That Captain Partridge held very decided views on the subject of the physical training of students, and that he did not believe ordinary military exercises were sufficient, and that he was impressed with the value and importance of gymnastic training, is shown by the following extract from a lecture by him:

Another defect in the present system is the entire neglect, in all our principal seminaries, of physical education. The great importance and even absolute necessity of a regular and systematic course of exercise for the preservation of health, and confirming and rendering vigorous the constitution, must be evident to the most superficial observer. It is for want of this that so many of our most prominent youths lose their health by the time they are prepared to enter on the grand theater of active and useful life. That the health of the closest applicant may be preserved, when he is subjected to a regular and systematic course of exercises, I know from practical experience; and I have no hesitation in asserting that in nine cases out of ten it is just as easy for a youth, however hard he may study, to attain the age of manhood with a firm and vigorous constitution as it is to grow up puny and debilitated, incapable of either body or mental exertion.

That the exponent of this theory, which after nearly a century's discussion has been finally accepted by educators the world over, did not content himself with theorizing is borne out by the fact that after he relinquished his command at West Point he established no less than four schools modeled upon the Military Academy plan. Physical Training speaks of his labors at Norwich as follows:

"Captain Partridge opened his American Literary Scientific Academy at Norwich, Vt., his native town, September 4, 1820. In a card published in April, 1825, on the eve of his departure for Middletown, Conn., for the purpose of reopening his seminary in that place, Captain Partridge set forth the results of his labors at Norwich. He claimed that his plan of "connecting mental improvement with a regular course of bodily exercises and the full development of the physical powers, the whole conducted under a military system of discipline," had succeeded beyond his most sanguine expectations. Out of 480 pupils who had entered the seminary from 21 States only one had died there. "Many of my pupils, and those the

closest applicants to study," he says, "walk with facility 40 miles per day. On a recent excursion to the summit of the most elevated of the White Mountains, with a party of 50 of my pupils, a large proportion of them walked, on the last day, 42 miles. Belonging to this party was a youth of but 12 years of age, who walked the whole distance, 160 miles, carrying his knapsack, and returned in good health."

In the absence of other evidence, the character of the man and his subsequent labors in the field of superior education are sufficient to establish the fact beyond reasonable doubt that physical training formed a part of the regular curriculum at the Military Academy during Captain Partridge's administration, and that the Academy was the first institution in America to recognize physical training officially. In 1817 the Academy was remodeled and reorganized, and a system of instruction was inaugurated which in all essentials has remained unchanged to the present time. Reforms are always accomplished at the expense of something, and in this instance it was at the expense of physical training; this is evident even from the meager records now on hand, which make no mention whatever of physical training except the military drills, sword exercises, and a crude game of football. That the results obtained from military drills were deemed highly satisfactory is evidenced by the following extracts from a paper by E. D. Mansfield, of the class of 1819, a son of Professor Mansfield, who was the head of the department of philosophy in 1802–3 and again in 1814–1818:

> The only remaining point peculiar to the system at West Point is that of military exercises. As a military institution, this is a necessity, but it is also a great advantage as a means to physical education. This is a kind of education too much neglected, and for which civil colleges afford little opportunity and no encouragement. * * *
>
> The military exercises at West Point accomplish great results. They give admirable exercise to the body, occupy time which might be wasted, and compel Cadets to give up late night studies. * * * Thus the system of discipline at the Military Academy at once strengthens the body, stimulates ambition, prevents idleness, and compels the mind to pursue the objects of reason rather than the charms of imagination.

This was written of an age when comforts were few and

inconveniences many; when the drill grounds were just as nature had made them, instead of beautiful turf-covered plateaus; when Cadets were compelled to do the work now usually done by horses, as in artillery drill, for instance; in fact, it was written about a time when the conditions of everyday life made rugged health an imperative factor, upon which more than anything else success was dependent. Changes were, however, constantly made, comforts were introduced, and as every academic department was intent upon perfecting and broadening its scope, military drills ceased to occupy the prominent place of years before. The rapid strides made in the development of the different departments had to be met by more constant application on the part of Cadets. In consequence, the benefits obtained from its curtailed military drills did not compensate for this extra mental exertion, and it is not surprising to find that this state of affairs did not escape the notice of the Board of Visitors for 1826. They made the following recommendation, which is of more than ordinary interest, as it is the first time gymnastic training for Cadets is officially mentioned:

> In the next place your committee believe that a building is wanted for gymnastical exercise, which will serve at the same time for a riding school, a fencing school, and a military drill hall. A thorough and careful physical education is of more importance to a military officer than to any other person; but it is not yet offered at this Academy. The drill during the summer months is sufficient to give cadets a healthful exercise and no more; but during the winter this source fails and the spirits and activity fail with it. It is proposed, therefore, that a plain building merely sufficient to afford shelter be erected, and that a systematic exercise of the whole person be diligently practiced during the winter under a gymnastical teacher, who shall be provided to superintend it.

The building recommended by this Board was not ready for occupancy until thirteen years later, and instead of being a plain building was a handsome stone structure, standing on the site of the present academic building. In it provision was made for recitation rooms, riding, and fencing hall. It is strange, however, that no provision was then made in this building for instruction in gymnastics. The subject of physical training rested here for thirty years, nothing more being

done until February 2, 1846. On that date the following special order was published:

1. In order to counteract the injurious effects likely to arise from too sedentary habits of the Corps of Cadets at this period of the year, when military exercises are necessarily suspended, and with a view to physical development, the Superintendent has caused a gymnasium to be prepared, which, however limited in extent, will, it is hoped, answer the desired end until something more extensive and prominent can be established.

2. The exercises will commence in the gymnasium to-day, under the direction of First Lieut. H. C. Wayne, First Artillery, who will designate such Cadets to assist him as have heretofore received instruction in a gymnasium.

The gymnasium referred to in the above order was prepared in the riding hall of the old Academy, and here exercises were conducted daily, Saturdays excepted, from 4 to 5 o'clock. The day following the above order another was issued excusing the members of the first class from attending this drill. The reason for this is not quite clear, but it is probable that it was decided that they did not require it, as they received sufficient exercise during instruction in fencing, that being a first-class subject till 1852, when it was made a part of the fourth-class course. Gymnastic instruction was continued until the spring drills began, March 15. There are no records available from which the character of the work, its results or its duration, may be gleaned. It is doubtful, judging from the crudeness of it all, if this new departure in the training of Cadets recommended itself very highly to those in charge. It was a beginning, however, upon which all that has since been accomplished in that line at the Academy is based. When the present riding hall was completed in 1855 a large portion of the basement of the academic building was converted into a gymnasium. The appliances and apparatus were crude and limited both as to usefulness and number; but yet the wedge had been entered, and from year to year the need of a suitable gymnasium became more apparent. Lieut. J. C. Kelton, afterwards Adjutant-General of the Army, was placed in charge of gymnastics from 1856 to 1861.

The administration which first recognized and introduced gymnastic training as an essential part of the training of

future army officers stands unique, as the following order testifies, in being, it is believed, the only one in the history of the Academy to encourage Cadets to indulge in athletics by special orders:

SPECIAL ORDERS, No. 120. } NOVEMBER 2, 1847.

As a means to healthful and manly exercise during the suspension of drills, the Superintendent requests the Cadets to form themselves into cricket clubs, and, with a view to perpetuating such clubs at the Academy, suggests that they take appropriate names. Such clubs are much in vogue in the British service, and are considered highly conducive to physical development.

As another means of recreation during the winter, it is intended to arrange the riding and fencing halls for gymnastic and other exercise, during the evenings of the week between parade and call to quarters.

The cricket clubs were formed and the game, under the direction of Mr. Francis Newlands, for many years chief clerk to the quartermaster, was indulged in during the fall of that year. Cricket, however, has never appealed to the young American, and it is not surprising that the game lasted only one season.

Regular instruction in gymnastics was discontinued in 1861, and from then until 1882, when it was again resumed, Cadets were permitted to use the gymnasium as they saw fit. The attendance was regular and insisted upon, but everybody was allowed to choose the form of work which appealed to him, the chief object being to keep busy, regardless of everything else. As a rule the officer in charge was present and it was his duty to see that all were employed.

In 1882 the fallacies of such a system of training became so apparent that an effort was made to put the instruction upon a systematic basis. The reconstruction of this feature was intrusted to Lieut. E. S. Farrow, Twenty-first Infantry, who continued in charge until 1884, when he was relieved by Lieut. Henry Kirby, Tenth Infantry. It is no reflection upon these gentlemen to state that from the standpoint of a professional there was but little system in the course pursued by them, and that it lacked many of the fundamentals of a rational system of training. They accomplished much, however, in breaking up the pernicious practice of permitting

Cadets to use the gymnasium as they saw fit. The work was placed under control, and the results obtained were beneficial instead of, as in many instances before, positively harmful. The gentlemen mentioned above are deserving of great credit, as their efforts brought about a realization of the importance and value of a thorough system of physical training for Cadets.

The system which obtains at the Academy at the present time was inaugurated in February, 1885. From a modest beginning in the old gymnasium, which was a gymnasium in name only, it has gradually grown to its present standing. It has not yet reached the limit of its usefulness and will not reach it until every member of the Corps of Cadets is permitted to enjoy its benefits during the entire time of his stay at the Academy. This is a question of serious import, not only to the individual or the institution, but to the Army and country.

It cannot be gainsaid that the curriculum at the Military Academy requires closer and more constant application than that of any other institution in the world. The constant mental strain which a successful mastery of the subjects taught here makes necessary is fraught with danger to the physical welfare of the cadet. To counteract this, to build up the weak so he may have an even chance with the naturally strong; to quicken the cadet physically, so his intellect may be at its best; to maintain him in a sound, healthful condition, and make him the possessor of a surplus of strength, energy, and vitality, against which he may draw in times of stress, are salient points around which a rational system of physical training must be constructed.

The system of training should be composed of exercises that will promote health, and at the same time develop strength, grace, agility, precision, self-reliance, courage and endurance. It is believed that the present system in vogue at the Academy does this, and does it, too, without for a moment losing sight of its principal and primary object.

The means are a very extensive and thorough course of exercises, every one of which has by long experience proven its worth, every movement having its object. All exercises

of questionable value and those in which there is danger of overexertion or of bodily injury are rigidly excluded.[a]

The fact that the physical training of students has well-defined educational limits is never lost sight of. To endeavor to turn out record-breaking strong men, or skilled acrobats, is wrong in every particular, as such a course is likely to do an irreparable injury to some and does the large majority an injustice by neglecting them. Experts in all walks in life are developed at the expense of many others less favorably endowed than themselves. In educational matters, where the object is to develop a high general standard, such as is the case at the Academy, it is wrong to develop the few at the expense of the many. It is our duty to direct our energies upon the average student, and upon him who is below the standard. This is the principle underlying the training of cadets; the greatest good to the greatest number, and only at the expense of those who can afford it. Those who are already superior to their fellows require but little encouragement, and may be depended upon not to neglect themselves.

There can be no question, however, that like results are almost impossible at any other institution, simply because conditions are not and can not be the same. In the discipline which prevails here, and in the pride and ambition of the cadets themselves in everything pertaining to their personal appearance, the training has powerful allies. Chief among these is discipline, which makes it imperative upon each pupil to carry out to the minutest detail every requirement. Through it the benefits accruing from the training are made permanent; erect and proper carriage and soldierly bearing are insisted upon, and while discipline insists, the exercises not only make this insistence possible, but pleasurable. Surrounded upon all sides by splendid specimens of young manhood, it is only natural that the new comer should find himself impelled to emulate them. He begins to take pride in his personal appearance, and gladly accepts any instruction that will tend toward improving his physique. In time this pride

[a] Experience has proved that the best results may be obtained through the employment of simple exercises and combinations, aud that it is the manner in which an exercise is executed rather than the exercise itself which makes training successful.

becomes a habit, and this habit a distinguishing characteristic of a West Pointer.

From 1885 till 1891 this work was conducted in the old gymnasium, which had been equipped with modern appliances. The value of the work having been recognized, the need for better accommodations was keenly felt. An appropriation for a suitable building was made by Congress, and in 1892 the present beautiful gymnasium was completed. This building contains a large gymnasium, 70 by 90 feet, running track, fencing rooms, dressing rooms, bowling alley, office, and a swimming tank, 30 by 60 feet. The equipment of the gymnasium proper is, it is belived, superior to any in the world. All its appliances are sufficiently numerous to facilitate the instruction of large squads, from six to twelve Cadets being able to exercise on the same kinds of appliances simultaneously.

Anthropometric measurements and strength tests have been taken since 1885, and all Cadets requiring special training have a plan of work laid down for them. The following table illustrates, so far as figures can, the effect of the work. The measurements are taken at the beginning and end of the course in gymnastics in October and in May:

Average measurements.	Height.	Weight.	Chest normal.	Chest expanded.	Waist.	Right upper arm.	Right upper arm set.	Left upper arm.	Left upper arm set.
	In.	*Lbs.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
October	68.38	141.60	33.60	35.88	28.23	9.68	11.29	9.54	11.05
May	68.78	147.89	34.92	37.40	28.40	10.59	12.31	10.16	12.00
Gain	.40	6.29	1.32	1.52	.17	.91	1.02	.62	.95

In all some 26 measurements and 7 strength tests are taken of each Cadet. Only the more prominent of the measurements are quoted above.

Strength tests.

Average tests.	Pull up.	Dip.	Right forearm.	Left forearm.	Back.	Legs.	Lung capacity.
	Times.	*Times.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Cu. in.*
October	7.11	4.95	122.93	110.44	347.66	478.83	239.79
May	10.40	10.44	138.62	123.29	427.41	620.32	256.13
Gain	4.29	5.49	15.69	12.85	79.75	141.49	16.34

The "pull up" is the number of times a Cadet can "chin" himself; the "dip" how often he can raise his body, by bending his arms as low as possible and again extending them, on the parallel bars. Right and left forearm tests are grip tests; the back and leg tests show how many pounds a Cadet can lift with back or legs.

Outline of the Plan and Scope of the Physical Training of Cadets at the U. S. Military Academy.

At present, and since the introduction of the present methods in 1885, the training of Cadets, so far as it pertains to the regular instruction of gymnastics, is confined to the members of the fourth class.

This class receives instruction in the setting-up exercise immediately upon its arrival here. The daily drills are of forty-five minutes' duration. When the class joins the battalion of the Corps of Cadets, which is about three weeks after its arrival, these drills are discontinued.

Gymnastic work is again taken up on October 1 and ends on June 1, there being three drills, each of forty-five minutes, per week.

Cadets of the other three classes, while not obliged to attend gymnastic or fencing instruction, are encouraged to do so during the suspension of the afternoon drills from November 1 to March 15.

Setting-up Period.

From the time of arrival till the battalion is joined, about three weeks. Daily drill, duration forty-five minutes: 1, position of attention; 2, starting position; 3, simple exercises of various parts of body; 4, marching; 5, simple combinations; 6, marching and exercises while marching; 7, running; 8, simple combinations while standing, walking, sitting, and lying down.

First Period.

[From October to January.]

Three lessons weekly, each of forty-five minutes' duration.

First Month.

This month's work is entirely preliminary.

1, strength tests; 2, setting-up exercises, simple movements; 3, exercise on chest weights; 4, exercise on intercostal and back and loin machines; 5, running, walking, and exercises in walking; 6, preliminary series on horses and horizontal bars.

Second Month.

1, setting-up exercises, simple combinations; 2, running, walking, etc.; 3, repetition of preliminary series on horse and horizontal bars; 4, preliminary series on parallel bars, mounts, and rests; 5, dumb-bells and wands.

THIRD MONTH.

1, setting-up exercises, advanced work; 2, running, walking, etc.; 3, first series on club exercises; 4, first series on horses and horizontal bars; 5, preliminary series on rings and vaulting bars; 6, climbing and jumping.

SECOND PERIOD.

[From January to April.]

1, iron wands, dumb-bells and clubs; 2, second series on horses and horizontal bars; 3, first series on parallel bars; 4, first series on vaulting bars and rings; 5, medicine balls, squad work; 6, climbing and jumping.

SECOND MONTH.

1, clubs, second series, bells and wands; 2, third series on horses; 3, second series on parallel bars; 4, second series on rings; 5, contests, wrestling, etc.; 6, jumping and climbing.

THIRD MONTH.

1, clubs, third series, bells, wands, and medicine balls; 2, third series on horizontal bars and horses; 3, third series on parallel bars; 4, second series on vaulting bars; 5, jumping and climbing.

THIRD PERIOD.

[From April to June.]

1, club combinations; 2, repetition and review of all work previously taken with hand appliances; 3, third series on vaulting bars; 4, third series on rings; 5, review of all work done on apparatus.

FENCING.

Baron Steuben in the scheme for the organization of a Military Academy, which he submitted to General Washington in April, 1783, recommended that horsemanship, fencing, dancing, and music be made a part of the regular curriculum. Of these fencing, probably because the use of the sword was considered of indispensible importance to military men, received prompt attention.

The use of the sword has been taught at this Academy continuously since 1816. From time to time the work done by Cadets in this branch of their training engaged the attention of different Boards of Visitors. Thus, in the report for 1823 we find that the sword exercises taught at the Academy at that time were far from satisfactory.

The board for 1832 recommended that the use of the broadsword and lance should be added to that of the foil, and should be well taught as they would improve "the health and appearance of Cadets."

Instruction was confined to the first class until 1852, when it was made a part of the fourth class course. Besides the professional instructors,

fencing was taught by Lieut. H. C. Wayne, in 1843 and again in 1846–47; and by Lieut. J. C. Kelton, afterwards Adjutant-General of the Army. The following is a list of instructors who served at the Academy: Pierre Thomas, 1816–26; Pierre Trainque, 1826–27; Louis S. Simon, 1827–32; Albert Jumel, 1832–37; Ferdinand Dupare, 1837–40; H. G. Boulet, 1840–42; Patrice de Janon, 1846–58, when he was appointed professor of Spanish; Antoine Lorentz, 1858–84; H. J. Koehler, 1885–1902.

During the first century of the Academy's existence only one accident can be charged to fencing. Cadet Carter, in 1837, while fencing with a fellow cadet, was fatally wounded. The button of his adversary's blade broke off and the blade pierced his brain.

The present system of fencing instruction was introduced in 1885. Instruction, which is confined to the members of the fourth class, three times a week, is given in the use of the foil, saber, and bayonet. Owing to the limited time and the large classes it is impossible to impart a knowledge of the refinements of the art to cadets. Enough is given, however, so that those who desire can develop themselves into very fair swordsmen. Besides the regular instruction a voluntary fencing squad is organized every winter for the purpose of developing a team for the intercollegiate fencing championships. The Academy has been represented by teams at the last two of these competitions, winning the team and individual championships at both of them.

The 1902 team was composed of the following Cadets: Strong ('04), Breckinridge ('05), and Nichols ('05). Strong was awarded the individual championship medal. The 1903 team was composed of Breckinridge ('05), Honeycutt ('04), and Scott, W. R. ('04). Breckinridge and Honeycutt were tied for the individual honors. Besides this competition the Cadets met and defeated the following teams in dual meets during the 1902 season: Harvard, Yale, Columbia, Pennsylvania, and Cornell. During the 1903 season they defeated teams representing Yale, Columbia, Cornell, and Pennsylvania.

The following is a synopsis of the work done in fencing by the fourth class during the year:

Instruction in fencing is given to members of the fourth class only. Classes are divided into three sections, and each section receives three lessons per week, of forty-five minutes each. Sections number from forty to fifty members, depending upon the size of the class. All work is, therefore, class or squad work, every movement being executed simultaneously by all members. The following is the plan of instruction.

FIRST PERIOD.

[From October to December.]

FOILS.

Three lessons weekly, each forty-five minutes.

I.

A. Lesson without weapon in single rank: 1, guard; 2, calls; 3, advance; 4, retreat; 5, extension; 6, lunge; 7, combination of above movements.

B. Lessons without weapon in double rank: 1, guard; 2, calls; 3, advance, 4, retreat; 5, extension; 6, lunge; 7, combination of above movements.

II.

A. Lessons with weapon in single rank: 1, explanation of parts of foil, and lines of attack and defense; 2, guard; 3, recoveries; 4, advance and retreat; 5, arm extension; 6, arm and leg extensions; 7, lunges; 8, combinations of above movements; 9, simple parries; 10, simple thrusts; 11, thrusts and parries in combination with advance and retreat.

B. Target practice: Lunging at a mark with: 1, straight lunges; 2, straight lunges in connection with advance and retreat; 3, straight lunges, parrying before lunges; 4, same, parrying after lunge; 5, same, parrying before and after lunge; 6, same, advancing and parrying before lunge; 7, same, retreating; 8, same, advancing, parrying, lunging, retreating, and parrying.

III.

Lessons in double rank with weapon (a direct attack and simple defense): 1, explanation of engagements; 2, quarte engagement; 3, tierce engagement; 4, change of engagement, single and double; 5, advance and retreat; 6, change of engagement while advancing and retreating; 7, direct attacks in quarte and tierce, high and low, and simple parries; 8, direct attack, simple parries, and direct reposte.

B. Direct attack and simple defense: 1, disengage; 2, cut over; 3, feint of one, two, and one, two, three; 4, feint in line in connection with above attacks; 5, feint low and deceive low parry; 6, cut over and disengage; same reversed; 7, cut over and one, two; same reversed; 8, cut over, disengage, and cut; 9, feint-in-line, cut, and disengage; also the feint-in-line in connection with other thrusts.

C. Indirect attack, simple parries, and direct or indirect reposte: 1, as above, the one parrying to make a direct straight reposte immediately after parrying; 2, same as above only that the reposte is not a direct one.

D. Counter parries: 1, counter quarte; 2, counter tierce; 3, counter low tierce; 4, counter low quarte; 5, indirect attack parried by counter parries or by simple and counter parries; 6, indirect attack parried as above with direct or indirect reposte, when indirect the reposte to be parried with counter or simple parry; 7, combination of two or more thrusts

at command, or at will; 8, double, parried by counter and simple parry; 9, double, parried by two counters; 10, double and disengage, parried by counter and two simple parries, or by counter, simple, and counter; 11, double and one, two, parried as above, or by counter, two simple, and counter parry; 12, reverse double, parried by simple, counter, and simple parries.

The above movements with direct or indirect reposte.

E. Beat, glide, and press: 1, above movements in connection with direct and indirect attacks, parried by simple and counter parries; 2, combinations at command and at will.

F. Time and stop thrusts: 1, explanation and practical application of above thrusts.

G. Salute.

SECOND PERIOD.

[From January to March.]

SABER.

Two lessons per week, duration as above.

FOILS.

One lesson per week.

Foil fencing is continued throughout the year, the work consisting chiefly of combinations of the more difficult order, executed at command or at will.

SABER.

A. Single-rank exercises with saber: 1, moulinets; 2, guard, advance, and retreat; 3, cuts; 4, parries; 5, cuts and parries combined; 6, advance and retreat in connection with cuts and parries.

B. Double-rank exercises with saber: 1, engagements, and change of engagement; 2, simple cuts and parries; 3, simple cuts and parries and direct reposte; 4, simple feints and parries; 5, simple feints and parries and direct reposte; 6, simple feints and parries and indirect reposte; 7, double feints and parries; 8, double feints and parries and direct reposte; 9, double feints and parries and indirect reposte; 10, combinations at command or at will; 11, at will.

THIRD PERIOD.

[From March to June.]

BAYONET.

Two lessons per week, duration as above.

FOILS AND SABERS.

These alternate on the third day, and the work consists of combinations executed at command or at will.

BAYONET.

A. Single rank without rifle: 1, guard, advance, and retreat; 2, front and rear pass; 3, change of guard forward and backward; 4, volts; 5, leaps and side stepping; 6, lunges; 7, combinations of the above.

B. Single rank with rifle: 1, repetition of all the above movements; 2, parries and thrusts; 3, blows with the butt; 4, combinations of the above movements.

C. Double rank with rifle: 1, engagements and changes; 2, direct attack and parries; 3, indirect attack and parries; 4, the same with direct and indirect reposte; 5, combinations; 6, at will.

SWIMMING.

Lieut. J. C. Kelton, in 1858 and 1859, made an effort to have swimming made a part of the Cadets' summer drill; in fact, he gave instructions, which were, however, discontinued when he was relieved. In 1883 the matter was again taken up, but the work lacked system and little was accomplished. The present system began in 1885, and since then Cadets have been compelled to attend swimming, no matter to what class they belong, until they accomplish the test which qualifies them and excuses them from further instruction. This test consists in swimming for at least ten minutes with the breast stroke. When it is considered that at least 70 per cent of those who report here can either not swim at all, or fail in the test, the importance of this work is manifest. From 1885 till 1894 swimming instruction was conducted at Washington Valley; since then it has been given in the tank in the gymnasium.

RIDING.

Equitation engaged the attention of those in authority at the Academy from the beginning, but owing to the expense this would entail upon the Government, it was many years before their wishes were considered. Horses, too, were not supplied for the artillery drills until about 1840, Cadets being compelled to drag the pieces about by hand.

The first data bearing on this subject is contained in the report of the Board of Visitors for 1819. The subject is brought to the notice of Congress and the War Department in a recommendation for an appropriation of $1,020 for the construction of a riding shed, the employment of a riding master, and the hire of six horses.

Congress did not think well of this scheme, modest though it was, and the question of equitation at the Academy was not again officially mentioned till 1826, when the Board of Visitors recommended "that a plain building suitable for gymnastical exercise, which will serve at the same time for a riding school and fencing school," be erected.

Thirteen years later, in 1839, the old academic building, in the basement of which provision for riding had been made, was completed, and

the War Department ordered a detachment of Dragoons to the Academy. They arrived in June, 1839, and it is from that time instruction in riding at the Academy dates, it having been continuous since that date. The present riding hall was completed in 1855.

The following is a list of riding masters who served at the Academy: James McAuley, 1839–42; H. Hershberger, 1842–48; F. R. O. de Béville, 1850–52. McAuley and Hershberger had been sergeants of cavalry in our Army; de Béville was a French riding master. Since 1852 the instruction has been intrusted to officers of the Army. Instruction in riding is, at present, a part of the first, second, and third class courses.

DANCING.

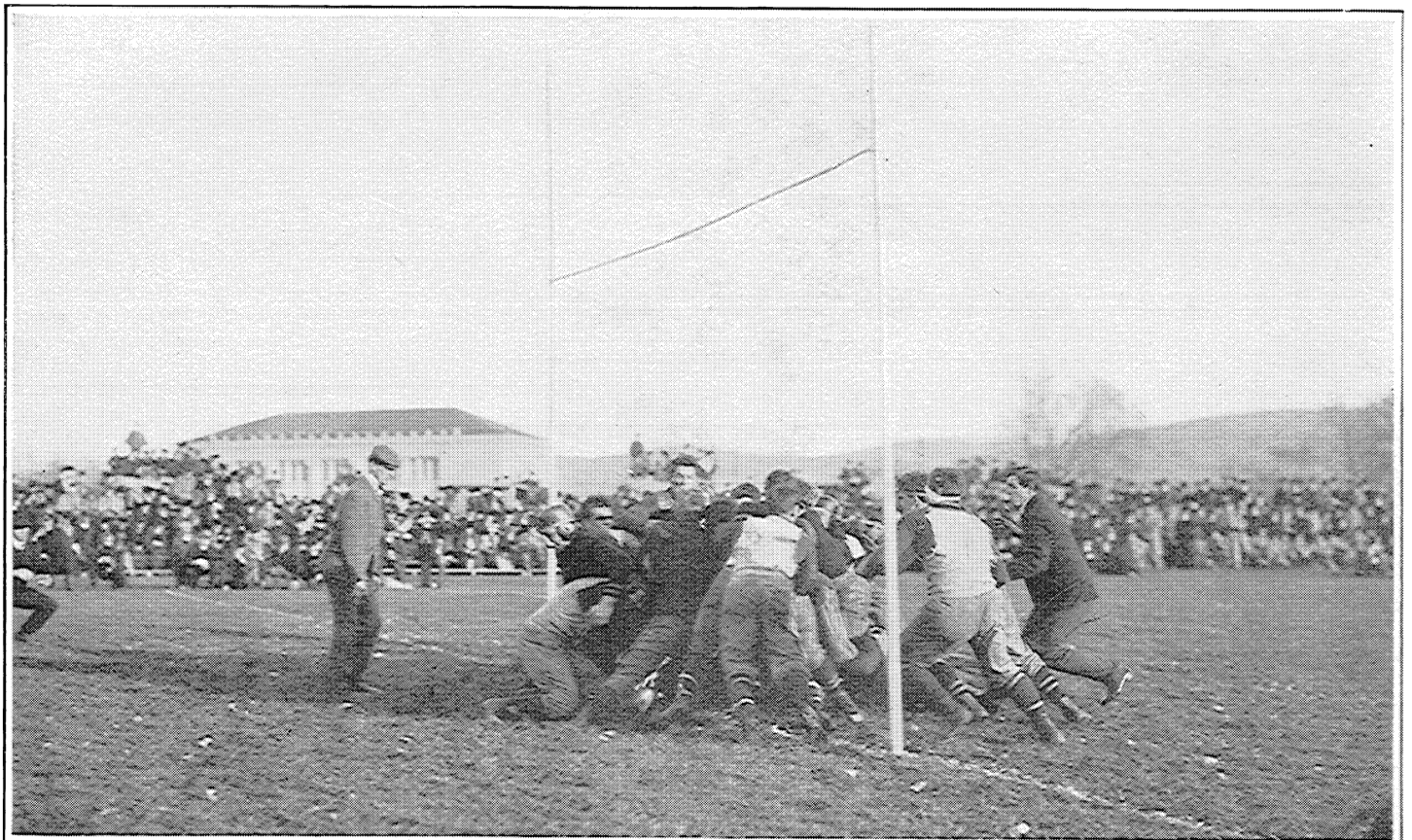
As has been stated before, dancing was one of the accomplishments recommended by Baron Steuben in his scheme for the organization of a Military Academy, but it was not recognized officially as a part of the regular training of cadets until about 1823.

In 1817, at the request of the cadets, the Academy's first sword master, Pierre Thomas, was permitted to organize a voluntary dancing class, and this class was continued until about 1823, when instruction in dancing was made compulsory. A famous master from Boston—Papanti—was engaged to instruct cadets during their summer encampment, an arrangement which has remained unchanged to the present day.

The inaccessibility of West Point, owing to the meager transportation facilities and the fact that society dancing was an accomplishment not at all common with a people who had sterner duties to perform in the development of a young nation, put the possibilities of hops in which ladies participated out of the question. As a result, cadets were compelled to practice dancing among themselves. The company streets were converted into hop rooms where impromptu country dances were instituted.

Many well-known instructors of dancing were connected with the Academy for longer or shorter periods since dancing has been recognized. The one to whom most credit is due, however, is Mr. L. W. Vizay, who occupied the position of teacher of dancing for a period of twenty years, when he resigned in favor of his son, R. W. Vizay, the present instructor.

So far as can be discovered, dancing instruction has always been confined to members of the third and fourth classes, the first class instruction being voluntary. Lessons are given daily, their duration being three-quarters of an hour, the period of instruction extending from July 4 to August 28.



WEST POINT VS. YALE, 1902.

ATHLETIC SPORTS AT THE U. S. MILITARY ACADEMY, 1840-1902.

By Captain RICHMOND P. DAVIS,

Artillery Corps, U. S. Army—United States Military Academy, 1887.

The whole test of the worth of any sport should be the demand that sport makes upon those qualities which in their sum we call manliness.—*Roosevelt.*

THOUGH the Military Academy has just completed the first century of its history, it is only during the last decade that the Cadets have indulged to a considerable degree in any form of athletics. From modest beginnings in 1890 our athletic development has been so rapid that to-day the cadet teams are in the first rank of excellence, and in the ethics of sport occupy a position second to none. These results are but the natural outcome of conditions at the Academy, for the basic principles upon which the success of the institution mainly depends became the determining cause in our athletic development.

It has been my good fortune to have been intimately connected with athletics at the Military Academy since 1891, and from visiting teams I have uniform expressions to the effect that games with the cadets are always looked forward to as fair, manly, and clear-cut types of sport for sport's sake.

From the very beginning of organized sport the directors of athletics have had fair play as the watchword, and effort has been made to instil into the members of each and every team the fine sentiment of the following quotation:

Who misses or who wins the prize
Go lose or conquer, as you can;
But if you fail, or if you rise,
Be each, pray God, a gentleman.

Appreciating thoroughly the maxim "mens sana in corpore sano," and realizing the value of athletic games in accomplishing this, it is hard to explain the tardy development of athletics at the Military Academy.

For the last hundred years Cadets have been drawn from the same walks of life, and innately the American boy of fifty years ago was the same as the American boy of to-day—full of life and action and only too prone to spend in outdoor games time that should be devoted to work.

A full appreciation of this latter characteristic no doubt was largely instrumental in causing the early controllers of our destiny to so hamper any attempts at athletic games with rules, regulations, and restrictions as to cause a natural death, but so it was until the beginning of the last decade. Why it was so is hard to comprehend, for every movement of a cadet is so regulated that excess is impossible, and the proper balance between work and play a matter of easy adjustment by anyone who appreciates that old saying: "All work and no play makes Jack a dull boy."

Certain spasmodic attempts at various athletic games during the years before 1890 illustrate the desire of the cadets for outdoor amusement, and the prompt withering in each case of the athletic sprout well illustrates the impossibility of athletic development under the then existing conditions. The year 1890, however, marks the dividing line between the unrecorded and recorded periods of our athletic history.

There were present at the centennial in June, 1902, graduates dating back to 1842, and an unusual opportunity was thus offered to learn what was done in athletics at the Academy during the last fifty years of the unrecorded period.

The usual answer to my first query was to the effect that athletics amounted to nothing, and in many cases was accompanied by a shrug of the shoulders which, being interpreted, meant: "I do not approve of the modern conditions." The facts are the academic courses are more extended now than formerly, and yet we have time for athletics without infringing upon the Academy work.

As compared to the present, athletics in the early days truly amounted to nothing, but back in the forties we find evidence of the athletic spirit in spasmodic attempts at sport with a round football; lines were drawn, sides chosen, and the ball kicked all over the field, and the side won which succeeded in kicking the ball across the opponents' line. In the

words of one of our retired officers, "There was in the game not much science but lots of exercise." This sport at frequent intervals extended over a number of years.

About 1850 there was a little cricket, but it seems to have taken no hold. Shortly after this a poorly equipped gynasium was prepared in the end of the old riding hall under the Academy Building; with slight extensions this gymnasium was used until 1893, when the present one was completed. Prior to 1890 gymnastic exercise and training can not be considered as having been an important factor in the duties or pleasures of Cadets.

Between 1860 and 1870 there was a little town ball and slight symptoms of baseball, but no regular games. Just after the civil war considerable interest was manifested in boating, especially about 1868–1870, and at one time it seemed probable that organization in athletics such as now exists might be a possibility. The various classes subscribed for boats, class contests were authorized, and Cadets were allowed to row upon the river during recreation hours. Unfortunately, early in the seventies, some one took undue advantage of the permission, and, instead of disciplining the individuals concerned, there was a sweeping interdiction of the rowing privileges, and what might have been the beginning of organized athletics received a death blow.

Exercise with a round football in the manner of the earlier days, spasmodic efforts at baseball, if a bat and ball could be procured on a Saturday afternoon, and tennis under conditions prohibiting even an approximation to excellence were found during the last fifteen years of the unrecorded period. These were games in dress coats, as under no circumstances could a cadet appear in any other dress beyond the confines of the area. Such were the conditions more than ten years after regularly organized sport had become an important factor in eastern university life.

Baseball being a game familiar to nearly every boy, the implements to play it being few and inexpensive, and classes being natural rivals, it is in class baseball contests that organized athletic games naturally found their beginning.

An old score book of a series of baseball games between

the classes of 1891 and 1893 furnishes the first authentic record of our recorded athletic history. There was thus in 1890 the beginning of active athletics at the U. S. Military Academy; at last the dormant athletic spirit was to have a chance, but only after it was well developed at most of the progressive institutions of learning.

A full recognition at this time by the authorities of the real value of the gymnastic part of the course of instruction had resulted in obtaining an appropriation for a new and well-equipped gymnasium. The importance and value of gymnastic instruction carried with it a realization of the great benefits to be derived from athletic sports, which would give both exercise and diversion during recreation hours.

It was but a step from organized class games to match games with outside teams, and we find that the following euphonious aggregations of players tried conclusions with the Cadets in the summer of 1890, viz: The "Merriams," of Philadelphia; "Sylvans," of New York, and "Atlantics," of Governors Island.

The cadets won two of the games and the other was a tie. These games were not scientific exhibitions but they are of great interest as they were the foundation for an athletic career which has not only been of vast benefit to the individuals who have taken part in the games, but has added vastly to the prestige of the Military Academy.

The interest elicited by the games was shortly increased to full intensity by a challenge from the cadets at the Naval School to play a game of football. This challenge came toward the end of October, and though few of our men knew the shape, intention, or purpose of a football, Michie and Prince organized a team and the game was arranged for November 29, 1890. On that auspicious date we met the enemy and became theirs by a score of 24 to 0.

We had only two men who had ever handled a football, and several who had never seen one. But little, save pluck, could have been expected of our team; there was plenty of pluck, but it was only half the fight. Our men lost manfully, and there was burnt into their souls a determination

which was to mean much in our athletic development. Both officers and cadets were from that day bent upon retrieving the disaster, and unusual effort was devoted to developing a team the following year.

The game was played on the field that we use to-day, in the southeast corner of the grass plain, the only spectators being the officers and cadets of the post, with a few (hardly a hundred) visitors from a distance.

What a contrast with to-day's Army and Navy game, for for which 28,000 tickets are distributed with 28,000 additional people clamoring for tickets that can not be supplied, and at which there is exhibition of scientific football which ranks with that of Harvard and Yale. Such has been the change in twelve years, and it indeed speaks volumes for our system.

The baseball in 1891 consisted of some class games and two games with the Manhattan Athletic Club. The football was somewhat more extended, but very meager as compared with that of to-day. Games were played at the Academy with the following teams: Rutgers, Tufts, Stevens Institute, Fordham, and Princeton Second. Of these Rutgers was the only victory, but some of the other games were hard fought. On November 28 our team met the Naval Cadets at Annapolis and signally retrieved the defeat of the previous year by the score of 32 to 16. Michie (class '92) was captain of the Military Academy team, and deserved the great credit which was accorded him both as a player and captain. H. H. Williams, of Yale, who has been of vast service in our athletics, came down from Newburgh occasionally and coached the team; he was also a very important factor in our second very signal victory over Annapolis, namely, in 1899, when the score was 17 to 5. All of us who are interested in Academy athletics are much indebted to this our pioneer coach who launched us upon the Yale system of play, to which we have adhered to this day. The funds for this year were contributed by the cadets and a few officers on the post. The games were little talked of generally, and some of the officers who reported for duty in September did not even know that there were to be games until after the first one was played; but the players

and those actually in contact with the team had all season been using their best endeavors to have a team to retrieve the defeat of the year before, and they were amply rewarded.

Defeat stimulates in a way and likewise victory; after the Annapolis game more general interest was manifested. Officers and cadets began to realize that old Alma Mater had really branched out in a new field. As a consequence more and better baseball and football games were arranged for 1892. The results of the year were not, however, as good as desired; we were not able to obtain satisfactory football coaches, and our season closed disastrously with a defeat by the Navy, the score being 12 to 4. Increasing interest and observation of this season showed the great need of organization for control and support of athletics to obtain the best results; the outcome was the formation of the Army Officers' Athletic Association to encourage athletics at the Military Academy and throughout the Army, and of the U. S. Military Academy Athletic Association for the direct control of the Academy teams. Time has proven the great value of these organizations without which our athletic success would simply have been impossible. The Army Officers' Athletic Association was organized with the usual officers of such organizations and representatives for the following sports: Football, baseball, tennis, and general athletics, the duties of each representative being to supervise and encourage his particular sport.

One of the first results of the formation of the associations was the organization of track teams, so that in 1893, in addition to baseball and football games, there were track events. The first field day was held on April 18, each class being represented by a team of five men.

The events and winners were:

Event.	Winner.	Year.
100-yard dash	Timberlake	1893
120-yard hurdle race [a]	Timberlake	1893
	Hinkley	1896
Putting 16-pound shot	Dallam	1896
Running high jump	Timberlake	1893
Standing broad jump	Hinkley	1896
Standing hop, step, and jump	Sturtevant	1894
220-yard hurdle race	Hinkley	1896
Standing high jump	do	1896
Running broad jump	Timberlake	1893
Pole vault	Hyer	1893
440-yard race	Reisinger	1896

[a] Dead heat.

The class of 1896 won the meet and was awarded a banner, which, with the banners for succeeding years, is hanging in the gymnasium.

The baseball team won three and lost two of its scheduled games, but none of the teams were especially good ones and we can not pride ourselves on the season's results. The football plans were much more ambitious than before. Systematic training and coaching were introduced and the schedule included games with Yale, Princeton, and the Naval Cadets, in addition to those with minor college teams. We were sadly beaten by both Yale and Princeton and lost to Annapolis by a score of 4 to 6.

It was not to be expected that much of a showing would be made against the teams of Yale and Princeton, but a great step in advance was made when we were able to arrange games with them at all. This first Yale game was the beginning of a fast friendship with Yale, which has resulted in a yearly game with the Blue which attracts to our grounds more people than does any other. There seems to be something of a fatality about our playing against Yale, our best game of the season; even in years when we were badly beaten by Harvard and Princeton, we have ordinarily made a good showing against Yale. The following series of scores with her are interesting: 0 to 28; 5 to 12; 8 to 28; 2 to 16; 6 to 6; 0 to 10; 0 to 24; 0 to 18; 5 to 5; 6 to 6. The score of 5 to 12 above is for 1894, which shows that we had a good team that

year. This game and a loss to Brown at 0 to 10 were our two important games. This year marks two events, one fortunate and one unfortunate; the former was securing Mr. Harmon S. Graves, of Yale, as our coach, who has been a most prominent figure in our rapid athletic development. We now fully embarked upon the Yale system of play and have clung tenaciously to it ever since. The second event was the interdiction at Washington upon the recommendation of Colonel Ernst, Superintendent of the Academy, of the game with the Naval Cadets. Football, which may be considered the spinal column of all athletics, thus received a blow which we feared might permanently impair our athletic development, but it only suspended it temporarily.

There is no doubt that a strong desire existed then and still exists on our part to meet the Naval Cadets in athletic contests. They are our natural rivals. The Military and Naval academies are on a different basis from all other institutions of learning, and are therefore usually considered and thought of in a classs by themselves.

The effect of the order was not as bad as it might have been, as there always lingered a hope and belief that the annual championship game would again be authorized; furthermore there was a possibility of arranging yearly games with Yale and Harvard, which would give the necessary stimulus to arouse the cadets to their best efforts. So while regretting the loss of a championship game, we yet pushed ahead with a determination to attain greater success on the athletic fields and rise to a recognized place among the leaders of athletic sports. Eighteen hundred and ninety-four was a disastrous baseball year; we met comparatively weak teams and won only one game. The limited time of the cadets will never permit us to attain that excellence in this sport and track athletics that we do in football. In fact until 1901 our baseball was very mediocre in character; at times there was a good game, but this was the exception and not the rule.

The field day was held in June in 1894 and one day during graduation week has been regularly set aside for it. The events were nearly the same as in preceding years and again

the banner was won by '96, which seemed to have an invincible combination.

After the football game with the Naval Cadets was stopped, the game with Brown University became one of the principal objectives, as it was the last of the season. The important games of the schedule for 1895 were those with Yale, Harvard, and Brown. This year is noteworthy for the first appearance of a Harvard team on our field and a good game we had with a score of 4 to 0 in Harvard's favor the second week in October. This was the beginning of a very interesting series of games which has been interrupted only by a failure to arrange a game in 1896. Finding that our athletics were supported entirely by voluntary subscriptions of officers and Cadets and their friends, Harvard insisted upon paying all her own expenses, and has done so whenever she visits us. Her lead has been followed by the teams from the other great universities, and our games therefore are typical sporting events of the college world. The score with Yale this year was bad, 8 to 28, but the season closed with a magnificent victory over Brown, the score being 26 to 0.

The season's record entitled us to a place at the head of the second-class teams. There was still, it is true, a considerable gap between the "Big Four" (Yale, Pennsylvania, Princeton, and Harvard), but it was much smaller than it had ever been before. King and Nolan of this year's team were among the best players in the country.

A slight falling off in excellence is to be noted in the football team of 1896, the important scores being 2 to 16, 0 to 11, and 8 to 6, with Yale, Princeton, and Brown, respectively. A noteworthy incident is the introduction this year of an indoor meet for gymnastic events in which 25 per cent of the entire corps took part. Similar meets have been held yearly since that date, and are always of great interest.

The class of 1897 won the banner for the field day, in June, and thus wrested the championship from the record-breaking athletic class of 1896.

In 1897 we had a football team second to none. The scores with Yale and Harvard were 6 to 6 and 0 to 10, while Brown, though she had famous halves, Gammons and Fultz, was

overwhelmed by a score of 42 to 0. This is the last time that a Brown team has visited us, and on this occasion came up expecting to win.

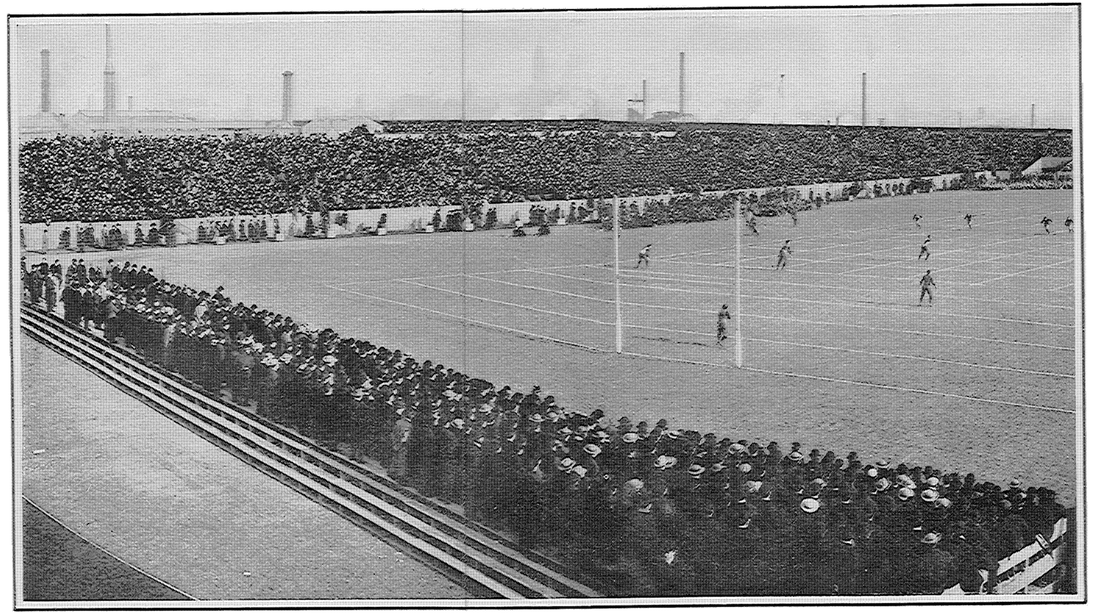
A departure in our coaching methods is to be noted. We embarked this year upon the graduate system of coaching, with Mr. Koehler as head coach. This system has worked satisfactorily and is still in vogue. It has been the custom to supplement the graduates' work with the best recognized talent from the great universities with the most beneficial results.

The absence of Brown from the football schedule of 1898 caused the season to close much earlier than usual. Harvard slaughtered us with a score of 28 to 0; the Yale game was fair with a score of 10 to 0, and the season closed splendidly with the Princeton game; it was a tie, the score being 5 to 5, and was played on November 5, just about the time that our team should really begin to develop well.

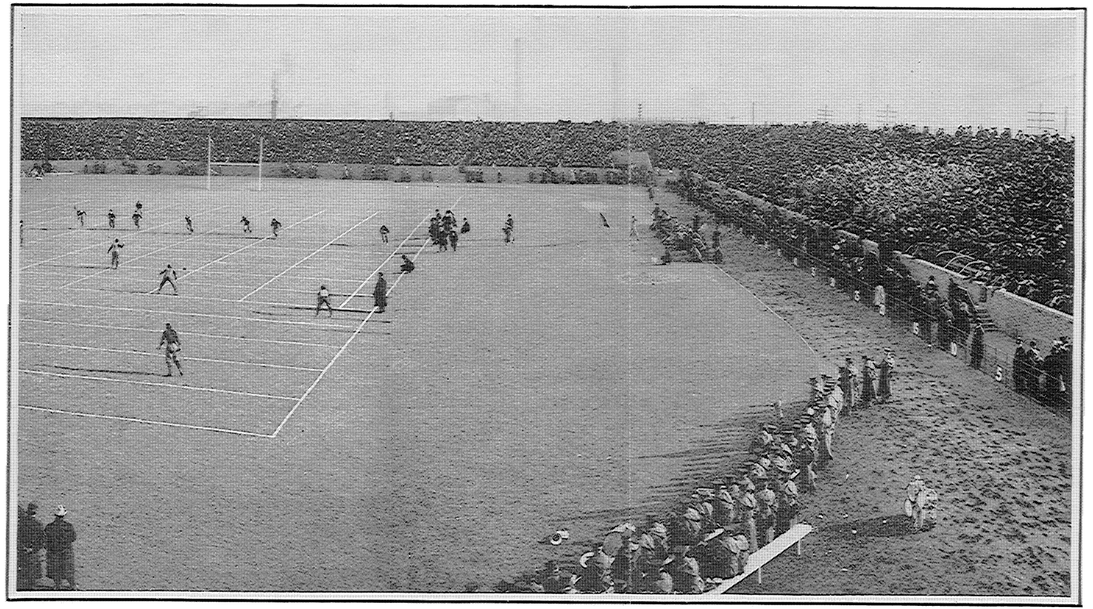
Six new records were established at the indoor meet and three for the field events in June. The class of 1899 won the field day banner.

Eighteen hundred and ninety-nine marks a new period, for in this year we renewed athletic relations with the Naval Cadets. Through the kind offices of Dr. J. William White, a member of our Board of Visitors, a game was arranged to be played on the grounds of the University of Pennsylvania as the guests of that great Institution. Ideal hosts they made, and the game was, from our standpoint at least, a great success, for we simply outclassed our opponents at every point, winning by the score of 17 to 5. Our football season was a failure up to the last game. We had an end and center left from the previous year which was not a very strong foundation to build upon. We were badly beaten by Harvard, Yale, and Princeton, but redeemed ourselves by the great victory over the Navy team, which has been heralded as the best that the Naval Academy had ever produced.

Colonel Robert M. Thompson, a graduate of the Naval Academy, and Major Theodore K. Gibbs, a civil war veteran, offered a cup to be held by the winners of the Army and Navy game until teams of either institution should have won it three



FOOTBALL GAME, NOVEMBER 28, 1903, AT PHILADELPHIA. WEST POINT VS. ANNAPOLIS.



FOOTBALL GAME, NOVEMBER 28, 1903, AT PHILADELPHIA. WEST POINT VS. ANNAPOLIS.

times, when it was to become the permanent property of the Academy represented by the winning team. By our fine victory we held the trophy for the first year, but hopes of three successive victories were badly shattered in 1900, for we lost to the Navy at Franklin Field by a score of 7 to 11. The sting of this defeat was, however, somewhat tempered by a victory in a baseball game with the Naval Cadets on May 18, 1901, at the Naval Academy. This was the first year that scientific exhibitions in this sport were given by our team. The Lehigh and Seventh Regiment teams were the only ones in a list of nine who won from our cadets during the season.

Nineteen hundred and one was a red-letter year in our football history. The cadets not only played the teams of the "Big Four," but tied Yale and Princeton, won handsomely from Pennsylvania, and lost to Harvard by a single score in the last minute of play, and won from the best team the Naval Academy has ever produced. No team of any other institution has ever done as much in any year; it may be that there have been teams which could have done it, but the history of it is that none have. With the record of our team up to its Navy game, every one went to the field expecting the latter to be outclassed; but it was not so, and we won only after the hardest kind of a fight. The quality of the ball was first class in every particular and the game redounded greatly to the credit of the Academies. The President of the United States, members of his Cabinet, and other distinguished Government officials were present, in addition to many generals, admirals, the faculties of the University of Pennsylvania and of the Military and Naval Academies.

The usual indoor meet was held, but there was no field day. This year's record gave us a position in the "Big Four" with Harvard, Yale, and Princeton.

In 1902 we find greater diversity of sports than in any previous year, viz, polo, golf, tennis, fencing, track events, baseball, and football.

The athletic season began with fencing tournaments. Our team met teams from Yale, Harvard, Pennsylvania, Columbia, and Cornell without losing a single match. It then went to the intercollegiate meet at the New York

Athletic Club, and won the team match by a large margin and tied representatives from Columbia and Annapolis for the best individual score. As this was our first year in competitive fencing the record was phenomenal.

The indoor meet was very successful, and was followed by a baseball season which did not reach its promise. For the first time in our history teams from Yale and Harvard played here, but outclassed us, and we lost to Annapolis by a score of 5 to 3. The Yale game was played during centennial week, in the presence of the greatest number of alumni that has ever assembled, but it was, from our point of view, a disappointment.

A few days later came the track events. The Class of 1904 won the banner, and the winners in the various events are given below, as this was the centennial meet:

Event.	Winner.	Class.
100-yard dash	Hammond, J. S.	1905
220-yard dash	do	1905
440-yard run	Stillwell	1904
120-yard hurdle	Daly, C. D	1905
Hammer throw	Bunker	1903
Putting shot	do	1903
Pole vault	Wilson, A. H Dillon	1904
Running high jump	Carrithers Anderson, W. D. A.	1903 1904
Running broad jump	Daly, C. D	1905
Relay race	Classes 1903 and 1905.	.....

The Field-day banner was won by the class of 1905.

The football season of 1902 was characterized by the best team we have ever produced. We more than sustained our position as a member of the "big four," and administered to the midshipmen a most crushing defeat at Franklin Field on November 29. The important scores of the season were 6 to 14, 6 to 6, 46 to 0, 22 to 8, with Harvard, Yale, Syracuse, and midshipmen.

During the last ten years some tennis has been played, but no great degree of excellence has been attained by the Cadets.

A golf course was laid out in 1894, extending across the

plain into Fort Clinton and below Trophy Point, but not until 1897 did Cadets take any interest in the game. To-day many of them may be seen upon the course during recreation hours.

Polo is the last game which has been introduced, and rapid progress has been made, but the conditions are such that a great degree of skill can not be acquired.

Through the efforts of General A. L. Mills, the Superintendent, and Colonel Charles G. Treat, the Commandant, some ponies were furnished by the Government, and both officers and cadets constantly play on the flats, where a field has been laid out. Two match games of polo were played this year with Squadron A, National Guard, State of New York, but our men were not allowed the handicaps usual in such games between members of the Polo Association, and, as was to be expected, lost both games by a considerable margin.

Captains Cassatt and Howze really introduced the game a few years ago, but no progress was made, as they tried to play with cavalry horses on the cavalry plain.

Black and gray were adopted as the Academy colors by the Cadet Athletic Association, but were changed in 1898 to black, gold, and gray. These make a very good combination and have since been officially recognized in the Cadet Corps flag, and have also been adopted by the Association of Graduates.

Cadets who distinguished themselves in athletics are entitled to wear a large gray A (for Army). The privilege of wearing the A is restricted to those who play on the Academy teams against three visiting teams in one season or one Naval Academy team, who have broken an Academy record at one of the regular field days, or who have won the prizes for the best athlete and all-around gymnast at an indoor meet.

Those members of our football teams who have been recognized among the foremost players of their time are: Nolan ('96), King ('96), Nesbitt ('93), Scales ('98), Kromer ('99), Romeyn ('99), Smith, W. D. ('01), Boyers ('02), Bunker ('03), Farnsworth ('04), Graves ('05), Daly ('05), Torney ('06). We, of course, have had many other fine players, but those given

above have been recognized as members or substitutes on what is known in the athletic world as the All-American Team.

The data below give the field records, and the scores of the two polo games, of the four important baseball games, of the fencing tournaments, and of the football games.

FIELD RECORDS.

	Seconds.
100-yard dash	$10\frac{1}{5}$
220-yard dash	$22\frac{4}{5}$
120-yard hurdle	$16\frac{3}{4}$
440-yard run	$52\frac{1}{5}$

	Ft.	in.
Running broad jump	21	7
Running high jump	5	$7\frac{3}{4}$
Standing broad jump	9	$11\frac{3}{4}$
Pole vault	10	9
Hammer throw	96	10
Putting shot	37	$11\frac{3}{4}$

POLO.

First game—U. S. Military Academy, $2\frac{1}{2}$; Squadron A, National Guard, State of New York, $9\frac{1}{2}$.

Second game—U. S. Military Academy, 3; Squadron A, National Guard, State of New York, 10.

FENCING.

At West Point, 1902.—U. S. Military Academy, 6; Columbia, 3. U. S. Military Academy, 6; Cornell, 3. U. S. Military Academy, 9; Harvard, 0. U. S. Military Academy, 7; Pennsylvania University, 2. U. S. Military Academy, 4; Yale, 2.

At New York Athletic Club, 1902.—Teams from Columbia, Cornell, Harvard, Naval Academy, University of Pennsylvania, U. S. Military Academy, and Yale were represented at the Intercollegiate Fencing Tournament.

	Percentage.
U. S. Military Academy	0.741
Columbia	.646
U. S. Naval Academy	.629
Cornell	.593
Harvard	.482
Yale	.288
Pennsylvania	.149

BASEBALL.

1901.—U. S. Military Academy, 4; Naval Academy, 3.

1902.—U. S. Military Academy, 3; Naval Academy, 5; U. S. Military Academy, 4; Harvard, 14. U. S. Military Academy, 4; Yale, 15.

Football scores.

	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	Total.
U. S. Military Academy				12	18									30
Amherst				4	0									4
U. S. Military Academy					42									42
Boston Institute					0									0
U. S. Military Academy					0	26	8	42						76
Brown					10	0	6	0						16
U. S. Military Academy											18			18
Bucknell											10			10
U. S. Military Academy										0				0
Columbia										16				16
U. S. Military Academy						6				6				12
Dartmouth						0				2				2
U. S. Military Academy													11	11
Dickinson													0	0
U. S. Military Academy		10								24				34
Fordham		4								0				4
U. S. Military Academy												20		20
Franklin and Marshall												0		0
U. S. Military Academy											11			11
Hamilton											0			0
U. S. Military Academy						0		0	0	0	0	0	6	6
Harvard						4		10	28	18	29	6	6	101
U. S. Military Academy				36										36
Lafayette				0										0
U. S. Military Academy				0				48	18					66
Lehigh				18				6	0					24
U. S. Military Academy	0	32	4	4						17	7	11	22	97
U. S. Naval Academy	24	16	12	6						5	11	5	8	87
U. S. Military Academy												24		24
Pennsylvania University												0		0
U. S. Military Academy										0	0			0
Pennsylvania State										6	0			6
U. S. Military Academy				4			0		5	0		6		15
Princeton				36			11		5	23		6		81
U. S. Military Academy		12	14											26
Princeton, second		12	0											12
U. S. Military Academy		(?) 6												(?) 6
Rutgers		(?)16												(?)16
U. S. Military Academy		14	42											56
Stevens		12	0											12
U. S. Military Academy										12			46	58
Syracuse										6			0	6
U. S. Military Academy		16												16
Siglars		6												6
U. S. Military Academy			24	18		50		38			28	17		175
Trinity			0	11		0		6			0	0		17
U. S. Military Academy		6				35	27	30	40	22			5	165
Tufts		27				0	0	0	0	0			0	27

Football scores—Continued.

	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1898.	1900.	1901.	1902.	Total.
U. S. Military Academy	.....	.....	.....	6	30	16	44	.....	.....	.....	.....	.....	56	152
Union	.....	.....	.....	0	0	0	0	.....	.....	.....	.....	.....	0	0
U. S. Military Academy	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
Volunteers	.....	.....	.....	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
U. S. Military Academy	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	15	28	49
Williams	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	0	0	0
U. S. Military Academy	.....	.....	6	.....	.....	.....	12	12	27	.....	.....	.....	.....	57
Wesleyan	.....	.....	6	.....	.....	.....	12	9	8	.....	.....	.....	.....	35
U. S. Military Academy	.....	.....	.....	0	5	8	2	6	0	0	0	5	6	32
Yale	.....	.....	.....	28	12	28	16	6	10	24	18	5	6	153
U.S. Military Academy	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,294
Opponents	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	641

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