Military Schools

AND

COURSES OF INSTRUCTION

IN THE

SCIENCE AND ART OF WAR,

IN

FRANCE, PRUSSIA, AUSTRIA, RUSSIA, SWEDEN, SWITZERLAND, SARDINIA, ENGLAND, AND THE UNITED STATES.

DRAWN FROM RECENT OFFICIAL REPORTS AND DOCUMENTS.

By HENRY BARNARD, LL. D.

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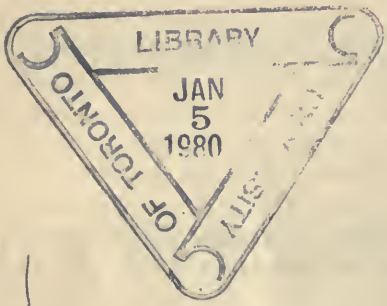


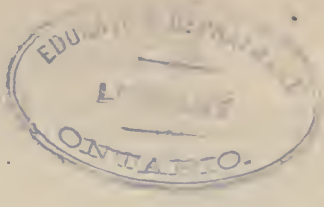
REVISED EDITION.

The first edition of Military Schools in France and Prussia was issued in 1862, as a number of the American Journal of Education; and subsequently in the same year this portion was printed as Part I. of a comprehensive survey of the whole field of Instruction in the Science and Art of War in different countries. The circumstances under which the publication was begun, are set forth in the Preface to the imperfect edition of 1862. Now that the survey in the serial chapters of the Journal is as complete as the material at the command of the Editor, and the space which he can give to this special subject enable him to make it, the several chapters have been revised and brought together in a single volume, to present the actual condition of this important department of national education in the principal states of Europe, as well as in our own country.

It is due to the late Col. Samuel Colt, the inventor of the Colt Revolver, and the founder of the Colt Patent Fire-Arms Factory—two enterprises which have changed the character and the mode of constructing fire-arms in every country—to state that the information contained in the first edition of this Treatise, was collected and prepared at his request, to assist him in maturing the plan of a School of Mechanical Engineering, which he proposed to establish on his estate at Hartford, and on which, after the breaking out of the War of Secession, he decided to engraft both military drill, and military history, and to give that scientific instruction which every graduate of our national Military and Naval Academies ought to possess. Soon after Col. Colt's death (Jan. 10, 1862), Mrs. Elizabeth Jarvis Colt, learning what had been done in the direction of her husband's wishes, authorized the use which has been made, of the material already collected, in the preparation of this treatise, and of the volume already published on Technical Schools in different countries, and of any more which might be collected and prepared at her expense, to illustrate any department of his plan of a scientific school at Hartford.

HENRY BARNARD.

Hartford, Conn., March, 1872.



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MILITARY SCHOOLS AND EDUCATION.

An account of the Military and Naval Schools of different countries, with special reference to the extension and improvement, among ourselves, of similar institutions and agencies, both national and state, for the special training of officers and men for the exigencies of war, was promised by the Editor in his original announcement of "*The American Journal and Library of Education.*" Believing that the best preparation for professional and official service of any kind, either of peace or war, is to be made in the thorough culture of all manly qualities, and that all special schools should rest on the basis, and rise naturally out of a general system of education for the whole community, we devoted our first efforts to the fullest exposition of the best principles and methods of elementary instruction, and to improvements in the organization, teaching, and discipline of schools, of different grades, but all designed to give a proportionate culture of all the faculties. We have from time to time introduced the subject of Scientific Schools—or of institutions in which the principles of mathematics, mechanics, physics, and chemistry are thoroughly mastered, and their applications to the more common as well as higher arts of construction, machinery, manufactures, and agriculture, are experimentally taught. In this kind of instruction must we look for the special training of our engineers, both civil and military; and schools of this kind established in every state, should turn out every year a certain number of candidates of suitable age to compete freely in open examinations for admission to a great National School, like the Polytechnic at Paris, or the purely scientific course of the Military Academy at West Point, and then after two years of severe study, and having been found qualified by repeated examinations, semi-annual and final, by a board composed, not of honorary visitors, but of experts in each science, should pass to schools of application or training for the special service for which they have a natural aptitude and particular preparation.

The terrible realities of our present situation as a people—the fact that within a period of twelve months a million of able bodied men have been summoned to arms from the peaceful occupations of the office, the shop, and the field, and are now in hostile array, or in actual conflict, within the limits of the United States, and the no less alarming aspect of the future, arising not only from the delicate position of our own relations with foreign governments, but from the armed interference of the great Military Powers of Europe in the internal affairs of a neighboring republic, have brought up the subject of Military Schools, and Military Education, for consideration and action with an urgency which admits of no delay. Something must and will be done at once. And in reply to numerous letters for information and suggestions, and to enable those who are urging the National, State or Municipal authorities to provide additional facilities for military instruction, or who may propose to establish schools, or engraft on existing schools exercises for this purpose,—to profit by the experience of our own and other countries, in the work of training officers and men for the Art of War, we shall bring together into a single volume, "*Papers on Military Education,*" which it was our intention to publish in successive numbers of the New Series of the "*American Journal of Education.*"

This volume, as will be seen by the Contents, presents a most comprehensive survey of the Institutions and Courses of Instruction, which the chief nations of Europe have matured from their own experience, and the study of each other's improvements, to perfect their officers for every department of military and naval service which the exigences of modern warfare require, and at the same time, furnishes valuable hints for the final organization of our entire military establishments, both national and state.

We shall publish in the Part devoted to the United States, an account of the Military Academy at West Point, the Naval Academy at Newport, and other Institutions and Agencies,—State, Associated, and Individual, for Military instruction, now in existence in this country, together with several communications and suggestions which we have received in advocacy of Military Drill and Gymnastic exercises in Schools. We do not object to a moderate amount of this Drill and these exercises, properly regulated as to time and amount, and given by competent teachers. There is much of great practical value in the military element, in respect both to physical training, and moral and mental discipline. But we do not believe in the physical degeneracy, or the lack of military aptitude and spirit of the American people—at least to the extent asserted to exist by many writers on the subject. And we do not believe that any amount of juvenile military drill, any organization of cadet-corps, any amount of rifle or musket practice, or target shooting, valuable as these are, will be an adequate substitute for the severe scientific study, or the special training which a well organized system of military institutions provides for the training of officers both for the army and navy.

Our old and abiding reliance for industrial progress, social well being, internal peace, and security from foreign aggression rests on:—

I. The better Elementary education of the whole people—through better homes and better schools—through homes, such as Christianity establishes and recognizes, and schools, common because cheap enough for the poorest, and good enough for the best,—made better by a more intelligent public conviction of their necessity, and a more general knowledge among adults of the most direct modes of effecting their improvement, and by the joint action of more intelligent parents, better qualified teachers, and more faithful school officers. This first great point must be secured by the more vigorous prosecution of all the agencies and measures now employed for the advancement of public schools, and a more general appreciation of the enormous amount of stolid ignorance and half education, or mis-education which now prevails, even in states where the most attention has been paid to popular education.

II. The establishment of a System of Public High Schools in every state—far more complete than exists at this time, based on the system of Elementary Schools, into which candidates shall gain admission only after having been found qualified in certain studies by an open examination. The studies of this class of schools should be preparatory both in literature and science for what is now the College Course, and for what is now also the requirements in mathematics in the Second Year's Course at the Military Academy at West Point.

III. A system of Special Schools, either in connection with existing Colleges, or on an independent basis, in which the principles of science shall be taught with special reference to their applications to the Arts of Peace and War. Foremost in this class should stand a National School of Science, organized and conducted on the plan of the Polytechnic School of France, and preparatory to Special Military and Naval Schools.

IV. The Appointment to vacancies, in all higher Public Schools, either among teachers or pupils, and in all departments of the Public Service by Open Competitive Examination.

HENRY BARNARD.

HARTFORD, CONN., 1862.

PART I

MILITARY SYSTEM AND SCHOOLS IN FRANCE.

AUTHORITIES.

The following account of the System of Military Education in France, except in the case of three or four schools, where credit is given to other authorities, is taken from an English Document entitled "*Report of the Commissioners appointed* (by the Secretary of War) *to consider the best mode of reorganizing the system of Training Officers for the Scientific Corps: together with an Account of Foreign and other Military Education.*" Reference has been had, especially in the Programmes and Courses of Instruction to the original authorities referred to by the Commissioners.

I. General Military Organizaton of France.
Vauchelle's Course d' Administration Militaire, 3 vols.

II. The Polytechnic.
1. Fourcy's Histoire de l'Ecole Polytechnique.
2. Décret portant l'Organisation, &c.
3. Règlement pour le Service Interieur.
4. Programme de l'Enseignement Interieur.
5. Programme des Connaissances Exigées pour Admission, &c.
6. Rapport de la Commission Mixte, 1850.
7. Répertoire de l'Ecole Polytechnique; by M. Marielle.
8. Calenders from 1833.
9. Pamphlets—by M. le Marquis de Chambray, 1836; by V. D. Bugnot, 1837; by M. Arago, 1853.

III. School of Application at Metz, and St. Cyr.
Décret Impérial, &c., 1854.

IV. School for the Staff at Paris.
Manuel Réglementaire a l' Usage, &c.

V. Annuaire de l'Instruction Publique, 1860.

MILITARY SYSTEM AND SCHOOLS OF FRANCE.

I. MILITARY SYSTEM.

The French armies are composed of soldiers levied by yearly conscription for a service of seven years. Substitutes are allowed, but in accordance with a recent alteration, they are selected by the state. Private arrangements are no longer permitted; a fixed sum is paid over to the authorities, and the choice of the substitutes made by them.

The troops are officered partly from the military schools and partly by promotion from the ranks. The proportions are established by law. One-third of the commissions are reserved for the military schools, and one-third left for the promotion from the ranks. The disposal of the remaining third part is left to the Emperor.

The promotion is partly by seniority and partly by selection.

The following regulations exist as to the length of service in each rank before promotion can be given, during a period of peace:—

A second Lieutenant can not be promoted to	Lieutenant	under	2	years'	service.	
A Lieutenant	"	"	Captain	"	2	"
A Captain	"	"	Major	"	4	"
A Major	"	"	Lieut-Col.	"	3	"
A Lieutenant-Colonel	"	"	Colonel	"	2	"

But in time of war these regulations are not in force.

Up to the rank of captain, two-thirds of the promotion takes place according to seniority, and the other one-third by selection.

From the rank of captain to that of major (*chef de bataillon ou d'escadron*) half of the promotion is by seniority and the other half by selection, and from major upwards, it is entirely by selection.

The steps which lead to the selection are as follows:—The general officers appointed by the minister at war to make the annual inspections of the several divisions of the army of France, who are called inspectors-general, as soon as they have completed their tours of inspection, return to Paris and assemble together for the purpose of comparing their notes respecting the officers they have each seen, and thus prepare a list arranged in the order in which they recommend that the selection for promotion should be made.

We were informed that the present minister of war almost invariably promoted the officers from the head of this list, or, in other words, followed the recommendation of the inspector-general.

II. MILITARY SCHOOLS.

The principal Military Schools at present existing in France are the following:—

1. The Polytechnic School at Paris (*Ecole Impériale Polytechnique,*) preparatory to—
2. The Artillery and Engineers School of Application at Metz (*Ecole Impériale d'Application de l'Artillerie et du Génie.*)
3. The Military School at St. Cyr (*Ecole Impériale Spéciale Militaire,*) for the Infantry and Cavalry, into which the Officers' Department of the Cavalry School at Saumur has lately been absorbed.
4. The Staff School at Paris (*Ecole Impériale d'Application d'Etat Major.*)
5. The Military Orphan School (*Prytanée Impériale Militaire*) at La Flèche.
6. The Medical School (*Ecole Impériale de Médicine et de Pharmacie Militaires*) recently established in connection with the Hospital of Val-de-Grâce.
7. The School of Musketry (*Ecole Normale de Tir*) at Vincennes, founded in 1842.
8. The Gymnastic School (*Ecole Normale de Gymnastique*) near Vincennes.
9. The Music School (*Gymnase Musical.*)
10. The Regimental Schools (*Ecoles Régimentaires.*)

The military schools are under the charge of the minister of war, with whom the authorities of the schools are in direct communication.

The expenses to the state of the military schools, including the pay of the military men who are employed in connection with them, for the year 1851, are as follows:—

For Polytechnic School at Paris,	*fr.*	554,911. 91
" Artillery and Engineers School at Metz,,		187,352. 06
" Infantry and Cavalry School at St. Cyr,		682,187. 35
" Cavalry School at Saumur,		196,170. 27
" Staff School at Paris,		145,349. 96
" Gymnastic School of Musketry at Vincennes,		33,211. 33
" Regimental Schools,		108,911½,30

From this sum, 2,224,542*fr.*, should be deducted 421,372*fr.* secured from paying pupils, leaving the total cost to the state to be 1,803,308*fr.*, or about $360,000, for about 2,100 pupils. The cost to the state for training an officer of Artillery and Engineers is about $1,500, and that of an officer of the Staff is about $1,400.

SUBJECTS AND METHODS OF INSTRUCTION

IN MATHEMATICS AS PRESCRIBED FOR ADMISSION TO THE POLYTECHNIC SCHOOL OF FRANCE.

"L'École Polytechnique" is too well known, by name at least, to need eulogy in this journal. Its course of instruction has long been famed for its completeness, precision, and adaptation to its intended objects. But this course had gradually lost somewhat of its symmetrical proportions by the introduction of some new subjects and the excessive development of others. The same defects had crept into the programme of the subjects of examination for admission to the school. Influenced by these considerations, the Legislative Assembly of France, by the law of June 5th, 1850, appointed a "*Commission*" to revise the programmes of admission and of internal instruction. The President of the Commission was Thenard, its "Reporter" was Le Verrier, and the other nine members were worthy to be their colleagues. They were charged to avoid the error of giving to young students, subjects and methods of instruction "too elevated, too abstract, and above their comprehension;" to see that the course prescribed should be "adapted, not merely to a few select spirits, but to average intelligences;" and to correct "the excessive development of the preparatory studies, which had gone far beyond the end desired."

The Commission, by M. Le Verrier, prepared an elaborate report of 440 quarto pages, only two hundred copies of which were printed, and these merely for the use of the authorities. A copy belonging to a deceased member of the Commission (the lamented Professor *Theodore Olivier*), having come into the hands of the present writer, he has thought that some valuable hints for our use in this country might be drawn from it, presenting as it does a precise and thorough course of mathematical instruction, adapted to any latitude, and arranged in the most perfect order by such competent authorities. He has accordingly here presented, in a condensed form, the opinions of the Commission on *the proper subjects for examination in mathematics, preparatory to admission to the Polytechnic School, and the best methods of teaching them.*

The subjects which will be discussed are Arithmetic; Geometry; Algebra; Trigonometry; Analytical Geometry; Descriptive Geometry.

I. ARITHMETIC.

A knowledge of Arithmetic is indispensable to every one. The merchant, the workman, the engineer, all need to know how to calculate with rapidity and precision. The useful character of arithmetic indicates that its methods should admit of great simplicity, and that its teaching should be most carefully freed from all needless complication. When we enter into the spirit of the methods of arithmetic, we perceive that they all flow clearly and simply from the very principles of numeration, from some precise definitions, and from certain ideas of relations between numbers, which all minds easily perceive, and which they even possessed in advance, before their teacher made them recognize them and taught them to class them in a methodical and fruitful order. We therefore believe that there is no one who is not capable of receiving, of understanding, and of enjoying well-arranged and well-digested arithmetical instruction.

But the great majority of those who have received a liberal education do not possess this useful knowledge. Their minds, they say, are not suited to the study of mathematics. They have found it impossible to bend themselves to the study of those abstract sciences whose barrenness and dryness form so striking a contrast to the attractions of history, and the beauties of style and of thought in the great poets; and so on.

Now, without admitting entirely the justice of this language, we do not hesitate to acknowledge, that the teaching of elementary mathematics has lost its former simplicity, and assumed a complicated and pretentious form, which possesses no advantages and is full of inconveniences. The reproach which is cast upon the sciences in themselves, we out-and-out repulse, and apply it only to the vicious manner in which they are now taught.

Arithmetic especially is only an instrument, a tool, the theory of which we certainly ought to know, but the practice of which it is above all important most thoroughly to possess. The methods of analysis and of mechanics, invariably lead to solutions whose applications require reduction into numbers by arithmetical calculations. We may add that the numerical determination of the final result is almost always indispensable to the clear and complete comprehension of a method ever so little complicated. Such an application, either by the more complete condensation of the ideas which it requires, or by its fixing the mind on the subject more precisely and clearly, develops a crowd of remarks which otherwise would not have been made, and it thus contributes to facilitate the comprehension of theories in such an efficacious manner

that the time given to the numerical work is more than regained by its being no longer necessary to return incessantly to new explanations of the same method.

The teaching of arithmetic will therefore have for its essential object, to make the pupils acquire the habit of calculation, so that they may be able to make an easy and continual use of it in the course of their studies. The theory of the operations must be given to them with clearness and precision; not only that they may understand the mechanism of those operations, but because, in almost all questions, the application of the methods calls for great attention and continual discussion, if we would arrive at a result in which we can confide. But at the same time every useless theory must be carefully removed, so as not to distract the attention of the pupil, but to devote it entirely to the essential objects of this instruction.

It may be objected that these theories are excellent exercises to form the mind of the pupils. We answer that such an opinion may be doubted for more than one reason, and that, in any case, exercises on useful subjects not being wanting in the immense field embraced by mathematics, it is quite superfluous to create, for the mere pleasure of it, difficulties which will never have any useful application.

Another remark we think important. It is of no use to arrive at a numerical result, if we cannot answer for its correctness. The teaching of calculation should include, as an essential condition, that the pupils should be shown how every result, deduced from a series of arithmetical operations, may always be controlled in such a way that we may have all desirable certainty of its correctness; so that, though a pupil may and must often make mistakes, he may be able to discover them himself, to correct them himself, and never to present, at last, any other than an exact result.

The *Programme* given below is made very minute to avoid the evils which resulted from the brevity of the old one. In it, the limits of the matter required not being clearly defined, each teacher preferred to extend them excessively, rather than to expose his pupils to the risk of being unable to answer certain questions. The examiners were then naturally led to put the questions thus offered to them, so to say; and thus the preparatory studies grew into excessive and extravagant development. These abuses could be remedied only by the publication of programmes so detailed, that the limits within which the branches required for admission must be restricted should be so apparent to the eyes of all, as to render it impossible for the examiners to go out of them, and thus to permit teachers to confine their instruction within them.

The new programme for arithmetic commences with the words Deci mal numeration. This is to indicate that the Duodecimal numeration will not be required.

The only practical verification of Addition and Multiplication, is to recommence these operations in a different order.

The Division of whole numbers is the first question considered at all difficult. This difficulty arises from the complication of the methods by which division is taught. In some books its explanation contains twice as many reasons as is necessary. The mind becomes confused by such instruction, and no longer understands what is a demonstration, when it sees it continued at the moment when it appeared to be finished. In most cases the demonstration is excessively complicated and does not follow the same order as the practical rule, to which it is then necessary to return. There lies the evil, and it is real and profound.

The phrase of the programme, Division of whole numbers, intends that the pupil shall be required to explain the practical rule, and be able to use it in a familiar and rapid manner. We do not present any particular mode of demonstration, but, to explain our views, we will indicate how we would treat the subject if we were making the detailed programme of a *course* of arithmetic, and not merely that of an *examination*. It would be somewhat thus:

"The quotient may be found by addition, subtraction, multiplication;

"Division of a number by a number of one figure, when the quotient is less than 10;

"Division of any number by a number less than 10;

"Division of any two numbers when the quotient has only one figure;

"Division in the most general case.

"*Note.*—The practical rule may be entirely explained by this consideration, that by multiplying the divisor by different numbers, we see if the quotient is greater or less than the multiplier."

The properties of the Divisors of numbers, and the decomposition of a number into prime factors should be known by the student. But here also we recommend simplicity. The theory of the greatest common divisor, for example, has no need to be given with all the details with which it is usually surrounded, for it is of no use in practice.

The calculation of Decimal numbers is especially that in which it is indispensable to exercise students. Such are the numbers on which they will generally have to operate. It is rare that the data of a question are whole numbers; usually they are decimal numbers which are not even known with rigor, but only with a given decimal approximation; and the result which is sought is to deduce from these, other decimal numbers, themselves exact to a certain degree of approximation,

fixed by the conditions of the problem. It is thus that this subject should be taught. The pupil should not merely learn how, in one or two cases, he can obtain a result to within $\frac{1}{n}$, n being any number, but how to arrive by a practicable route to results which are exact to within a required decimal, and on the correctness of which they can depend.

Let us take decimal multiplication for an example. Generally the pupils do not know any other rule than "to multiply one factor by the other, without noticing the decimal point, except to cut off on the right of the product as many decimal figures as there are in the two factors." The rule thus enunciated is methodical, simple, and apparently easy. But, in reality, it is practically of a repulsive length, and is most generally inapplicable.

Let us suppose that we have to multiply together two numbers having each six decimals, and that we wish to know the product also to the sixth decimal. The above rule will give twelve decimals, the last six of which, being useless, will have caused by their calculation the loss of precious time. Still farther; when a factor of a product is given with six decimals, it is because we have stopped in its determination at that degree of approximation, neglecting the following decimals; whence it results that several of the decimals situated on the right of the calculated product are not those which would belong to the rigorous product. What then is the use of taking the trouble of determining them?

We will remark lastly that if the factors of the product are incommensurable, and if it is necessary to convert them into decimals before effecting the multiplication, we should not know how far we should carry the approximation of the factors before applying the above rule. It will therefore be necessary to teach the pupils the abridged methods by which we succeed, at the same time, in using fewer figures and in knowing the real approximation of the result at which we arrive.

Periodical decimal fractions are of no use. The two elementary questions of the programme are all that need be known about them.

The Extraction of the square root must be given very carefully, especially that of decimal numbers. It is quite impossible here to observe the rule of having in the square twice as many decimals as are required in the root. That rule is in fact impracticable when a series of operations is to be effected. "When a number N increases by a comparatively small quantity d, the square of that number increases very nearly as $2Nd$." It is thus that we determine the approximation with which a number must be calculated so that its square root may afterwards be obtained with the necessary exactitude. This supposes that before determining the square with all necessary precision, we have a

suitable lower limit of the value of the root, which can always be done without difficulty.

The Cube root is included in the programme. The pupils should know this; but while it will be necessary to exercise them on the extraction of the square root by numerous examples, we should be very sparing of this in the cube root, and not go far beyond the mere theory. The calculations become too complicated and waste too much time. Logarithms are useful even for the square root; and quite indispensable for the cube root, and still more so for higher roots.

When a question contains only quantities which vary in the same ratio, or in an inverse ratio, it is immediately resolved by a very simple method, known under the name of *reduction to unity.* The result once obtained, it is indispensable to make the pupils remark that it is composed of the quantity which, among the data, is of the nature of that which is sought, multiplied successively by a series of abstract ratios between other quantities which also, taken two and two, are of the same nature. Hence flows the rule for writing directly the required result, without being obliged to take up again for each question the series of reasonings. This has the advantage, not only of saving time, but of better showing the spirit of the method, of making clearer the meaning of the solution, and of preparing for the subsequent use of formulas. The consideration of "homogeneity" conduces to these results.

We recommend teachers to abandon as much as possible the use of examples in abstract numbers, and of insignificant problems, in which the data, taken at random, have no connection with reality. Let the examples and the exercises presented to students always relate to objects which are found in the arts, in industry, in nature, in physics, in the system of the world. This will have many advantages. The precise meaning of the solutions will be better grasped. The pupils will thus acquire, without any trouble, a stock of precise and precious knowledge of the world which surrounds them. They will also more willingly engage in numerical calculations, when their attention is thus incessantly aroused and sustained, and when the result, instead of being merely a dry number, embodies information which is real, useful, and interesting.

The former arithmetical programme included the theory of *progressions* and *logarithms;* the latter being deduced from the former. But the theory of logarithms is again deduced in algebra from exponents, much the best method. This constitutes an objectionable "*double emploi.*" There is finally no good reason for retaining these theories in arithmetic.

The programme retains the questions which can be solved by making two arbitrary and successive hypotheses on the desired result. It is true

that these questions can be directly resolved by means of a simple equation of the first degree; but we have considered that, since the resolution of problems by means of hypotheses, constitutes the most fruitful method really used in practice, it is well to accustom students to it the soonest possible. This is the more necessary, because teachers have generally pursued the opposite course, aiming especially to give their pupils direct solutions, without reflecting that the theory of these is usually much more complicated, and that the mind of the learner thus receives a direction exactly contrary to that which it will have to take in the end.

"Proportions" remain to be noticed.

In most arithmetics problems are resolved first by the method of "reduction to unity," and then by the theory of proportions. But beside the objection of the "*double emploi*," it is very certain that the method of reduction to unity presents, in their true light and in a complete and simple manner, all the questions of ratio which are the bases of arithmetical solutions; so that the subsequent introduction of proportions teaches nothing new to the pupils, and only presents the same thing in a more complicated manner. We therefore exclude from our programme of examination the solution of questions of arithmetic, presented under the special form which constitutes the theory of proportions.

This special form we would be very careful not to invent, if it had not already been employed. Why not say simply "The ratio of M to N is equal to that of P to Q," instead of hunting for this other form of enunciating the same idea, "M *is to* N *as* P *is to* Q"? It is in vain to allege the necessities of geometry; if we consider all the questions in which proportions are used, we shall see that the simple consideration of the equality of ratios is equally well adapted to the simplicity of the enunciation and the clearness of the demonstrations. However, since all the old books of geometry make use of proportions, we retain the properties of proportions at the end of our programme; but with this express reserve, that the examiners shall limit themselves to the simple properties which we indicate, and that they shall not demand any application of proportions to the solution of arithmetical problems.

PROGRAMME OF ARITHMETIC.

Decimal numeration.

Addition and subtraction of whole numbers.

Multiplication of whole numbers.—Table of Pythagoras.—The product of several whole numbers does not change its value, in whatever order the multiplications are effected.—To multiply a number by the product of several factors, it is sufficient to multiply successively by the factors of the product.

Division of whole numbers.—To divide a number by the product of several factors, it is sufficient to divide successively by the factors of the product.

Remainders from dividing a whole number by 2, 3, 5, 9, and 11.—Applications to the characters of divisibility by one of those numbers; to the verification of the product of several factors; and to the verification of the quotient of two numbers.

Prime numbers. Numbers prime to one another.

To find the greatest common divisor of two numbers.—If a number divides a product of two factors, and if it is prime to one of the factors, it divides the other.—To decompose a number into its prime factors.—To determine the smallest number divisible by given numbers.

Vulgar fractions.

A fraction does not alter in value when its two terms are multiplied or divided by the same number. Reduction of a fraction to its simplest expression. Reduction of several fractions to the same denominator. Reduction to the smallest common denominator.—To compare the relative values of several fractions.

Addition and subtraction of fractions.—Multiplication. Fractions of fractions.—Division.

Calculation of numbers composed of an entire part and a fraction.

Decimal numbers.

Addition and subtraction.

Multiplication and division.—How to obtain the product of the quotient to within a unit of any given decimal order.

To reduce a vulgar fraction to a decimal fraction.—When the denominator of an irreducible fraction contains other factors than 2 and 5, the fraction cannot be exactly reduced to decimals; and the quotient, which continues indefinitely, is periodical.

To find the vulgar fraction which generates a periodical decimal fraction: 1° when the decimal fraction is simply periodical; 2° when it contains a part not periodical.

System of the new measures.

Linear Measures.—Measures of surface.—Measures of volume and capacity.—Measures of weight.—Moneys.—Ratios of the principal foreign measures (England, Germany, United States of America) to the measures of France.

Of ratios. Resolution of problems.

General notions on quantities which vary in the same ratio or in an inverse ratio.—Solution, by the method called *Reduction to unity*, of the simplest questions in which such quantities are considered.—To show the homogeneity of the results which are arrived at; thence to deduce the general rule for writing directly the expression of the required solution.

Simple interest.—General formula, the consideration of which furnishes the solution of questions relating to simple interest.—Of discount, as practised in commerce.

To divide a sum into parts proportional to given numbers.

Of questions which can be solved by two arbitrary and successive hypotheses made on the desired result.

Of the square and of the square root. Of the cube and of the cube root.

Formation of the square and the cube of the sum of two numbers.—Rules for extracting the square root and the cube root of a whole number.—If this root is not entire, it cannot be exactly expressed by any number, and is called incommensurable.

Square and cube of a fraction.—Extraction of the square root and cube root of vulgar fractions.

Any number being given, either directly, or by a series of operations which permit only an approximation to its value by means of decimals, how to extract the square root or cube root of that number, to within any decimal unit.

Of the proportions called geometrical.

In every proportion the product of the extremes is equal to the product of the means.—Reciprocal proportion.—Knowing three terms of a proportion to find the fourth.—Geometrical mean of two numbers.—How the order of the terms of a proportion can be inverted without disturbing the proportion.

When two proportions have a common ratio, the two other ratios form a proportion.

In any proportion, each antecedent may be increased or diminished by its consequent without destroying the proportion.

When the corresponding terms of several proportions are multiplied together, the four products form a new proportion.—The same powers or the same roots of four numbers in proportion form a new proportion.

In a series of equal ratios, the sum of any number of antecedents and the sum of their consequents are still in the same ratio.

II. GEOMETRY

Some knowledge of Geometry is, next to arithmetic, most indispensable to every one, and yet very few possess even its first principles. This is the fault of the common system of instruction. We do not pay sufficient regard to the natural notions about straight lines, angles, parallels, circles, etc., which the young have acquired by looking around them, and which their minds have unconsciously considered before making them a regular study. We thus waste time in giving a dogmatic form to truths which the mind seizes directly.

The illustrious *Clairaut* complains of this, and of the instruction commencing always with a great number of definitions, postulates, axioms, and preliminary principles, dry and repulsive, and followed by propositions equally uninteresting. He also condemns the profusion of self-evident propositions, saying, "It is not surprising that Euclid should give himself the trouble to demonstrate that two circles which intersect have not the same centre; that a triangle situated within another has the sum of its sides smaller than that of the sides of the triangle which contains it; and so on. That geometer had to convince obstinate sophists, who gloried in denying the most evident truths. It was therefore necessary that geometry, like logic, should then have the aid of formal reasonings, to close the mouths of cavillers; but in our day things have changed face; all reasoning about what mere good sense decides in advance is now a pure waste of time, and is fitted only to obscure the truth and to disgust the reader."

Bezout also condemns the multiplication of the number of theorems, propositions, and corollaries; an array which makes the student dizzy, and amid which he is lost. All that follows from a principle should be given in natural language as far as possible, avoiding the dogmatic form. It is true that some consider the works of Bezout deficient in rigor, but he knew better than any one what really was a demonstration. Nor do we find in the works of the great old masters less generality of views, less precision, less clearness of conception than in modern treatises. Quite the contrary indeed.

We see this in Bezout's *definition of a right line*—that it tends continually towards one and the same point; and in that of *a curved line* —that it is the trace of a moving point, which turns aside infinitely little at each step of its progress; definitions most fruitful in consequences. When we define a right line as the shortest path from one point to another, we enunciate a property of that line which is of no use for demonstrations. When we define a curved line as one which is neither straight

nor composed of straight lines, we enunciate two negations which can lead to no result, and which have no connection with the peculiar nature of the curved line. Bezout's definition, on the contrary, enters into the nature of the object to be defined, seizes its mode of being, its character, and puts the reader immediately in possession of the general idea from which are afterwards deduced the properties of curved lines and the construction of their tangents.

So too when Bezout says that, in order to form an exact idea of an angle, it is necessary to consider the movement of a line turning around one of its points, he gives an idea at once more just and more fruitful in consequences, both mathematical and mechanical, than that which is limited to saying, that the indefinite space comprised between two straight lines which meet in a point, and which may be regarded as prolonged indefinitely, is called an *angle;* a definition not very easily comprehended and absolutely useless for ulterior explanations, while that of Bezout is of continual service.

We therefore urge teachers to return, in their demonstrations, to the simplest ideas, which are also the most general; to consider a demonstration as finished and complete when it has evidently caused the truth to enter into the mind of the pupil, and to add nothing merely for the sake of silencing sophists.

Referring to our Programme of Geometry, given below, our first comments relate to the "Theory of parallels." This is a subject on which all students fear to be examined; and this being a general feeling, it is plain that it is not their fault, but that of the manner in which this subject is taught. The omission of the natural idea of the constant direction of the right line (as defined by Bezout) causes the complication of the first elements; makes it necessary for Legendre to demonstrate that all right angles are equal (a proposition whose meaning is rarely understood); and is the real source of all the pretended difficulties of the theory of parallels. These difficulties are now usually avoided by the admission of a *postulate*, after the example of Euclid, and to regulate the practice in that matter, we have thought proper to prescribe that this proposition—*Through a given point only a single parallel to a right line can be drawn*—should be admitted purely and simply, without demonstration, and as a direct consequence of our idea of the nature of the right line.

We should remark that the order of ideas in our programme supposes the properties of lines established without any use of the properties of surfaces. We think that, in this respect, it is better to follow Lacroix than Legendre.

When we prove thus that three parallels always divide two right lines into proportional parts, this proposition can be extended to the case in which the ratio of the parts is incommensurable, either by the method called *Reductio ad absurdum*, or by the method of *Limits*. We especially recommend the use of the latter method. The former has in fact nothing which satisfies the mind, and we should never have recourse to it, for it is always possible to do without it. When we have proved to the pupil that a desired quantity, X, cannot be either larger or smaller than A, the pupil is indeed forced to admit that X and A are equal; but that does not make him understand or feel why that equality exists. Now those demonstrations which are of such a nature that, once given, they disappear, as it were, so as to leave to the proposition demonstrated the character of a truth evident *à priori*, are those which should be carefully sought for, not only because they make that truth better felt, but because they better prepare the mind for conceptions of a more elevated order. The method of limits, is, for a certain number of questions, the only one which possesses this characteristic—that the demonstration is closely connected with the essential nature of the proposition to be established.

In reference to the relations which exist between the sides of a triangle and the segments formed by perpendiculars let fall from the summits, we will, once for all, recommend to the teacher, to exercise his students in making numerical applications of relations of that kind, as often as they shall present themselves in the course of geometry. This is the way to cause their meaning to be well understood, to fix them in the mind of students, and to give these the exercise in numerical calculation to which we positively require them to be habituated.

The theory of similar figures has a direct application in the art of surveying for plans (*Lever des plans*). We wish that this application should be given to the pupils in detail; that they should be taught to range out and measure a straight line on the ground; that a graphometer should be placed in their hands; and that they should use it and the chain to obtain on the ground, for themselves, all the data necessary for the construction of a map, which they will present to the examiners with the calculations in the margins.

It is true that a more complete study of this subject will have to be subsequently made by means of trigonometry, in which calculation will give more precision than these graphical operations. But some pupils may fail to extend their studies to trigonometry (the course given for the Polytechnic school having become the model for general instruction in France), and those who do will thus learn that trigonometry merely gives means of more precise calculation. This application will also be

an encouragement to the study of a science whose utility the pupil will thus begin to comprehend.

It is common to say that an angle is measured by the arc of a circle, described from its summit or centre, and intercepted between its sides. It is true that teachers add, that since a quantity cannot be measured except by one of the same nature, and since the arc of a circle is of a different nature from an angle, the preceding enunciation is only an abridgment of the proposition by which we find the ratio of an angle to a right angle. Despite this precaution, the unqualified enunciation which precedes, causes uncertainty in the mind of the pupil, and produces in it a lamentable confusion. We will say as much of the following enunciations: "A dihedral angle is measured by the plane angle included between its sides;" "The surface of a spherical triangle is measured by the excess of the sum of its three angles above two right angles," etc.; enunciations which have no meaning in themselves, and from which every trace of homogeneity has disappeared. Now that everybody is requiring that the students of the Polytechnic school should better understand the meaning of the formulas which they are taught, which requires that their homogeneity should always be apparent, this should be attended to from the beginning of their studies, in geometry as well as in arithmetic. The examiners must therefore insist that the pupils shall never give them any enunciations in which homogeneity is not preserved.

The proportionality of the circumferences of circles to their radii must be inferred *directly* from the proportionality of the perimeters of regular polygons, of the same number of sides, to their apothems. In like manner, from the area of a regular polygon being measured by half of the product of its perimeter by the radius of the inscribed circle, it must be *directly* inferred that the area of a circle is measured by half of the product of its circumference by its radius. For a long time, these properties of the circle were differently demonstrated by proving, for example, with Legendre, that the measure of the circle could not be either smaller or greater than that which we have just given, whence it had to be inferred that it must be equal to it. The "Council of improvement" finally decided that this method should be abandoned, and that the method of limits should alone be admitted, in the examinations, for demonstrations of this kind. This was a true advance, but it was not sufficient. It did not, as it should, go on to consider the circle, purely and simply, as the limit of a series of regular polygons, the number of whose sides goes on increasing to infinity, and to regard the circle as possessing every property demonstrated for polygons. Instead of this, they inscribed and circumscribed to the circle two polygons of the same number of sides, and

proved that, by the multiplication of the number of the sides of these polygons, the difference of their areas might become smaller than any given quantity, and thence, finally, deduced the measure of the area of the circle; that is to say, they took away from the method of limits all its advantage as to simplicity, by not applying it *frankly*.

We now ask that this shall cease; and that we shall no longer reproach for want of rigor, the Lagranges, the Laplaces, the Poissons, and Leibnitz, who has given us this principle: that "A curvilinear figure may be regarded as equivalent to a polygon of an infinite number of sides; whence it follows that whatsoever can be demonstrated of such a polygon, no regard being paid to the number of its sides, the same may be asserted of the curve." This is the principle for *the most simple* application of which to the measure of the circle and of the round bodies we appeal.

Whatever may be the formulas which may be given to the pupils for the determination of the ratio of the circumference to the diameter (the "Method of isoperimeters" is to be recommended for its simplicity), they must be required to perform the calculation, so as to obtain at least two or three exact decimals. These calculations, made with logarithms, must be methodically arranged and presented at the examination. It may be known whether the candidate is really the author of the papers, by calling for explanations on some of the steps, or making him calculate some points afresh.

The enunciations relating to the measurement of areas too often leave indistinctness in the minds of students, doubtless because of their form. We desire to make them better comprehended, by insisting on their application by means of a great number of examples.

As one application, we require the knowledge of the methods of surveying for content (*arpentage*), differing somewhat from the method of triangulation, used in the surveying for plans (*lever des plans*). To make this application more fruitful, the ground should be bounded on one side by an irregular curve. The pupils will not only thus learn how to overcome this practical difficulty, but they will find, in the calculation of the surface by means of trapezoids, the first application of the method of quadratures, with which it is important that they should very early become familiar. This application will constitute a new sheet of drawing and calculations to be presented at the examination.

Most of our remarks on plane geometry apply to geometry of three dimensions. Care should be taken always to leave homogeneity apparent, and to make numerous applications to the measurement of volumes.

The theory of similar polyhedrons often gives rise in the examinations of the students to serious difficulties on their part. These difficulties be-

long rather to the form than to the substance, and to the manner in which each individual mind seizes relations of position; relations always easier to feel than to express. The examiners should be content with arriving at the results enunciated in our programme, by the shortest and easiest road.

The simplicity desired cannot however be attained unless all have a common starting-point, in the definition of similar polyhedrons. The best course is assuredly to consider that theory in the point of view in which it is employed in the arts, especially in sculpture; i. e. to conceive the given system of points, M, N, P, ... to have lines passing from them through a point S, the *pole of similitude*, and prolonged beyond it to M′, N′, P′, ... so that SM′, SN′, SP′, ... are proportional to SM, SN, SP, ... Then the points M′, N′, P′, ... form a system *similar* to M, N, P, ...

The areas and volumes of the cylinder, of the cone, and of the sphere must be deduced from the areas and from the volumes of the prism, of the pyramid, and of the polygonal sector, with the same simplicity which we have required for the measure of the surface of the circle, and for the same reasons. It is, besides, the only means of easily extending to cones and cylinders with any bases whatever, right or oblique, those properties of cones and cylinders,—right and with circular bases,—which are applicable to them.

Numerical examples of the calculations, by logarithms, of these areas and volumes, including the area of a spherical triangle, will make another sheet to be presented to the examiners.

PROGRAMME OF GEOMETRY.

1. OF PLANE FIGURES.

Measure of the distance of two points.—Two finite right lines being given, to find their common measure, or at least their approximate ratio.

Of angles.—Right, acute, obtuse angles.—Angles vertically opposite are equal.

Of triangles.—Angles and sides.—The simplest cases of equality.—Elementary problems on the construction of angles and of triangles.

Of perpendiculars and of oblique lines.

Among all the lines that can be drawn from a given point to a given right line, the perpendicular is the shortest, and the oblique lines are longer in proportion to their divergence from the foot of the perpendicular.

Properties of the isosceles triangle.—Problems on tracing perpendiculars.—Division of a given straight line into equal parts.

Cases of equality of right-angled triangles.

Of parallel lines.

Properties of the angles formed by two parallels and a secant.—Reciprocally, when these properties exist for two right lines and a common secant, the two lines are parallel.*—Through a given point, to draw a right line parallel to a given right line, or cutting it at a given angle.—Equality of angles having their sides parallel and their openings placed in the same direction.

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* It will be admitted, as a postulate, that only one parallel to a given right line can pass through a given point.

Sum of the angles of a triangle.

The parts of parallels intercepted between parallels are equal, and reciprocally.

Three parallels always divide any two right lines into proportional parts. The ratio of these parts may be incommensurable.—Application to the case in which a right line is drawn, in a triangle, parallel to one of its sides.

To find a fourth proportional to three given lines.

The right line, which bisects one of the angles of a triangle, divides the opposite side into two segments proportional to the adjacent sides.

Of similar triangles.

Conditions of similitude.—To construct on a given right line, a triangle similar to a given triangle.

Any number of right lines, passing through the same point and met by two parallels, are divided by these parallels into proportional parts, and divide them also into proportional parts.—To divide a given right line in the same manner as another is divided.—Division of a right line into equal parts.

If from the right angle of a right-angled triangle a perpendicular is let fall upon the hypothenuse, 1° this perpendicular will divide the triangle into two others which will be similar to it, and therefore to each other; 2° it will divide the hypothenuse into two segments, such that each side of the right angle will be a mean proportional between the adjacent segment and the entire hypothenuse; 3° the perpendicular will be a mean proportional between the two segments of the hypothenuse.

In a right-angled triangle, the square of the number which expresses the length of the hypothenuse is equal to the sum of the squares of the numbers which express the lengths of the other two sides.

The three sides of any triangle being expressed in numbers, if from the extremity of one of the sides a perpendicular is let fall on one of the other sides, the square of the first side will be equal to the sum of the squares of the other two, *minus* twice the product of the side on which the perpendicular is let fall by the distance of that perpendicular from the angle opposite to the first side, if the angle is *acute*, and *plus* twice the same product, if this angle is *obtuse*.

Of polygons.

Parallelograms.—Properties of their angles and of their diagonals.

Division of polygons into triangles.—Sum of their interior angles.—Equality and construction of polygons.

Similar polygons.—Their decomposition into similar triangles.—The right lines similarly situated in the two polygons are proportional to the homologous sides of the polygons.—To construct, on a given line, a polygon similar to a given polygon.—The perimeters of two similar polygons are to each other as the homologous sides of these polygons.

Of the right line and the circumference of the circle.

Simultaneous equality of arcs and chords in the same circle.—The greatest arc has the greatest chord, and reciprocally.—Two arcs being given in the same circle or in equal circles, to find the ratio of their lengths.

Every right line drawn perpendicular to a chord at its middle, passes through the centre of the circle and through the middle of the arc subtended by the chord.—Division of an arc into two equal parts.—To pass the circumference of a circle through three points not in the same right line.

The tangent at any point of a circumference is perpendicular to the radius passing through that point.

The arcs intercepted in the same circle between two parallel chords, or between a tangent and a parallel chord, are equal.

Measure of angles.

If from the summits of two angles two arcs of circles be described with the same radius, the ratio of the arcs included between the sides of each angle will be the same as that of these angles.—Division of the circumference into degrees, minutes, and seconds.—Use of the protractor.

An angle having its summit placed, 1° at the centre of a circle; 2° on the circumference of that circle; 3° within the circle between the centre and the circumference; 4° without the circle, but so that its sides cut the circumference; to determine the ratio of that angle to the right angle, by the consideration of the arc included between its sides.

From a given point without a circle, to draw a tangent to that circle.

To describe, on a given line, a segment of a circle capable of containing a given angle.

To make surveys for plans. (*Lever des plans.*)

Tracing a straight line on the ground.—Measuring that line with the chain.

Measuring angles with the graphometer.—Description of it.

Drawing the plan on paper.—Scale of reduction.—Use of the rule, the triangle, and the protractor.

To determine the distance of an inaccessible object, with or without the graphometer.

Three points, A, B, C, being situated on a smooth surface and represented on a map, to find thereon the point P from which the distances A B and A C have been seen under given angles. "The problem of the three points." "The *Trilinear* problem."

Of the contact and of the intersection of circles.

Two circles which pass through the same point of the right line which joins their centres have in common only that point in which they touch; and reciprocally, if two circles touch, their centres and the point of contact lie in the same right line.

Conditions which must exist in order that two circles may intersect.

Properties of the secants of the circle.

Two secants which start from the same point without the circle, being prolonged to the most distant part of the circumference, are reciprocally proportional to their exterior segments.—The tangent is a mean proportional between the secant and its exterior segment.

Two chords intersecting within a circle divide each other into parts reciprocally proportional.—The line perpendicular to a diameter and terminated by the circumference, is a mean proportional between the two segments of the diameter.

A chord, passing through the extremity of the diameter, is a mean proportional between the diameter and the segment formed by the perpendicular let fall from the other extremity of that chord.—To find a mean proportional between two given lines.

To divide a line in extreme and mean ratio.—The length of the line being given numerically, to calculate the numerical value of each of the segments.

Of polygons inscribed and circumscribed to the circle.

To inscribe or circumscribe a circle to a given triangle.

Every regular polygon can be inscribed and circumscribed to the circle.

A regular polygon being inscribed in a circle, 1° to inscribe in the same circle a polygon of twice as many sides, and to find the length of one of the sides of the second polygon; 2° to circumscribe about the circle a regular polygon of the same number of sides, and to express the side of the circumscribed polygon by means of the side of the corresponding inscribed polygon.

To inscribe in a circle polygons of 4, 8, 16, 32.....sides.

To inscribe in a circle polygons of 3, 6, 12, 24, ...sides.

To inscribe in a circle polygons of 5, 10, 20, 40.....sides.

To inscribe in a circle polygons of 15, 30, 60.....sides.

Regular polygons of the same number of sides are similar, and their perimeters are to each other as the radii of the circles to which they are inscribed or circumscribed.—The circumferences of circles are to each other as their radii.

To find the approximate ratio of the circumference to the diameter.

Of the area of polygons and of that of the circle.

Two parallelograms of the same base and of the same height are equivalent.—Two triangles of the same base and height are equivalent.

The area of a rectangle and that of a parallelogram are equal to the product of the base by the height.—What must be understood by that enunciation.—The area of a triangle is measured by half of the product of the base by the height.

To transform any polygon into an equivalent square.—Measure of the area of a polygon.—Measure of the area of a trapezoid.

The square constructed on the hypothenuse of a right-angled triangle is equivalent to the sum of the squares constructed on the other two sides.—The squares constructed on the two sides of the right angle of a right-angled triangle and on the hypothenuse are to each other as the adjacent segments and entire hypothenuse.

The areas of similar polygons are to each other as the squares of the homologous sides of the polygons.

Notions on surveying for content (*arpentage*).—Method of decomposition into triangles.—Simpler method of decomposition into trapezoids.—Surveyor's cross.—Practical solution, when the ground is bounded, in one or more parts, by a curved line.

The area of a regular polygon is measured by half of the product of its perimeter by the radius of the inscribed circle.—The area of a circle is measured by half of the product of the circumference by the radius.—The areas of circles are to each other as the squares of the radii.

The area of a sector of a circle is measured by half of the product of the arc by the radius.—Measure of the area of a segment of a circle.

2. OF PLANES AND BODIES TERMINATED BY PLANE SURFACES.

Conditions required to render a right line and a plane respectively perpendicular.

Of all the lines which can be drawn from a given point to a given plane, the perpendicular is the shortest, and the oblique lines are longer in proportion to their divergence from the foot of the perpendicular.

Parallel right lines and planes.—Angles which have their sides parallel, and their openings turned in the same direction, are equal, although situated in different planes.

Dihedral angle.—How to measure the ratio of any dihedral angle to the right dihedral angle.

Planes perpendicular to each other.—The intersection of two planes perpendicular to a third plane, is perpendicular to this third plane.

Parallel planes.—When two parallel planes are cut by a third plane the intersections are parallel.—Two parallel planes have their perpendiculars common to both.

The shortest distance between two right lines, not intersecting and not parallel.

Two right lines comprised between two parallel planes are always divided into proportional parts by a third plane parallel to the first two.

Trihedral angle.—The sum of any two of the plane angles which compose a trihedral angle is always greater than the third.

The sum of the plane angles which form a convex polyhedral angle is always less than four right angles.

If two trihedral angles are formed by the same plane angles, the dihedral angles comprised between the equal plane angles are equal.—There may be absolute equality or simple symmetry between the two trihedral angles.

Of polyhedrons.

If two tetrahedrons have each a trihedral angle composed of equal and similarly arranged triangles, these tetrahedrons are equal. They are also equal if two faces of the one are equal to two faces of the other, are arranged in the same manner, and form with each other the same dihedral angle.

When the triangles which form two homologous trihedral angles of two tetrahedrons are similar, each to each, and similarly disposed, these tetrahedrons are similar. They are also similar if two faces of the one, making with each other the same angle as two faces of the other, are also similar to these latter, and are united by homologous sides and summits.

Similar pyramids.—A plane parallel to the base of a pyramid cuts off from it a pyramid similar to it.—To find the height of a pyramid when we know the dimension of its trunk with parallel bases.

Sections made in any two pyramids at the same distance from these summits are in a constant ratio.

Parallelopipedon.—Its diagonals.

Any polyhedron can always be divided into triangular pyramids.—Two bodies composed of the same number of equal and similarly disposed triangular pyramids, are equal.

Similar polyhedrons.

The homologous edges of similar polyhedrons are proportional; as are also the diagonals of the homologous faces and the interior diagonals of the polyhedrons.—The areas of similar polyhedrons are as the squares of the homologous edges.

Measure of volumes.

Two parallelopipedons of the same base and of the same height are equivalent in volume.

If a parallelogram be constructed on the base of a triangular prism, and on that parallelogram, taken as a base, there be constructed a parallelopipedon of the same height as the triangular prism, the volume of this prism will be half of the volume of the parallelopipedon.—Two triangular prisms of the same base and the same height are equivalent.

Two tetrahedrons of the same base and the same height are equivalent.

A tetrahedron is equivalent to the third of the triangular prism of the same base and the same height.

The volume of any parallelopipedon is equal to the product of its base by its height.—What must be understood by that enunciation.—The volume of any prism is equal to the product of its base by its height.

The volume of a tetrahedron and that of any pyramid are measured by the third of the product of the base by the height.

Volume of the truncated oblique triangular prism.

The volumes of two similar polyhedrons are to each other as the cubes of the homologous edges.

3. OF ROUND BODIES.

Of the right cone with circular base.

Sections parallel to the base.—Having the dimensions of the trunk of a cone with parallel bases, to find the height of the entire cone.

The area of a right cone is measured by half of the product of the circumference of its circular base by its side.—Area of a trunk of a right cone with parallel bases.

Volume of a pyramid inscribed in the cone.—The volume of a cone is measured by the third of the product of the area of its base by its height.*

Which of the preceding properties belong to the cone of any base whatever?

Of the right cylinder with circular base.

Sections parallel to the base.

The area of the convex surface of the right cylinder is measured by the product of the circumference of its base by its height.—This is also true of the right cylinder of any base.

Measure of the volume of a prism inscribed in the cylinder.—The volume of a right cylinder is measured by the product of the area of its base by its height.—This is also true of any cylinder, right or oblique, of any base whatever.

Of the sphere.

Every section of the sphere, made by a plane, is a circle.—Great circles and small circles.

In every spherical triangle any one side is less than the sum of the other two. The shortest path from one point to another, on the surface of the sphere, is the arc of a great circle which joins the two given points.

The sum of the sides of a spherical triangle, or of any spherical polygon, is less than the circumference of a great circle.

Poles of an arc of a great or small circle.—They serve to trace arcs of circles on the sphere.

Every plane perpendicular to the extremity of a radius is tangent to the sphere.

Measure of the angle of two arcs of great circles.

Properties of the polar or supplementary triangle.

Two spherical triangles situated on the same sphere, or on equal spheres, are equal in all their parts, 1° when they have an equal angle included between sides respectively equal; 2° when they have an equal side adjacent to two angles respectively equal; 3° when they are mutually equilateral; 4° when they are mutually equiangular. In these different cases the triangles may be equal, or merely symmetrical.

The sum of the angles of any spherical triangle is less than six, and greater than two, right angles.

The lune is to the surface of the sphere as the angle of that lune is to four right angles.

Two symmetrical spherical triangles are equivalent in surface.

The area of a spherical triangle is to that of the whole sphere as the excess of the sum of its angles above two right angles is to eight right angles.

When a portion of a regular polygon, inscribed in the generating circle of the sphere, turns around the diameter of that circle, the convex area engendered is measured by the product of its height by the circumference of the circle inscribed in the generating polygon.—The volume of the corresponding polygonal sector is measured by the area thus described, multiplied by the third of the radius of the inscribed circle.

The surface of a spherical zone is equal to the height of that zone multiplied by the circumference of a great circle.—The surface of the sphere is quadruple that of a great circle.

Every spherical sector is measured by the zone which forms its base, multiplied by the third of the radius. The whole sphere is measured by its surface multiplied by the third of its radius.†

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* The volume of the cone is derived from that of the pyramid; and it is to be noted that the demonstration applies to the cone with closed base, whatever the figure of that base.

† Numerical examples on the areas and volumes of the round bodies, including the area of a spherical triangle, will be required by the examiners. The calculations will be made by logarithms.

III. ALGEBRA.

ALGEBRA is not, as are Arithmetic and Geometry, indispensable to every one. It should be very sparingly introduced into the general education of youth, and we would there willingly dispense with it entirely, excepting logarithms, if this would benefit the study of arithmetic and geometry. The programme of it which we are now to give, considers it purely in view of its utility to engineers, and we will carefully eliminate every thing not necessary for them.

Algebraical calculation presents no serious difficulty, when its students become well impressed with this idea, that every letter represents a number; and particularly when the consideration of negative quantities is not brought in at the outset and in an absolute manner. These quantities and their properties should not be introduced except as the solution of questions by means of equations causes their necessity to be felt, either for generalizing the rules of calculation, or for extending the meaning of the formulas to which it leads. CLAIRAUT pursues this course. He says, "I treat of the multiplication of negative quantities, that dangerous shoal for both scholars and teachers, only after having shown its necessity to the learner, by giving him a problem in which he has to consider negative quantities independently of any positive quantities from which they are subtracted. When I have arrived at that point in the problem where I have to multiply or divide negative quantities by one another, I take the course which was undoubtedly taken by the first analysts who have had those operations to perform and who have wished to follow a perfectly sure route: I seek for a solution of the problem which does not involve these operations; I thus arrive at the result by reasonings which admit of no doubt, and I thus see what those products or quotients of negative quantities, which had given me the first solution, must be." BEZOUT proceeds in the same way.

We recommend to teachers to follow these examples; not to speak to their pupils about negative quantities till the necessity of it is felt, and

* The true distinction between ALGEBRA and ARITHMETIC is so commonly overlooked that it may be well to present it here, in the words of Comte. "The complete solution of every question of calculation is necessarily composed of two successive parts, which have essentially distinct natures. In the first, the object is to *transform* the proposed equations, so as to make apparent the manner in which the unknown quantities are formed by the known ones: it is this which constitutes the *Algebraic* question. In the second, our object is *to find the value* of the formulas thus obtained; that is, to determine directly the values of the numbers sought, which are already represented by certain explicit functions of given numbers; this is the *Arithmetical* question. Thus the stopping-point of the algebraic part of the solution becomes the starting-point of the arithmetical part.

"ALGEBRA may therefore be defined as having for its object the *resolution of equations*; taking this expression in its full logical meaning, which signifies the transformation of *implicit* functions into equivalent *explicit* ones. In the same way ARITHMETIC may be defined as intended for *the determination of the values of functions*. Henceforth, therefore, we may call ALGEBRA *the Calculus of Functions*, and ARITHMETIC *the Calculus of Values*."

when they have become familiar with algebraic calculation; and above all not to lose precious time in obscure discussions and demonstrations, which the best theory will never teach students so well as numerous applications.

It has been customary to take up again, in algebra, the calculus of fractions, so as to generalize the explanations given in arithmetic, since the terms of literal fractions may be any quantities whatsoever. Rigorously, this may be well, but to save time we omit this, thinking it better to employ this time in advancing and exercising the mind on new truths, rather than in returning continually to rules already given, in order to imprint a new degree of rigor on their demonstration, or to give them an extension of which no one doubts.

The study of numerical equations of the first degree, with one or several unknown quantities, must be made with great care. We have required the solution of these equations to be made by the method of *substitution*. We have done this, not only because this method really comprehends the others, particularly that of *comparison*, but for this farther reason. In treatises on algebra, those equations alone are considered whose numerical coefficients and solutions are very simple numbers. It then makes very little difference what method is used, or in what order the unknown quantities are eliminated. But it is a very different thing in practice, where the coefficients are complicated numbers, given with decimal parts, and where the numerical values of these coefficients may be very different in the same equation, some being very great and some very small. In such cases the method of *substitution* can alone be employed to advantage, and that with the precaution of taking the value of the unknown quantity to be eliminated from that equation in which it has relatively the greatest coefficient. Now the method of *comparison* is only the method of substitution put in a form in which these precautions cannot be observed, so that in practice it will give bad results with much labor.

The candidates must present to the examiners the complete calculations of the resolution of four equations with four unknown quantities, made with all the precision permitted by the logarithmic tables of Callet, and the proof that that precision has been obtained. The coefficients must contain decimals and be very different from one another, and the elimination must be effected with the above precautions.

The teaching of the present day disregards too much the applicability of the methods given, provided only that they be elegant in their form; so that they have to be abandoned and changed when the pupils enter on practice. This disdain of practical utility was not felt by our great mathematicians, who incessantly turned their attention towards applica-

tions. Thus the illustrious Lagrange made suggestions like those just given; and Laplace recommended the drawing of curves for solving directly all kinds of numerical equations.

As to literal equations of the first degree, we call for formulas sufficient for the resolution of equations of two or three unknown quantities. Bezout's method of elimination must be given as a first application of that fruitful method of indeterminates. The general discussion of formulas will be confined to the case of two unknown quantities. The discussion of three equations with three unknown quantities, x, y, and z, in which the terms independent of the unknown quantities are null, will be made directly, by this simple consideration that the system then really includes only two unknown quantities, to wit, the ratios of x and y, for example, to z.

The resolution of inequalities of the first degree with one or more unknown quantities, was added to equations of the first degree some years ago. We do not retain that addition.

The equations of the second degree, like the first, must be very carefully given. In dwelling on the case where the coefficient of x^2 converges towards zero, it will be remarked that, when the coefficient is very small, the ordinary formula would give one of the roots by the difference of two numbers almost equal; so that sufficient exactness could not be obtained without much labor. It must be shown how that inconvenience may be avoided.

It is common to meet with expressions of which the maximum or the minimum can be determined by the consideration of an equation of the second degree. We retain the study of them, especially for the benefit of those who will not have the opportunity of advancing to the general theory of maxima and minima.

The theory of the algebraic calculation of imaginary quantities, given *à priori*, may, on the contrary, be set aside without inconvenience. It is enough that the pupils know that the different powers of $\sqrt{-1}$ continually reproduce in turn one of these four values, ± 1, $\pm\sqrt{-1}$. We will say as much of the calculation of the algebraic values of radicals, which is of no use. The calculation of their *arithmetical* values will alone be demanded. In this connection will be taught the notation of fractional exponents and that of negative exponents.

The theory of numbers has taken by degrees a disproportionate development in the examinations for admission; it is of no use in practice, and, besides, constitutes in the pure mathematics a science apart.

The theory of continued fractions at first seems more useful. It is employed in the resolution of algebraic equations, and in that of the ex-

ponential equation $a^x = b$. But these methods are entirely unsuited to practice, and we therefore omit this theory.

The theory of series, on the contrary, claims some farther developments. Series are continually met with in practice; they give the best solutions of many questions, and it is indispensable to know in what circumstances they can be safely employed.

We have so often insisted on the necessity of teaching students to calculate, as to justify the extent of the part of the programme relating to logarithms. We have suppressed the inapplicable method of determining logarithms by continued fractions, and have substituted the employment of the series which gives the logarithm of $n+1$, knowing that of n. To exercise the students in the calculation of the series, they should be made to determine the logarithms of the numbers from 1 to 10, from 101 to 110, and from 10,000 to 10,010, the object of these last being to show them with what rapidity the calculation proceeds when the numbers are large; the first term of the series is then sufficient, the variations of the logarithms being sensibly proportional to the variations of the numbers, within the limits of the necessary exactness. In the logarithmic calculations, the pupils will be exercised in judging of the exactness which they may have been able to obtain: the consideration of the numerical values of the proportional parts given in the tables is quite sufficient for this purpose, and is beside the only one which can be employed in practice.

The use of the sliding rule, which is merely an application of logarithms, gives a rapid and portable means of executing approximately a great number of calculations which do not require great exactness. We desire that the use of this little instrument should be made familiar to the candidates. This is asked for by all the professors of the "School of application," particularly those of Topography, of Artillery, of Construction, and of Applied Mechanics, who have been convinced by experience of the utility of this instrument, which has the greatest possible analogy with tables of logarithms.

Before entering on the subjects of higher algebra, it should be remembered that the reductions of the course which we have found to be so urgent, will be made chiefly on it. The general theory of equations has taken in the examinations an abnormal and improper development, not worth the time which it costs the students. We may add, that it is very rare to meet a numerical equation of a high degree requiring to be resolved, and that those who have to do this, take care not to seek its roots by the methods which they have been taught. These methods moreover are not applicable to transcendental equations, which are much more frequently found in practice.

The theory of the greatest common algebraic divisor, in its entire generality, is of no use, even in pure science, unless in the elimination between equations of any degree whatever. But this last subject being omitted, the greatest common divisor is likewise dispensed with.

It is usual in the general theory of algebraic equations to consider the derived polynomials of entire functions of x. These polynomials are in fact useful in several circumstances, and particularly in the theory of equal roots; and in analytical geometry, they serve for the discussion of curves and the determination of their tangents. But since transcendental curves are very often encountered in practice, we give in our programme the calculation of the derivatives of algebraic and fractional functions, and transcendental functions, logarithmic, exponential, and circular. This has been long called for, not only because it must be of great assistance in the teaching of analytical geometry, but also because it will facilitate the elementary study of the infinitesimal calculus.

We have not retrenched any of the general ideas on the composition of an entire polynomial by means of factors corresponding to its roots. We retain several theorems rather because they contain the germs of useful ideas than because of their practical utility, and therefore wish the examiners to restrict themselves scrupulously to the programme.

The essential point in practice is to be able to determine conveniently an incommensurable root of an algebraic or transcendental equation, when encountered. Let us consider first an algebraic equation.

All the methods which have for their object to separate the roots, or to approximate to them, begin with the substitution of the series of consecutive whole numbers, in the first member of the equation. The direct substitution becomes exceedingly complicated, when the numbers substituted become large. It may be much shortened, however, by deducing the results from one another by means of their differences, and guarding against any possibility of error, by verifying some of those results, those corresponding to the numbers easiest to substitute, such as ± 10, ± 20. The teacher should not fail to explain this to his pupils.

Still farther: let us suppose that we have to resolve an equation of the third degree, and that we have recognized by the preceding calculations the necessity of substituting, between the numbers 2 and 3, numbers differing by a tenth, either for the purpose of continuing to effect the separation of the roots, or to approximate nearer to a root comprised between 2 and 3. If we knew, for the result corresponding to the substitution of 2, the first, second, and third differences of the results of the new substitutions, we could thence deduce those results themselves with as much simplicity, as in the case of the whole numbers. The new third difference, for example, will be simply the thousandth part of the old

third difference. We may also remark that there is no possibility of error, since, the numbers being deduced from one another, when we in this way arrive at the result of the substitution of 3, which has already been calculated, the whole work will thus be verified.

Let us suppose again that we have thus recognized that the equation has a root comprised between 2.3 and 2.4; we will approximate still nearer by substituting intermediate numbers, differing by 0.01, and employing the course just prescribed. As soon as the third differences can be neglected, the calculation will be finished at once, by the consideration of an equation of the second degree; or, if it is preferred to continue the approximations till the second differences in their turn may be neglected, the calculation will then be finished by a simple proportion.

When, in a transcendental equation $f(X)=0$, we have substituted in $f(X)$ equidistant numbers, sufficiently near to each other to allow the differences of the results to be neglected, commencing with a certain order, the 4th, for example, we may, within certain limits of x, replace the transcendental function by an algebraic and entire function of x, and thus reduce the search for the roots of $f(X)=0$ to the preceding theory.

Whether the proposed equation be algebraic or transcendental, we can thus, when we have obtained one root of it with a suitable degree of exactness, continue the approximation by the method of Newton.

PROGRAMME OF ALGEBRA.

Algebraic calculation.

Addition and subtraction of polynomials.—Reduction of similar terms.

Multiplication of monomials.—Use of exponents.—Multiplication of polynomials. Rule of the signs.—To arrange a polynomial.—Homogeneous polynomials.

Division of monomials. Exponent *zero*.—Division of polynomials. How to know if the operation will not terminate.—Division of polynomials when the dividend contains a letter which is not found in the divisor.

Equations of the first degree.

Resolution of numerical equations of the first degree with one or several unknown quantities by the method of substitution.—Verification of the values of the unknown quantities and of the degree of their exactness.

Of cases of impossibility or of indetermination.

Interpretation of negative values.—Use and calculation of negative quantities.

Investigation of general formulas for obtaining the values of the unknown quantities in a system of equations of the first degree with two or three unknown quantities.—Method of Bezout.—Complete discussion of these formulas for the case of two unknown quantities.—Symbols $\frac{m}{0}$ and $\frac{0}{0}$.

Discussion of three equations with three unknown quantities, in which the terms independent of the unknown quantities are null.

Equations of the second degree with one unknown quantity.

Calculus of radicals of the second degree.

Resolution of an equation of the second degree with one unknown quantity.—Double solution.—Imaginary values.

When, in the equation $ax^2+bx+c=0$, a converges towards 0, one of the roots increases indefinitely.—Numerical calculation of the two roots, when a is very small.

Decomposition of the trinomial x^2+px+q into factors of the first degree.—Relations between the coefficients and the roots of the equation $x^2+px+q=0$.

Trinomial equations reducible to the second degree.

Of the maxima and minima which can be determined by equations of the second degree.

Calculation of the *arithmetical* values of radicals.

Fractional exponents.—Negative exponents.

Of series.

Geometrical progressions.—Summation of the terms.

What we call a series.—Convergence and divergence.

A geometrical progression is convergent, when the ratio is smaller than unity; diverging, when it is greater.

The terms of a series may decrease indefinitely and the series not be converging.

A series, all the terms of which are positive, is converging, when the ratio of one term to the preceding one tends towards a *limit* smaller than unity, in proportion as the index of the rank of that term increases indefinitely.—The series is diverging when this *limit* is greater than unity. There is uncertainty when it is equal to unity.

In general, when the terms of a series decrease indefinitely, and are alternately positive and negative, the series is converging.

Combinations, arrangements, and permutations of m letters, when each combination must not contain the same letter twice.

Development of the entire and positive powers of a binomial.—General terms.

Development of $(a+b\sqrt{-1})^m$.

Limit towards which $\left(1+\frac{1}{m}\right)^m$ tends, when m increases indefinitely.

Summation of piles of balls.

Of logarithms and of their uses.

All numbers can be produced by forming all the powers of any positive number, greater or less than *one*.

General properties of logarithms.

When numbers are in geometrical progression, their logarithms are in arithmetical progression.

How to pass from one system of logarithms to another system.

Calculation of logarithms by means of the series which gives the logarithm of $n+1$, knowing that of n.—Calculation of Napierian logarithms.—To deduce from them those of Briggs. Modulus.

Use of logarithms whose base is 10.—Characteristics.—Negative characteristics. Logarithms entirely negative are not used in calculation.

A number being given, how to find its logarithm in the tables of Callet. A logarithm being given, how to find the number to which it belongs.—Use of the proportional parts.—Their application to appreciate the exactness for which we can answer.

Employment of the sliding rule.

Resolution of exponential equations by means of logarithms.

Compound interest. Annuities.

Derived functions.

Development of an entire function F $(x+h)$ of the binomial $(x+h)$.—Derivative of an entire function.—To return from the derivative to the function.

The derivative of a function of x is the limit towards which tends the ratio of the increment of the function to the increment h of the variable, in proportion as h tends towards zero.

Derivatives of trigonometric functions.

Derivatives of exponentials and of logarithms.

Rules to find the derivative of a sum, of a product, of a power, of a quotient of functions of x, the derivatives of which are known.

Of the numerical resolution of equations.

Changes experienced by an entire function $f(x)$ when x varies in a continuous manner.—When two numbers a and b substituted in an entire function $f(x)$ give results with contrary signs, the equation $f(x)=0$ has at least one real root not comprised between a and b. This property subsists for every species of function which remains continuous for all the values of x comprised between a and b.

An algebraic equation of uneven degree has at least one real root.—An algebraic equation of even degree, whose last term is negative, has at least two real roots.

Every equation $f(x)=0$, with coefficients either real or imaginary of the form $a+b\sqrt{-1}$, admits of a real or imaginary root of the same form. [Only the enunciation, and not the demonstration of this theorem, is required.]

If a is a root of an algebraic equation, the first member is divisible by $x-a$. An algebraic equation of the m^{th} degree has always m roots real or imaginary, and it cannot admit more.—Decomposition of the first members into factors of the first degree. Relations between the coefficients of an algebraic equation and its roots.

When an algebraic equation whose coefficients are real, admits an imaginary root of the form $a+b\sqrt{-1}$, it has also for a root the conjugate expression $a-b\sqrt{-1}$.

In an algebraic expression, complete or incomplete, the number of the positive roots cannot surpass the number of the variations; consequence, for negative roots.

Investigation of the product of the factors of the first degree common to two entire functions of x.—Determination of the roots common to two equations, the first members of which are entire functions of the unknown quantity.

By what character to recognize that an algebraic equation has equal roots.—How we then bring its resolution to that of several others of lower degree and of unequal roots.

Investigation of the commensurable roots of an algebraic equation with entire coefficients.

When a series of equidistant numbers is substituted in an entire function of the m^{th} degree, and differences of different orders between the results are formed, the differences of the m^{th} order are constant.

Application to the separation of the roots of an equation of the third degree.—Having the results of the substitution of -1, 0, and $+1$, to deduce therefrom, by means of differences, those of all other whole numbers, positive or negative.—The progress of the calculation leads of itself to the limits of the roots.—Graphical representation of this method.

Substitution of numbers equidistant *by a tenth*, between two consecutive whole numbers, when the inspection of the first results has shown its necessity.—This substitution is effected directly, or by means of new differences deduced from the preceding.

How to determine, in continuing the approximation towards a root, at what moment the consideration of the first difference is sufficient to give that root with all desirable exactness, by a simple proportion.

The preceding method becomes applicable to the investigation of the roots of a transcendental equation $X=0$, when there have been substituted in the first member, numbers equidistant and sufficiently near to allow the differences of the results to be considered as constant, starting from a certain order.—Formulas of interpolation.

Having obtained a root of an algebraic or transcendental equation, with a certain degree of approximation, to approximate still farther by the method of Newton.

Resolution of two numerical equations of the second degree with two unknown quantities.

Decomposition of rational fractions into simple fractions.

IV. TRIGONOMETRY.

In explaining the use of trigonometrical tables, the pupil must be able to tell with what degree of exactness an angle can be determined by the logarithms of any of its trigonometrical lines. The consideration of the proportional parts will be sufficient for this. It will thus be seen that if the *sine* determines perfectly a small angle, the degree of exactness, which may be expected from the use of that line, diminishes as the angle increases, and becomes quite insufficient in the neighborhood of 90 degrees. It is the reverse for the *cosine*, which may serve very well to represent an angle near 90 degrees, while it would be very inexact for small angles. We see, then, that in our applications, we should distrust those formulas which give an angle by its sine or cosine. The *tangent*

being alone exempt from these difficulties, we should seek, as far as possible, to resolve all questions by means of it. Thus, let us suppose that we know the hypotheuuse and one of the sides of a right-angled triangle, the direct determination of the included angle will be given by a cosine, which will be wanting in exactness if the hypothenuse of the triangle does not differ much from the given side. In that case we should begin by calculating the third side, and then use it with the first side to determine the desired angle by means of its tangent. When two sides of a triangle and the included angle are given, the tangent of the half difference of the desired angles may be calculated with advantage; but we may also separately determine the tangent of each of them. When the three sides of a triangle are given, the best formula for calculating an angle, and the only one never at fault, is that which gives the tangent of half of it.

The surveying for plans, taught in the course of Geometry, employing only graphical methods of calculation, did not need any more accurate instruments than the chain and the graphometer; but now that trigonometry furnishes more accurate methods of calculation, the measurements on the ground require more precision. Hence the requirement for the pupil to measure carefully a base, to use telescopes, verniers, etc., and to make the necessary calculations, the ground being still considered as plane. But as these slow and laborious methods can be employed for only the principal points of the survey, the more expeditious means of the plane-table and compass will be used for the details.

In spherical trigonometry, all that will be needed in geodesy should be learned before admission to the school, so that the subject will not need to be again taken up. We have specially inscribed in the programme the relations between the angles and sides of a right-angled triangle, which must be known by the students; they are those which occur in practice. In tracing the course to be pursued in the resolution of the three cases of any triangles, we have indicated that which is in fact employed in the applications, and which is the most convenient. As to the rest, ambiguous cases never occur in practice, and therefore we should take care not to speak of them to learners.

In surveying, spherical trigonometry will now allow us to consider cases in which the signals are not all in the same plane, and to operate on uneven ground, obtain its projection on the plane of the horizon, and at the same time determine differences of level.

It may be remarked that Descriptive Geometry might supply the place of spherical trigonometry by a graphical construction, but the degree of exactitude of the differences of level thus obtained would be insufficient.

PROGRAMME OF TRIGONOMETRY.

1. PLANE TRIGONOMETRY.

Trigonometrical lines.—Their ratios to the radius are alone considered.—Relations of the trigonometric lines of the same angle.—Expressions of the sine and of the cosine in functions of the tangent.

Knowing the sines and the cosines of two arcs a and b, to find the sine and the cosine of their sum and of their difference.—To find the tangent of the sum or of the difference of two arcs, knowing the tangents of those arcs.

Expressions for sin. $2a$ and sin. $3a$; cos. $2a$ and cos. $3a$; tang. $2a$ and tang. $3a$.

Knowing sin. a or cos. a, to calculate sin. $\frac{1}{2}a$ and cos. $\frac{1}{2}a$.

Knowing tang. a, to calculate tang. $\frac{1}{2}a$.

Knowing sin. a, to calculate sin. $\frac{1}{3}a$.—Knowing cos. a, to calculate cos. $\frac{1}{3}a$.

Use of the formula $\cos. p + \cos. q = 2\cos. \frac{1}{2}(p+q)\cos. \frac{1}{2}(p-q)$, to render logarithms applicable to the sum of two trigonometrical lines, sines or cosines.—To render logarithms applicable to the sum of two tangents.

Construction of the trigonometric tables.

Use in detail of the tables of Callet.—Appreciation, by the proportional parts, of the degree of exactness in the calculation of the angles.—Superiority of the tangent formulas.

Resolution of triangles.

Relations between the angles and the sides of a right-angled triangle, or of any triangle whatever.—When the three angles of a triangle are given, these relations determine only the ratios of the sides.

Resolution of right-angled triangles.—Of the case in which the hypothenuse and a side nearly equal to it are given.

Knowing a side and two angles of any triangle, to find the other parts, and also the surface of the triangle.

Knowing two sides a and b of a triangle and the included angle C, to find the other parts and also the surface of the triangle.—The tang. $\frac{1}{2}(A-B)$ may be determined; or tang. A and tang. B directly.

Knowing the three sides a, b, c, to find the angles and the surface of the triangle.—Employment of the formula which gives tang. $\frac{1}{2}$ A.

Application to surveying for plans.

Measurement of bases with rods.

Measurement of angles.—Description and use of the circle.—Use of the telescope to render the line of sight more precise.—Division of the circle.—Verniers.

Measurement and calculation of a system of triangles.—Reduction of angles to the centres of stations.

How to connect the secondary points to the principal system.—Use of the plane table and of the compass.

2. SPHERICAL TRIGONOMETRY.

Fundamental relations ($\cos. a = \cos. b \cos. c + \sin. b \sin. c \cos. A$) between the sides and the angles of a spherical triangle.

To deduce thence the relations sin. A : sin. B = sin. a : sin. b; cot. a sin. b − cot. A sin. C = cos. b cos. C, and by the consideration of the supplementary triangle cos. A = − cos. B cos. C + sin. B sin. C cos. a.

Right-angled triangles.—Formulas cos. a = cos. b cos. c; sin. b = sin. a sin. B; tang. c = tang. a cos. B, and tang. b = sin. c tang. B.

In a right-angled triangle the three sides are less than 90°, or else two of the sides are greater than 90°, and the third is less. An angle and the side opposite to it are both less than 90°, or both greater.

Resolution of any triangles whatever:

1° Having given their three sides a, b, c, or their three angles A, B, C.—Formulas tang. $\frac{1}{2}a$, and tang. $\frac{1}{2}$ A, calculable by logarithms:

2° Having given two sides and the included angle, or two angles and the included side.—Formulas of Delambre:

3° Having given two sides and an angle opposite to one of them, or two angles and a side opposite to one of them. Employment of an auxiliary angle to render the formulas calculable by logarithms.

Applications.—Survey of a mountainous country.—Reduction of the base and of the angles to the horizon.—Determination of differences of level.

Knowing the latitude and the longitude of two points on the surface of the earth, to find the distance of those points.

V. ANALYTICAL GEOMETRY.

The important property of homogeneity must be given with clearness and simplicity.

The transformation of co-ordinates must receive some numerical applications, which are indispensable to make the student clearly see the meaning of the formulas.

The determination of tangents will be effected in the most general manner by means of the derivatives of the various functions, which we inserted in the programme of algebra. After having shown that this determination depends on the calculation of the derivative of the ordinate with respect to the abscissa, this will be used to simplify the investigation of the tangent to curves of the second degree and to curves whose equations contain transcendental functions. The discussion of these, formerly pursued by laborious indirect methods, will now become easy; and as curves with transcendental equations are frequently encountered, it will be well to exercise students in their discussion.

The properties of foci and of the directrices of curves of the second degree will be established directly, for each of the three curves, by means of the simplest equations of these curves, and without any consideration of the analytical properties of foci, with respect to the general equation of the second degree. With even greater reason will we dispense with examining whether curves of higher degree have foci, a question whose meaning even is not well defined.

We retained in algebra the elimination between two equations of the second degree with two unknown quantities, a problem which corresponds to the purely analytical investigation of the co-ordinates of the points of intersection of two curves of the second degree. The final equation is in general of the fourth degree, but we may sometimes dispense with calculating that equation. A graphical construction of the curves, carefully made, will in fact be sufficient to make known, approximately, the co-ordinates of each of the points of intersection; and when we shall have thus obtained an approximate solution, we will often be able to give it all the numerical rigor desirable, by successive approximations, deduced from the equations. These considerations will be extended to the investigation of the real roots of equations of any form whatever with one unknown quantity.

Analytical geometry of three dimensions was formerly entirely taught within the Polytechnic school, none of it being reserved for the course of admission. For some years past, however, candidates were required to know the equations of the right line in space, the equation of the plane, the solution of the problems which relate to it and the transfor-

mation of co-ordinates. But the consideration of surfaces of the second order was reserved for the interior teaching. We think it well to place this also among the studies to be mastered before admission, in accordance with the general principle now sought to be realized, of classing with them that double instruction which does not exact a previous knowledge of the differential calculus.

We have not, however, inserted here all the properties of surfaces of the second order, but have retained only those which it is indispensable to know and to retain. The transformation of rectilinear co-ordinates, for example, must be executed with simplicity, and the teacher must restrict himself to giving his pupils a succinct explanation of the course to be pursued; this will suffice to them for the very rare cases in which they may happen to have need of them. No questions will be asked relating to the general considerations, which require very complicated theoretical discussions, and especially that of the general reduction of the equation of the second degree with three variables. We have omitted from the problems relating to the right line and to the plane, the determination of the shortest distance of two right lines.

The properties of surfaces of the second order will be deduced from the equations of those surfaces, taken directly in the simplest forms. Among these properties, we place in the first rank, for their valuable applications, those of the surfaces which can be generated by the movement of a right line.

PROGRAMME OF ANALYTICAL GEOMETRY.

1. GEOMETRY OF TWO DIMENSIONS.

Rectilinear co-ordinates.—Position of a point on a plane.

Representation of geometric loci by equations.

Homogencity of equations and of formulas.—Construction of algebraic expressions.

Transformation of rectilinear co-ordinates.

Construction of equations of the first degree.—Problems on the right line.

Construction of equations of the second degree.—Division of the curves which they represent into three classes.—Reduction of the equation to its simplest form by the change of co-ordinates.*

Problem of tangents.—The coefficient of inclination of the tangent to the curve, to the axis of the abscissas, is equal to the derivative of the ordinate with respect to the abscissa.

Of the ellipse.

Centre and axes.—The squares of the ordinates perpendicular to one of the axes are to each other as the products of the corresponding segments formed on that axis.

The ordinates perpendicular to the major axis are to the corresponding ordinates of the circle described on that axis as a diameter, in the constant ratio of the minor axis to the major.—Construction of the curve by points, by means of this property.

Foci; eccentricity of the ellipse.—The sum of the radii vectors drawn to any point of the ellipse is constant and equal to the major axis.—Description of the ellipse by means of this property.

* The students will apply these reductions to a numerical equation of the second degree, and will determine the situation of the new axes with respect to the original axes, by means of trigonometrical tables. They will show to the examiner the complete calculations of this reduction and the trace of the two systems of axes and of the curves.

Directrices.—The distance from each point of the ellipse to one of the foci, and to the directrix adjacent to that focus, are to each other as the eccentricity is to the major axis.

Equations of the tangent and of the normal at any point of the ellipse.*—The point in which the tangent meets one of the axes prolonged is independent of the length of the other axis.—Construction of the tangent at any point of the ellipse by means of this property.

The radii vectores, drawn from the foci to any point of the ellipse, make equal angles with the tangent at that point or the same side of it.—The normal bisects the angle made by the radii vectores with each other.—This property may serve to draw a tangent to the ellipse through a point on the curve, or through a point exterior to it.

The diameters of the ellipse are right lines passing through the centre of the curve.—The chords which a diameter bisects are parallel to the tangent drawn through the extremity of that diameter.—Supplementary chords. By means of them a tangent to the ellipse can be drawn through a given point on that curve or parallel to a given right line.

Conjugate diameters.—Two conjugate diameters are always parallel to supplementary chords, and reciprocally.—Limit of the angle of two conjugate diameters.—An ellipse always contains two equal conjugate diameters.—The sum of the squares of two conjugate diameters is constant.—The area of the parallelogram constructed on two conjugate diameters is constant.—To construct an ellipse, knowing two conjugate diameters and the angle which they make with each other.

Expression of the area of an ellipse in function of its axes.

Of the hyperbola.

Centre and axes.—Ratio of the squares of the ordinates perpendicular to the transverse axes.

Of foci and of directrices; of the tangent and of the normal; of diameters and of supplementary chords.—Properties of these points and of these lines, analogous to those which they possess in the ellipse.

Asymptotes of the hyperbola.—The asymptotes coincide with the diagonals of the parallelogram formed on any two conjugate diameters.—The portions of a secant comprised between the hyperbola and its asymptotes are equal.—Application to the tangent and to its construction.

The rectangle of the parts of a secant, comprised between a point of the curve and the asymptotes, is equal to the square of half of the diameter to which the secant is parallel.

Form of the equation of the hyperbola referred to its asymptotes.

Of the parabola.

Axis of the parabola.—Ratio of the squares of the ordinates perpendicular to the axis.

Focus and directrix of the parabola.—Every point of the curve is equally distant from the focus and from the directrix.—Construction of the parabola.

The parabola may be considered as an ellipse, in which the major axis is indefinitely increased while the distance from one focus to the adjacent summit remains constant.

Equations of the tangent and of the normal.—Sub-tangent and sub-normal. They furnish means of drawing a tangent at any point of the curve.

The tangent makes equal angles with the axis and with the radius vector drawn to the point of contact.—To draw, by means of this property, a tangent to the parabola, 1° through a point on the curve; 2° through an exterior point.

All the diameters of the parabola are right lines parallel to the axis, and reciprocally.—The chords which a diameter bisects are parallel to the tangent drawn at the extremity of that diameter.

Expression of the area of a parabolic segment.

Polar co-ordinates.—To pass from a system of rectilinear and rectangular co-ordinates to a system of polar co-ordinates, and reciprocally.

Polar equations of the three curves of the second order, the pole being situated at a focus, and the angles being reckoned from the axis which passes through that focus.

Summary discussion of some transcendental curves.—Determination of the tangent at one of their points.

Construction of the real roots of equations of any form with one unknown quantity.—Investigation of the intersections of two curves of the second degree.—Numerical applications of these formulas.

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* They will be deduced from the property, previously demonstrated, of the derivative of the ordinate with respect to the abscissa.

2. GEOMETRY OF THREE DIMENSIONS.

The sum of the projections of several consecutive right lines upon an axis is equal to the projection of the resulting line.—The sum of the projections of a right line on three rectangular axes is equal to the square of the right line.—The sum of the squares of the cosines of the angles which a right line makes with three rectangular right lines is equal to unity.

The projection of a plane area on a plane is equal to the product of that area by the cosine of the angle of the two planes.

Representation of a point by its co-ordinates.—Equations of lines and of surfaces.

Transformation of rectilinear co-ordinates.

Of the right line and of the plane.

Equations of the right line.—Equation of the plane.

To find the equations of a right line, 1° which passes through two given points, 2° which passes through a given point and which is parallel to a given line.

To determine the point of intersection of two right lines whose equations are known.

To pass a plane, 1° through three given points; 2° through a given point and parallel to a given plane; 3° through a point and through a given right line.

Knowing the equations of two planes, to find the projections of their intersection.

To find the intersection of a right line and of a plane, their equations being known.

Knowing the co-ordinates of two points, to find their distance.

From a given point to let fall a perpendicular on a plane; to find the foot and the length of that perpendicular (rectangular co-ordinates).

Through a given point to pass a plane perpendicular to a given right line (rectangular co-ordinates).

Through a given point, to pass a perpendicular to a given right line; to determine the foot and the length of that perpendicular (rectangular co-ordinates).

Knowing the equations of a right line, to determine the angles which that line makes with the axes of the co-ordinates (rectangular co-ordinates).

To find the angle of two right lines whose equations are known (rectangular co-ordinates).

Knowing the equation of a plane, to find the angles which it makes with the co-ordinate planes (rectangular co-ordinates).

To determine the angle of two planes (rectangular co-ordinates).

To find the angle of a right line and of a plane (rectangular co-ordinates).

Surfaces of the second degree.

They are divided into two classes; one class having a centre, the other not having any. Co-ordinates of the centre.

Of diametric planes.

Simplification of the general equation of the second degree by the transformation of co-ordinates.

The simplest equations of the ellipsoid, of the hyperboloid of one sheet and of two sheets, of the elliptical and the hyperbolic paraboloid, of cones and of cylinders of the second order.

Nature of the plane sections of surfaces of the second order.—Plane sections of the cone, and of the right cylinder with circular base.—Anti-parallel section of the oblique cone with circular base.

Cone asymptote to an hyperboloid.

Right-lined sections of the hyperboloid of one sheet.—Through each point of a hyperboloid of one sheet two right lines can be drawn, whence result two systems of right-lined generatrices of the hyperboloid.—Two right lines taken in the same system do not meet, and two right lines of different systems always meet.—All the right lines situated on the hyperboloid being transported to the centre, remaining parallel to themselves, coincide with the surface of the asymptote cone.—Three right lines of the same system are never parallel to the same plane.—The hyperboloid of one sheet may be generated by a right line which moves along three fixed right lines, not parallel to the same plane; and, reciprocally, when a right line slides on three fixed lines, not parallel to the same plane, it generates a hyperboloid of one sheet.

Right-lined sections of the hyperbolic paraboloid.—Through each point of the surface of the hyperbolic paraboloid two right lines may be traced, whence results the generation of the paraboloid by two systems of right lines.—Two right lines of the same system do not meet, but two right lines of different systems always meet.—All the right lines of the same system are parallel to the same plane.—The hyperbolic paraboloid may be generated by the movement of a right line which slides on three fixed right lines which are parallel to the same plane; or by a right line which slides on two fixed right lines, itself remaining always parallel to a given plane. Reciprocally, every surface resulting from one of these two modes of generation is a hyperbolic paraboloid.

General equations of conical surfaces and of cylindrical surfaces.

VI. DESCRIPTIVE GEOMETRY.

The general methods of Descriptive Geometry,—their uses in Stone-cutting and Carpentry, in Linear Perspective, and in the determination of the Shadows of bodies,—constitute one of the most fruitful branches of the applications of mathematics. The course has always been given at the Polytechnic School with particular care, according to the plans traced by the illustrious *Monge*, but no part of the subject has heretofore been required for admission. The time given to it in the school, being however complained of on all sides as insufficient for its great extent and important applications, the general methods of Descriptive Geometry will henceforth be retrenched from the internal course, and be required of all candidates for admission.

As to the programme itself, it is needless to say any thing, for it was established by *Monge*, and the extent which he gave to it, as well as the methods which he had created, have thus far been maintained. We merely suppress the construction of the shortest distance between two right lines, which presents a disagreeable and useless complication.

Candidates will have to present to the examiner a collection of their graphical constructions (*épures*) of all the questions of the programme, signed by their teacher. They are farther required to make free-hand sketches of five of their *épures*.

PROGRAMME OF DESCRIPTIVE GEOMETRY.

*Problems relating to the point, to the straight line, and to the plane.**

Through a point given in space, to pass a right line parallel to a given right line, and to find the length of a part of that right line.

Through a given point, to pass a plane parallel to a given plane.

To construct the plane which passes through three points given in space.

Two planes being given, to find the projections of their intersection.

A right line and a plane being given, to find the projections of the point in which the right line meets the plane.

Through a given point, to pass a perpendicular to a given plane, and to construct the projections of the point of meeting of the right line and of the plane.

Through a given point, to pass a right line perpendicular to a given right line, and to construct the projections of the point of meeting of the two right lines.

A plane being given, to find the angles which it forms with the planes of projection.

Two planes being given, to construct the angle which they form between them.

Two right lines which cut each other being given, to construct the angle which they form between them.

To construct the angle formed by a right line and by a plane given in position in space.

Problems relating to tangent planes.

To draw a plane tangent to a cylindrical surface or to a conical surface, 1° through a point taken on the surface; 2° through a point taken out of the surface; 3° parallel to a given right line.

Through a point taken on a surface of revolution, whose meridian is known, to pass a plane tangent to that surface.

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* The method of the change of the planes of projection will be used for the resolution of these problems.

Problems relating to the intersection of surfaces.

To construct the section made, on the surface of a right and vertical cylinder, by a plane perpendicular to one of the planes of projection.—To draw the tangent to the curve of intersection.—To make the development of the cylindrical surface, and to refer to it the curve of intersection, and also the tangent.

To construct the intersection of a right cone by a plane perpendicular to one of the planes of projection. Development and tangent.

To construct the right section of an oblique cylinder.—To draw the tangent to the curve of intersection. To make the development of the cylindrical surface, and to refer to it the curve which served as its base, and also its tangents.

To construct the intersection of a surface of revolution by a plane, and the tangents to the curve of intersection.—To resolve this question, when the generating line is a right line which does not meet the axis.

To construct the intersection of two cylindrical surfaces, and the tangents to that curve.

To construct the intersection of two oblique cones, and the tangents to that curve.

To construct the intersection of two surfaces of revolution whose axes meet.

VII. OTHER REQUIREMENTS.

The preceding six heads complete the outline of the elementary course of mathematical instruction which it was the object of this article to present; but a few more lines may well be given to a mere enumeration of the other requirements for admission to the school.

MECHANICS comes next. The programme is arranged under these heads: Simple motion and compound motion; Inertia; Forces applied to a free material point; Work of forces applied to a movable point; Forces applied to a solid body; Machines.

PHYSICS comprises these topics: General properties of bodies; Hydrostatics and hydraulics; Densities of solids and liquids; Properties of gases; Heat; Steam; Electricity; Magnetism; Acoustics; Light.

CHEMISTRY treats of Oxygen; Hydrogen; Combinations of hydrogen with oxygen; Azote or nitrogen; Combinations of azote with oxygen; Combination of azote with hydrogen, or ammonia; Sulphur; Chlorine; Phosphorus; Carbon.

COSMOGRAPHY describes the Stars; the Earth; the Sun; the Moon; the Planets; Comets; the Tides.

HISTORY and GEOGRAPHY treat of Europe from the Roman Empire to the accession of Louis XVI.

GERMAN must be known sufficiently for it to be translated, spoken a little, and written in its own characters.

DRAWING, besides the *épures* of descriptive geometry, must have been acquired sufficiently for copying an academic study, and shading in pencil and in India ink.

Will not our readers agree with M. Coriolis, that "*There are very few learned mathematicians who could answer perfectly well at an examination for admission to the Polytechnic School*"?

SCHOOLS OF PREPARATION FOR THE POLYTECHNIC SCHOOL.

THERE are strictly speaking no Junior Military Schools preparatory to the Polytechnic School, or to the Special Military School at St. Cyr. These schools are recruited in general from the *Lycées* and other schools for secondary instruction, upon which they exert a most powerful influence. Until 1852 there was no special provision made in the courses of instruction in the *Lycées* for the mathematical preparation required for admission into the Polytechnic, and the Bachelor's degree in science could not be obtained without being able to meet the requirements in Latin, rhetoric, and logic for graduation in the arts, which was necessary to the profession of law, medicine, and theology. In consequence, young men who prepared to be candidates for the preliminary examinations at the Polytechnic and the St. Cyr, left the *Lycées* before graduation in order to acquire more geometry and less literature in the private schools, or under private tuition.

A new arrangement, popularly called the *Bifurcation*, was introduced by the Decrees of the 10th of April, 1852; and has now come into operation. The conditions demanded for the degree in science were adapted to the requirements of the Military Schools; and in return for this concession it is henceforth to be exacted from candidates for the Military Schools. The diploma of arts is no longer required before the diploma of science can be given. The instruction, which in the upper classes of the *Lycées* had hitherto been mainly preparatory for the former, takes henceforth at a certain point (called that of *Bifurcation*) two different routes, conducting separately, the one to the baccalaureate of arts, the other to that of science. The whole system of teaching has accordingly been altered. Boys wanting to study algebra are no longer carried through a long course of Latin; mathematics are raised to an equality with literature; and thus military pupils—pupils desirous of admission at the Polytechnic and St. Cyr, may henceforth, it is hoped, obtain in the *Lycées* all the preparation which they had latterly sought elsewhere.

Under this new system the usual course for a boy seems to be the following:—

He enters the *Lycée*, in the Elementary Classes; or, a little later, in the Grammar Classes, where he learns Latin and begins Greek. At the age of about fourteen, he is called upon to pass an examination for admission into the Upper Division, and here, in accordance with the new regulations, he makes his choice for mathematics or for literature, the studies henceforth being divided, one course leading to the bachelorship of science, the other to that of arts.

In either case he has before him three yearly courses, three classes—the Third, the Second, and what is called the Rhetoric. At the close of this, or after passing, if he pleases, another year in what is called the Logic, he may go up for his bachelor's degree. The boy who wants to go to St. Cyr or the Polytechnic chooses, of course, the mathematical division leading to the diploma he will want, that of a bachelor of *science*. He accordingly begins algebra, goes on to trigonometry, to conic sections, and to mechanics, and through corresponding stages in natural philosophy, and the like. If he chooses to spend a fourth year in the Logic, he will be chiefly employed in going over his subjects again. He may take his bachelor's degree at any time after finishing his third year; and he may, if he pleases, having taken that, remain during a fifth or even a sixth year, in the class of Special Mathematics.

If he be intended for St. Cyr, he may very well leave at the end of his year in Rhetoric, taking of course his degree. One year in the course of Special Mathematics will be required before he can have a chance for the Polytechnic. Usually the number of students admitted at the latter, who have not passed more than one year in the *mathematiques spéciales* is very small. Very probably the young aspirant would try at the end of his first year in this class, and would learn by practice to do better at the end of the second.

The following are the studies of the mathematical section of the upper division as laid down by the ordinance of 30th August, 1854.

THE THIRD CLASS (*Troisième*,) at fourteen years old.

Arithmetic and first notions of Algebra. Plane Geometry and its applications. First notions of Chemistry and Physics. General notions of Natural History; Principles of classification. Linear and imitative Drawing.

THE SECOND CLASS (*Seconde*,) at fifteen years old.

Algebra; Geometry, figures in space, recapitulation; Applications of Geometry, notions of the geometrical representations of bodies by projections; Rectilineal Trigonometry; Chemistry; Physics; and Drawing.

THE RHETORIC, at sixteen years old.

Exercises in Arithmetic and Algebra; Geometry; notions on some common curves; and general recapitulation; Applications of Geometry; notions of leveling and its processes; recapitulation of Trigonometry; Cosmography; Mechanics; Chemistry concluded and reviewed; Zoölogy and Animal Physiology; Botany and Vegetable Physiology; Geology; Drawing. (The pupil may now be ready for the Degree and for St. Cyr.)

THE LOGIC, at seventeen years old.

Six lessons a week are employed in preparation for the bachelorship of science, and in a methodical recapitulation of the courses of the three preceding years according to the state of the pupil's knowledge.

Two lessons a week are allowed for reviewing the literary instruction; evening lessons in Latin, French, English, and German, and in History and Geography, having been given through the whole previous time.

THE SPECIAL MATHEMATICS, at eighteen and nineteen years old.

Five lessons a week are devoted to these studies; in the other lessons the pupils join those of the Logic class for reviewing all their previous subjects, whether for the bachelorship in science or for competition for admission at the *Ecole Normale* or the Polytechnic.

It will only be necessary to add a few sentences in explanation of the methods pursued in the upper classes of the *Lycées*. The classes are large—from 80 to above 100; the lessons strictly professorial lectures, with occasional questions, as at the Polytechnic itself. In large establishments the class is divided, and two professors are employed, giving two parallel courses on the same subject. To correct and fortify this general teaching, we find, corresponding to the interrogations of the Polytechnic, what are here called conferences. The members of the large class are examined first of all in small detachments of five or six by their own professors once a week; and, secondly, a matter of yet greater importance, by the professor who is conducting the parallel course, and by professors who are engaged for this purpose from other *Lycées* and preparatory schools, and from among the *répétiteurs* of the Polytechnic and the Ecole Normale themselves. It appeared by the table of the examinations of this latter kind which had been passed by the pupils of the class of Special Mathematics at the *Lycée* St. Louis, that the first pupil on the list had in the interval between the opening of the school and the date of our visit (February 16th) gone through as many as twenty-four.

The assistants, who bear the name of *répétiteurs* at the *Lycées*, do not correspond in any sense to those whom we shall hereafter notice at the Ecole Polytechnique. They are in the *Lycées* mere superintendents in the *salles d'étude*, who attend to order and discipline, who give some slight occasional help to the pupils, and may be em-

ployed in certain cases, where the parents wish for it, in giving private tuition to the less proficient. The system of *salles d'étude* appears to prevail universally; the number of the pupils placed in each probably varying greatly. At the Polytechnic we found eight or ten pupils in each; at St. Cyr as many as 200. The number considered most desirable at the *Lycée* of St. Louis was stated to be thirty.

It thus appears that in France not only do private establishments succeed in giving preparation for the military schools, but that even in the first-class public schools, which educate for the learned professions, it has been considered possible to conduct a series of military or science classes by the side of the usual literary or arts classes. The common upper schools are not, as they used to be, and as with us they are, *Grammar* schools, they are also *Science* schools. In every *Lycée* there is, so to say, a sort of elementary polytechnic department, giving a kind of instruction which will be useful to the future soldier, and at the same time to others, to those who may have to do with mines, manufactures, or any description of civil engineering. There is thus no occasion for Junior Military Schools in France, for all the schools of this class are more or less of a military character in their studies.

The conditions of admission to the examination for the degree of Bachelor of Science are simply, sixteen years of age, and the payment of fees amounting to about 200 fr. (10*l.*) Examinations are held three times a year by the Faculties at Paris, Besançon, Bordeaux, Caen, Clermont, Dijon, Grenoble, Lille, Lyons, Marseilles, Montpellier, Nancy, Poitiers, Rennes, Strasburg, and Toulouse, and once a year at Ajaccio, Algiers, and nineteen other towns. There is a written examination of six hours, and a vivâ voce examination of an hour and a quarter. It is, of course, only a *pass* examination, and is said to be much less difficult than the competitive examination for admission to St. Cyr.—*Report of English Commissioners*, 1856.

THE POLYTECHNIC SCHOOL OF FRANCE.

CONTENTS.

THE POLYTECHNIC SCHOOL AT PARIS.*

I. FOUNDATION AND HISTORY.

The origin of the *Ecole Polytechnique* dates from a period of disorder and distress in the history of France which might seem alien to all intellectual pursuits, if we did not remember that the general stimulus of a revolutionary period often acts powerfully upon thought and education. It is, perhaps, even more than the Institute, the chief scientic creation of the first French Revolution. It was during the government of the committee of public safety, when Carnot, as war minister, was gradually driving back the invading armies, and reorganizing victory out of defeat and confusion, that the first steps were taken for its establishment. A law, dating the 1st Ventose, year II., the 12th of March 1794, created a "Commission des Travaux Publics," charged with the duty of establishing a regular system for carrying on public works; and this commission ultimately founded a central school for public works, and drew up a plan for the competitive examination of candidates for admission to the service. It was intended at first to give a complete education for some of the public services, but it was soon changed into a preparatory school, to be succeeded by special schools of application. This was the Ecole Polytechnique.

The school and its plan were both owing to an immediate and pressing want. It was to be partly military and partly civil. Military, as well as civil education had been destroyed by the revolutionists. The committee of public safety had, indeed, formed a provisional school for engineers at Metz, to supply the immediate wants of the army on the frontier, and at this school young men were hastily taught the elements of fortification, and were sent direct to the troops, to learn as they best could, the practice of their art. "But such a method," says the report accompanying the law which founded the school, "does not form engineers *in any true sense of the term*, and can only be justified by the emergency of the

* Compiled from "*Report and Appendix of English Commissioners on Military Education.*" 1857.

time. The young men should be recalled to the new school to complete their studies." Indeed no one knew better than Carnot, to use the language of the report, "that patriotism and courage can not "always supply the want of knowledge;" and in the critical campaigns of 1793—4, he must often have felt the need of the institution which he was then contributing to set on foot. Such was the immediate motive for the creation of this school. At first, it only included the engineers amongst its pupils. But the artillery were added within a year.

We must not, however, omit to notice its civil character, the combination of which with its military object forms its peculiar feature, and has greatly contributed to its reputation. Amongst its founders were men, who though ardent revolutionists, were thirsting for the restoration of schools and learning, which for a time had been totally extinguished. The chief of these, besides Carnot, were Monge and Fourcroy, Berthollet and Lagrange. Of Carnot and Lagrange, one amongst the first of war ministers, the other one of the greatest of mathematicians, we need not say more. Berthollet, a man of science and practical skill, first suggested the school; Monge, the founder of Descriptive Geometry, a favorite *savant* of Napoleon though a zealous republican, united to real genius that passion for teaching and for his pupils, which makes the *beau idéal* of the founder of a school; and Fourcroy was a man of equal practical tact and science, who at the time had great influence with the convention, and was afterwards intrusted by Napoleon with much of the reorganization of education in France.

When the school first started there was scarcely another of any description in the country. For nearly three years the revolution had destroyed every kind of teaching. The attack upon the old schools, in France, as elsewhere, chiefly in the hands of the clergy, had been begun by a famous report of Talleyrand's, presented to the legislative assembly in 1791, which recommended to suppress all the existing academies within Paris and the provinces, and to replace them by an entirely new system of national education through the country. In this plan a considerable number of military schools were proposed, where boys were to be educated from a very early age. When the violent revolutionists were in power, they adopted the destructive part of Talleyrand's suggestions without the other. All schools, from the university downwards, were destroyed; the large exhibitions or *Bourses*, numbering nearly 40,000, were confiscated or plundered by individuals, and even the military schools and those for the public works (which were abso-

lutely necessary for the very roads and the defense of the country) were suppressed or disorganized. The school of engineers at Mézières (an excellent one, where Monge had been a professor,) and that of the artillery at La Fère, were both broken up, whilst the murder of Lavoisier, and the well known saying in respect to it, that "the Republic had no need of chemists," gave currency to a belief, which Fourcroy expressed in proposing the Polytechnic, "that the late conspirators had formed a deliberate plan to destroy the arts and sciences, and to establish their tyranny on the ruins of human reason."

Thus it was on the ruin of all the old teaching, that the new institution was erected; a truly *revolutionary* school, as its founders delighted to call it, using the term as it was then commonly used, as a synonym for all that was excellent. And then for the first time avowing the principle of public competition, its founders, Monge and Fourcroy, began their work with an energy and enthusiasm which they seem to have left as a traditional inheritance to their school. It is curious to see the difficulties which the bankruptcy of the country threw in their way, and the vigor with which, assisted by the summary powers of the republican government, they overcame them. They begged the old Palais Bourbon for their building; were supplied with pictures from the Louvre; the fortunate capture of an English ship gave them some uncut diamonds for their first experiments; presents of military instruments were sent from the arsenals of Havre; and even the hospitals contributed some chemical substances In fine, having set their school in motion, the government and its professors worked at it with such zeal and effect, that within five months after their project was announced, they had held their first entrance examination, open to the competition of all France, and started with three hundred and seventy-nine pupils.

The account of one of these first pupils, who is among the most distinguished still surviving ornaments of the Polytechnic, will convey a far better idea of the spirit of the young institution than could be given by a more lengthy description. M. Biot described to us vividly the zeal of the earliest teachers, and the thirst for knowledge which, repressed for awhile by the horrors of the period, burst forth with fresh ardor amongst the French youth of the time. Many of them, he said, like himself, had been carried away by the enthusiasm of the revolution, and had entered the army. "My father had sent me," he added, "to a mercantile house, and indeed I never felt any great vocation to be a soldier, but *Que voulez vous?*

les Prussiens etaient en Champagne." He joined the army, served two years under Dumouriez, and returned to Paris in the reign of terror, "to see from his lodgings in the Rue St. Honore the very generals who had led us to victory, Custine and Biron, carried by in the carts to the guillotine. "Imagine what it was when we heard that Robespierre was dead, and that we might return safely to study after all this misery, and then to have for our teachers La Place, Lagrange, and Monge. We felt like men brought to life again after suffocation. Lagrange said, modestly, "Let me teach them arithmetic." Monge was more like our father than our teacher; he would come to us in the evening, and assist us in our work till midnight, and when he explained a difficulty to one of our *chefs de brigade*, it ran like an electric spark through the party." The pupils were not then, he told us, as they have since been, shut up in barracks, they were left free, but there was no idleness or dissipation amongst them. They were united in zealous work and in good *camaraderie*, and any one known as a bad character was avoided. This account may be a little tinged by enthusiastic recollections, but it agreed almost entirely with that of M. de Barante, who bore similar testimony to the early devotion of the pupils, and the unique excellence of the teaching of Monge.

We are not, however, writing a history of this school, and must confine ourselves to such points as directly illustrate its system of teaching and its organization. These may be roughly enumerated in the following order:

1. Its early history is completed by the law of its organization, given it by La Place in his short ministry of the interior. This occurred in the last month of 1799, a memorable era in French history, for it was immediately after the revolution of the 18th of Brumaire, when Napoleon overthrew the Directory and made himself First Consul. One of his earliest acts was to sign the charter of his great civil and military school. This charter or decree deserves some attention, because it is always referred to as the law of the foundation of the school. It determined the composition of the two councils of instruction and improvement, the bodies to which the direction of the school was to be, and still is, intrusted; some of its marked peculiarities in the mode and subject of teaching. It is important to notice each of the two points.

The direction of the school was at first almost entirely in the hands of its professors, who formed what is still called its Council of Instruction. Each of them presided over the school alternately for one month, a plan copied from the revolutionary government of

the Convention. In the course of a few years, however, another body was added, which has now the real management of the school. This is called the "Council of Improvement" (*Conseil de perfectionnement,*) and a part of its business is to see that the studies form a good preparation for those of the more special schools (*écoles d'application*) for the civil and military service. It consists of eminent men belonging to the various public departments supplied by the school, and some of the professors. It has had, as far as we could judge, an useful influence; *first*, as a body not liable to be prejudiced in its proposals by the feelings of the school, and yet interested in its welfare and understanding it; *secondly*, as having shown much skill in the difficult task of making the theoretical teaching of the Polytechnic a good introduction to the practical studies of the public service; *thirdly*, as being sufficiently influential, from the character of its members, to shield the school from occasional ill-judged interference. It should be added that hardly any year has passed without the Council making a full report on the studies of the school, with particular reference to their bearing on the Special Schools of Application.

The method of scientific teaching has been peculiar from the beginning. It is the most energetic form of what may be called the *repetitorial* system, a method of teaching almost peculiar to France, and which may be described as a very able combination of professional and tutorial teaching. The object of the *répétiteur*, or private tutor, is to second every lecture of the professor, to explain and fix it by ocular demonstration, explanations, or examination. This was a peculiarity in the scheme of Monge and Fourcroy. The latter said, in the first programme, "Our pupils must not only learn, they must at once carry out their theory. We must distribute them into small rooms, where they shall practice the plans of descriptive geometry, which the professors have just shown them in their public lectures. And in the same manner they must go over in practice (*répéteront*) in separate laboratories the principal operations of chemistry." To carry out this system the twenty best pupils, of whom M. Biot was one, were selected as *répétiteurs* soon after the school had started. Since then the vacancies have always been filled by young but competent men, aspiring themselves to become in turn professors. They form a class of teachers more like the highest style of private tutors in our universities, or what are called in Germany *Privat-docenten*, than any other body—with this difference, that they do not give their own lectures, but breaking up the professor's large class into small classes of five and six pupils, exam-

ine these in *his* lecture. The success of this attempt we shall de scribe hereafter.

2. A change may be noticed which was effected very early by the Council of Improvement—the union of pupils for artillery and engineers in a single school of application. The first report in December 1800, speaks of the identity in extent and character of the studies required for these two services; and in conformity with its recommendation, the law of the 3rd of October 1802, (12th Vendémiaire, XI.) dissolved the separate artillery school at Châlons, and established the united school for both arms in the form which it still retains at Metz.

3. In 1805 a curious change was made, and one very characteristic of the school. The pupils have always been somewhat turbulent, and generally on the side of opposition. In the earliest times they were constantly charged with *incivisme*, and the aristocracy was said to have "taken refuge within its walls." In fact, one of its earliest and of its few great *literary* pupils, M. de Barante, confirmed this statement, adding, as a reason, that the school gave for a while the only good instruction in France. It was in consequence of some of these changes that the pupils who had hitherto lived in their own private houses or lodgings in Paris, were collected in the school building. This "*casernement*," said to be immediately owing to a burst of anger of Napoleon, naturally tended to give the school a more military character; but it was regarded as an unfortunate change by its chief scientific friends. "*Ah! ma pauvre école!*" M. Biot told us he had exclaimed, when he saw their knapsacks on their beds. He felt, he said, that the enthusiasm of free study was gone, and that now they would chiefly work by routine and compulsion.

4. The year 1809 may be called the epoch at which the school attained its final character. By this time the functions, both of boards and teachers, were accurately fixed, some alterations in the studies had taken place, and the plan of a final examination had been drawn up, according to which the pupils were to obtain their choice of the branch of the public service they preferred. In fact, the school may be said to have preserved ever since the form it then assumed, under a variety of governments and through various revolutions, in most of which, indeed, its pupils have borne some share; and one of which, the restoration of 1816, was attended with its temporary dissolution.

Thus, during the first years after its foundation the Polytechnic grew and flourished in the general dearth of public teaching, being

indeed not merely the only great school, but, until the Institute was founded, the only scientific body in France. Working on its first idea of high professorial lectures, practically applied and explained by *répétiteurs*, its success in its own purely scientific line was, and has continued to be, astonishing. Out of its sixteen earliest professors, ten still retain an European name. Lagrange, Monge, Fourcroy, La Place, Guyton de Morveau were connected with it. Malus, Hauy, Biot, Poisson, and De Barante, were among its earliest pupils. Arago, Cauchy, Cavaignac, Lamoricière, with many more modern names, came later. All the great engineers and artillerymen of the empire belonged to it, and the long pages in its calendar of distinguished men are the measure of its influence on the civil and military services of France. In fact its pupils, at a time of enormous demands, supplied all the scientific offices of the army, and directed all the chief public works, fortresses, arsenals, the improvement of cities, the great lines of roads, shipbuilding, mining—carried out, in a word, most of the great improvements of Napoleon. He knew the value of his school, "the hen" as he called it, "that laid him golden eggs"—and perhaps its young pupils were not improved by the excessive official patronage bestowed by him upon "the envy of Europe," "the first school in the world." It can not, however, be matter of surprise, that its vigor and success should have caused Frenchmen, even those who criticise its influence severely, to regard it with pride as an institution unrivaled for scientific purposes.

It is not necessary to give any detailed account of the later history of the school, but we must remark that disputes have frequently arisen with regard to the best mode of harmonizing its teaching with that of the special schools of application to which it conducts. These disputes have been no doubt increased by the union of a civil and military object in the same school. The scientific teaching desirable for some of the higher civil professions has appeared of doubtful advantage to those destined for the more practical work of war. There has been always a desire on the one side to qualify pure mathematics by application, a strong feeling on the other that mathematical study sharpens the mind most keenly for some of the practical pursuits of after life. We should add, perhaps, that there has been some protest in France (though little heard among the scientific men who have been the chief directors of the school) against the *esprit faux*, the exclusive pursuit of mathematics to the utter neglect of literature, and the indifference to moral and historical studies. Some one or other of these com-

plaints any one who studies the *literature*, the pamphlets, and history of the school will find often reproduced in the letters of war ministers, of artillery and engineer officers commanding the school of application at Metz, or of committees from the similar schools for the mines and the roads and bridges. The last of these occasions illustrates the present position of the school.

On the 5th of June 1850, the legislative assembly appointed a mixed commission of military men and civilians, who were charged to revise all the programs of instruction, and to recommend all needful changes in the studies of the pupils, both those preparatory to entrance* and those actually pursued in the school. The commission was composed as follows :—

M. Thenard, Member of the Academy of Sciences, and of the Board of Improvement of the Polytechnic School, President.
Le Verrier, Member of the Academy of Sciences and of the Legislative Assembly, Reporter.
Noizet, General of Brigade of Engineers.
Poncelet, General of Brigade of Engineers, Commandant of the Polytechnic School, Member of the Academy of Sciences.
Piobert, General of Brigade of Artillery, Member of the Academy of Sciences.
Mathieu, Rear Admiral.
Duhamel, Member of the Academy of Sciences, Director of Studies at the Polytechnic School.
Mary, Divisional Inspector of Roads and Bridges.
Morin, Colonel of Artillery, Member of the Academy of Sciences.
Regnault, Engineer of Mines, Member of the Academy of Sciences.
Olivier, Professor at the *Conservatoire des Arts et Metiers.*
Debacq, Secretary for Military Schools at the Ministry of War, Secretary.

A chronic dispute which has gone on from the very first year of the school's existence, between the exclusive study of abstract mathematics on the one hand, and their early practical application on the other, was brought to a head (though it has scarcely been set at rest) by this commission. All the alterations effected have been in the direction of eliminating a portion of the pure mathematics, and of reducing abstract study to the limits within which it was believed to be most directly applicable to practice. The results, however, are still a subject of vehement dispute, in which most of the old scientific pupils of the Polytechnic, and many of what may be styled its most practical members, the officers of the artillery and engineers, are ranged on the side of "early and deep scientific study *versus* early practical applications." It is, indeed, a question which touches the military pupils nearly, since it is in their case particularly that the proposed abstract studies of the Polytechnic might be thought of the most doubtful advantage. We do not try to solve the problem here, though the facts elsewhere stated will afford some materials for judgment. We incline to the opin-

* In an Analysis of the Report of this Commission, see page 97.

ion of those who think that the ancient *genius loci*, the traditional teaching of the school, will be too strong for legislative interference, and that, in spite of recent enactments, abstract science and analysis will reign in the lecture-rooms and halls of study of the Polytechnic, now as in the days of Monge.

II. AN OUTLINE OF THE MANAGEMENT AND OF THE ESTABLISHMENT OF THE SCHOOL, ETC.

The Polytechnic, as we have said, is a preparatory and general scientific school; its studies are not exclusively adapted for any one of the departments to which at the close of its course the scholars will find themselves assigned; and on quitting it they have, before entering on the actual discharge of their duties of whatever kind, to pass through a further term of teaching in some one of the schools of application specially devoted to particular professions.

The public services for which it thus gives a general preparation are the following:

Military: Under the Minister at War.

Artillery (*Artillerie de terre.*)
Engineers (*Génie.*)
The Staff Corps (*Corps d'Etat Major.*)
The Department of Powder and Saltpetre (*Poudres et Salpêtres.*)

Under the Minister of Marine.

Navy, (*Marine.*)
Marine Artillery (*Artillerie de mer.*)
Naval Architects (*Génie maritime.*)
The Hydrographical Department (*Corps des Ingénieurs Hydrographes.*)

Civil: Under the Minister of Public Works.

The Department of Roads and Bridges (*Ponts-et-chaussées.*)
The Department of Mines (*Mines.*)

Under the Minister of the Interior.

The Telegraph Department (*Lignes Télégraphiques.*)

Under the minister of Finance.

The Tobacco Department (*Administration des Tabacs.*)

To these may be added at any time, by a decree on the part of the government, any other departments, the duties of which appear to require an extensive knowledge of mathematics, physics, or chemistry.

Admission to the school is, and has been since its first commencement in 1794, obtained by competition in a general examination, held yearly, and open to all. Every French youth, between the age of sixteen and twenty, (or if in the army up to the age of twenty-five,) may offer himself as a candidate.

A board of examiners passes through France once every year, and examines all who present themselves, that have complied with the conditions, which are fully detailed in the decree given in the appendix. It commences at Paris.

A list of such of the candidates as are found eligible for admittance to the Polytechnic is drawn up from the proceedings of the board, and submitted to the minister at war; the number of places likely to be vacant has already been determined, and the minister fixes the number of admissions accordingly. The candidates admitted are invariably taken in the order of merit.

The annual charge for board and instruction is 40*l.* (1,000 fr.,) payable in advance in four installments. In addition there is the cost of outfit, varying from 20*l.* to 24*l.* Exhibitions, however, for the discharge of the whole or of one-half of the expense (*bourses* and *demi-bourses*,) are awarded by the state in favor of *all* the successful candidates, whose parents can prove themselves to be too poor to maintain their children in the school. Outfits and half outfits (*trousseaux*) and *demi-trousseaux*) are also granted in these cases, on the entrance of the student into the school; and the number of these *boursiers* and *demi-boursiers* amounts at the present time to one-third of the whole.

The course of study is completed in two years. On its successful termination which is preceded by a final examination, the students are distributed into the different services, the choice being offered them in the order of their merit, and laid down in the classified list drawn up after the examination. If it so happen that the number of places or the services which can be offered is not sufficient for the number of qualified students, those at the bottom of the list are offered service in the infantry or cavalry, and those who do not enter the public service, are supplied with certificates of having passed successfully through the school. Students who have been admitted into the school from the army, are abliged to re-enter the army.

All others, as has been said, have the right of choosing, according to their position on the list, the service which they prefer, so far, that is, as the number of vacancies in that service will allow; or they may if they please decline to enter the public service at all.

Such is a general outline of the plan and object of the school. We may add that, besides its military staff, it employs no less than thirty-nine professors and teachers; that it has four boards of management, and that ten scientific men unconnected with the school, and amongst the most distinguished in France, conduct its examina-

tions. The magnitude of this establishment for teaching may be estimated by the fact, that the number of pupils rarely exceeds three hundred and fifty, and is often much less.

A fuller enumeration of these bodies will complete our present sketch.

I. The military establishment consists of:—

The Commandant, a General Officer, usually of the Artillery or the Engineers, at present a General of Artillery.

A Second in Command, a Colonel or Lieutenant-Colonel, chosen from former pupils of school; at present a Colonel of Engineers.

Three Captains of Artillery and Three Captains of Engineers, as Inspectors of Studies, chosen also from former pupils of the school.

Six Adjutants (*adjoints*,) non-commissioned officers, usually such as have been recommended for promotion.

II. The civil establishment consists of:—

1. A Director of Studies, who has generally been a civilian, but is at present a Lieutenant-Colonel of Engineers.

2. Fifteen Professors, viz.:—Two of Mathematical Analysis. Two of Mechanics and Machinery. One of Descriptive Geometry. Two of Physics. Two of Chemistry. One of Military Art and Fortification. One of Geodesy. One of Architecture. One of French Composition. One of German. One of Drawing. Of these one is an officer of the Staff, another of the Artillery, and a third of the Navy; two are Engineers in Chief of the Roads and Bridges; nine are civilians, of whom two are Members of the Academy of Sciences.

3. Three Drawing Masters for Landscape and Figure Drawing; one for Machine Drawing, and one for Topographical Drawing.

4. Nineteen Assistant and Extra Assistant Teachers, (*répétiteurs* and *répétiteurs adjoints*) whose name and functions are both peculiar.

5. Five Examiners for Admission, consisting at present of one Colonel of Artillery, as President, and four civilians.

6. Five Examiners of Students (civilians,) four of them belonging to the Academy of Sciences.

7. There is also a separate Department for the ordinary Management of Administration of the affairs of the school, the charge of the fabric and of the library and museums; and a Medical Staff.

III. The general control or supervision of the school is vested, under the war department, in four great boards of councils, viz.:—

1. A board of administration, composed of the commandant, the second in command, the director of studies, two professors, two captains, and two members of the administrative staff. This board has the superintendence of all the financial business and all the minutiæ of the internal administration of the school.

2. A board of discipline, consisting of the second in command, the director, two professors, three captains (of the school,) and two captains of the army, chosen from former pupils. The duty of this board is to decide upon cases of misconduct.

3. A board of instruction, whose members are, the commandant, the second in command, the director, the examiners of students, and the professors; and whose chief duty is to make recommendations relating to ameliorations in the studies, the programmes of admission and of instruction in the school, to—

4. A board of improvement, charged with the general control of the studies, formed of—

The Commandant, as President.
The Second in Command.
The Director of Studies.
Two Delegates from the Department of Public Works.
One Delegate from the Naval Department.
One Delegate from the Home Department.
Three Delegates from the War Department.
Two Delegates from the Academy of Sciences.
Two Examiners of Students.
Three Professors of the School.

III. CONDITIONS AND EXAMINATIONS FOR ADMISSION.

The entrance examination is held yearly in August; the most important conditions for admission to it are always inserted in the *Moniteur* early in the year, and are—

1st. All candidates must be bachelors of science.

2nd. All candidates (unless they have served in the army) must have been as much as sixteen and not more than twenty years old on the 1st of January preceding.

3rd. Privates and non-commissioned officers of the army must be above twenty and under twenty-five years of age; must have served two years, and have certificates of good conduct.

4th. Candidates who propose to claim pecuniary assistance (a *bourse* or *demi-bourse*) must present formal proofs of their need of it.

The subjects of the entrance examination are the following:—

Arithmetic, including Vulgar and Decimal Fractions, Weights and Measures, Involution and Evolution; Simple Interest.

Geometry of Planes and Solids; application of Geometry to Surveying; Properties of Spherical Triangles.

Algebra, including Quadratic Equations with one unknown quantity, Series and Progressions in general; Binomial Theorem and its applications; Logarithms and their use; on Derived Functions; on the Theory of Equations; on Differences; application of the Theory of Differences to the Numerical Solution of Equations.

Plane and Spherical Trigonometry; Solution of Triangles; application of Trigonometry to Surveying.

Analytical Geometry, including Geometry of two dimensions; Co-ordinates; Equations of the first and second degree, with two variables; Tangents and Asymptotes; on the Ellipse, Hyperbola, and Parabola; Polar Co-ordinates; Curved Lines in general.

Geometry of three dimensions, including the Theory of Projections; Co-ordinates; the Right Line and Plane; Surfaces of the second degree; Conical and Cylindrical Surfaces.

Descriptive Geometry; Problems relative to a Point, Right Line and Plane; Tangent Planes; Intersection of Surfaces.

Mechanics; on the Movement of a Point considered geometrically; on the Effect of Forces applied to points and bodies at rest and moving; on the Mechanical Powers.

Natural Philosophy, including the Equilibrium of Liquids and Gasses; Heat;

Electricity; Magnetism; Galvanism; Electro-magnetism and Light; Cosmography.

Chemistry, the Elements; *French*; *German*; *Drawing*, and (optionally) *Latin*.

This examination is partly written and partly oral. It is not public, but conducted in the following manner:—

Five examiners are appointed by the minister of war to examine the candidates at Paris, and at the several towns named for the purpose throughout France.

Two of these examiners conduct what may be called a preliminary examination (*du premier degré*,) and the other three a second examination (*du second degré*.) The preliminary examiners precede by a few days in their journey through France those who conduct the second examination. The written compositions come before either.

The preliminary examination (*du premier degré*) is made solely for the purpose of ascertaining whether the candidates possess sufficient knowledge to warrant their being admitted to the second examination; and the second examination serves, in conjunction with the written compositions, for their classification in the order of merit.

Prior to the examination, each candidate is called upon to give in certain written sheets containing calculations, sketches, plans and drawings, executed by him at school during the year, certified and dated by the professor under whom he has studied. Care is taken to ascertain whether these are the pupils' own work, and any deception in this matter, if discovered, excludes at once from the competition of the school.

This done, the candidates are required to reply in writing to written or printed questions, and to write out French and German exercises; great care being taken to prevent copying. This written examination occupies about twenty-four hours during three and a half separate days, as shown in the following table. It usually takes place in the presence of certain official authorities, the examiners not being present.

First Sitting.	Hours.	*Second Sitting.*	Hours.
Arithmetic,	1	Algebra,	1
Geometry,	1	History, geography, and French,	3
Latin,	1		
	3		4
Third Sitting.		*Fourth Sitting.*	
Descriptive geometry, and diagram, or sketch,	4	Mechanics,	1
		Physics, chemistry, and cosmography,	2
			3

Fifth Sitting.	Hours.	*Sixth Sitting.*	Hours.
Applied analysis,	1½	Solution of a triangle by logarithms,	3
German exercise,	1½		
	3		

Seventh Sitting.

Drawing, - - - - 4 hours.

Total, - - - - - 24 hours.

Next, each candidate is examined orally for three-quarters of an hour, on two successive days, by each of the two examiners separately, and each examiner makes a note of the admissibility or non-admissibility of the candidate.

At the close of this oral examination, the notes relating to the various candidates are compared, and if the examiners differ as to the admissibility of any candidate, he is recalled, further orally examined, and his written exercises carefully referred to, both examiners being present. A final decision is then made.

The preliminary examiners then supply the others with a list of the candidates who are entitled to be admitted to the second oral examination. On this occasion each candidate is separately examined for one hour and a half by each examiner, but care is taken that in all the principal subjects of study the candidate is examined by at least two out of the three examiners.

Each examiner records his opinion of the merits of every candidate in replying, orally and in writing, by awarding him a credit varying between 0 and 20, the highest number indicating a very superior result.

This scale of merit is employed to express the value of the oral replies, written answers, or drawings. It has the following signification, and appears to be generally in use in the French military schools:—

20	denotes perfect.	8, 7, 6	denotes bad.
19, 18	" very good.	5, 4, 3	" very bad.
17, 16, 15	" good.	2, 1	" almost nothing.
14, 13, 12	" passable.	0	" nothing.
11, 10, 9	" middling		

Considerable latitude is granted to the examiner engaged in deciding upon the amount of credit to be allowed to the student, for the manner in which he replies to the various questions. He is ex-

pected to bear in mind the temperament of the candidate, his confidence or timidity, as well as the difficulty of the questions, when judging of the quality of the reply, more value being given for an imperfect answer to a difficult question than for a more perfect reply to an easy one.

The reports of the examiners, together with the various documents belonging to each candidate, are sent from each town to the minister at war, who transmits them to the commandant of the Polytechnic School to make out a classified list.

Very different value of course is attached to the importance of some of the subjects, when compared with others; and the measure of the importance is represented in French examinations by what are termed *co-efficients of influence*, varying for the several subjects of study and kind of examination. The particular co-efficients of influence for each subject in these written and oral examinations, are as follows:—

	Co-efficients of Influence.	
Oral examination—analytical mathematics,	20	52
" " geometrical ditto,	14	
" " physics and mechanics,	16	
" " German language,	2	
Written compositions on mathematical subjects,	5	34
" " descriptive geometry, drawing, and description,	5	
" " logarithmic calculations of a triangle,	2	
" " mechanics,	2	
" " physics or chemistry,	4	
German exercise,	1	
French composition,	5	
Latin translation,	5	
Copy of a drawing,	5	
Total,		86

In order to make out the above mentioned classified list, the respective credits awarded by the examiners to each candidate are multiplied by the co-efficients representing the weight or importance attached to each subject; and the sum of their products furnishes a numerical result, representing the degree of merit of each candidate.

A comparison of these numerical results is then made, and a general list of all the candidates is arranged in order of merit.

This list, and the whole of the documents from which it has been drawn up, are then submitted to a jury composed of the

Commandant of the School.
The Second in Command.
The Director of Studies.
Two Members of the Board of Improvement.
The Five Examiners.

It is the special business of this jury carefully to scrutinize the whole of the candidates' documents, drawings, &c., and they further take care that a failure in any one branch of study is duly noted, as such failure is a sufficient reason for the exclusion of the candidate from the general list.

As soon as this general list has been thoroughly verified, it is submitted to the minister of war, who is empowered to add one-tenth to the number actually required for the public services; and thus it may happen that one-tenth of the pupils may annually be disappointed.

IV. THE SCHOOL BUILDINGS AND THE COURSE AND METHOD OF STUDY.

A brief description of the buildings may be a suitable introduction to an account of the studies that are pursued, and the life that is lead in them.

The Polytechnic School stands near the Pantheon, and consists of two main buildings, one for the official rooms and the residence of the commandant and director of studies, the other, and larger one, for the pupils. Detached buildings contain the chemical lecture room and laboratory, the laboratory of natural philosophy, the library, fencing and billiard rooms.

The basement floor of the larger building contains the kitchen and refectories. On the first floor, are the two amphitheaters or great lecture rooms, assigned respectively to the pupils of the two years or divisions, in which the ordinary lectures are given. The rooms are large and well arranged; the seats fixed, the students' names attached to them. The students are admitted by doors behind the upper tier of seats; at the foot of all is a platform for the professor, with a blackboard facing his audience, and with sufficient room for a pupil to stand and work questions beside him. Room also is provided for one of the captains, inspectors of studies, whose duty it is to be present, for the director of studies, whose occasional presence is expected, and for the assistant teachers or *répétiteurs*, who in the first year of their appointment are called upon to attend the course upon which they will have to give their subsequent questions and explanations. On this floor are also the museums, or repositories of models, instruments, machines, &c., needed for use in the amphi theaters, or elsewhere. The museum provided for the lecturer on Physics (or Natural Philosophy) appeared in particular to be well supplied.

The whole of the second floor is taken up with what are called the *salles d'interrogation*, a long series of small cabinets or studies,

plainly furnished with six or eight stools and a table, devoted to the *interrogations particulières*, which will presently be described.

The third floor contains the halls of study, *salles d'étude*, or studying rooms, in which the greater part of the student's time during the day is passed—where he studies, draws, keeps his papers and instruments, writes his exercises, and prepares his lectures. These are small chambers, containing eight or, exceptionally, eleven occupants. A double desk runs down the middle from the window to the door, with a little shelf and drawers for each student. There is a blackboard for the common use, and various objects are furnished through the senior student, the sergeant, a selected pupil, more advanced than the rest, who is placed in charge of the room, and is responsible for whatever is handed in for the use of the students. He collects the exercises, and generally gives a great deal of assistance to the less proficient. "When I was sergeant," said an old pupil, "I was always at the board." The spirit of *camaraderie*, said to exist so strongly among the Polytechnic students, displays itself in this particular form very beneficially. Young men of all classes work heartily and zealously together in the *salles d'étude*, and no feeling of rivalry prevents them from assisting one another. The sergeant does not, however, appear to exercise any authority in the way of keeping discipline.

These chambers for study are arranged on each side of a long corridor which runs through the whole length of the building, those of the juniors being separated from those of the seniors by a central chamber or compartment, the *cabinet de service*, where the officers charged with the discipline are posted, and from hence pass up and down the corridor, looking in through the glass doors and seeing that no interruption to order takes place.

The fourth story is that of the dormitories, airy rooms, with twelve beds in each. These rooms are arranged as below, along the two sides of a corridor, and divided in the same manner into the senior and junior side. A non-commissioned officer is lodged at each end of the corridor to see that order is kept.

Such is the building into which at the beginning of November the successful candidates from the *Lycées* and the *Ecoles préparatoires* are introduced, in age resembling the pupils whom the highest classes of English public schools send annually to the universities, and in number equal perhaps to the new under-graduates at one of the largest colleges at Cambridge. There is not, however, in other points much that is common, least of all in the methods

and habits of study we are about to describe. This will be best understood by a summary of a day's work.

The students are summoned to rise at half-past five, have to answer the roll-call at six, from six to eight are to occupy themselves in study, and at eight they go to breakfast. On any morning except Wednesday, at half-past eight, we should find the whole of the new admission assembled in an amphitheater, permanent seats in which are assigned to them by lot, and thus placed they receive a lecture from a professor, rough notes of which they are expected to take while it goes on. The first half hour of the hour and a half assigned to each lecture is occupied with questions put by the professor relating to the previous lecture. A name is drawn by lot, the student on whom the lot falls is called up to the blackboard at which the professor stands, and is required to work a problem and answer questions. The lecture concluded, the pupils are conducted to the *salles d'étude*, which have just been described, where they are to study. Here for one hour they devote themselves to completing and writing out in full the notes of the lecture they have just heard. The professor and his assistants, the *répétiteurs*, are expected to follow and make a circuit through the corridors, to give an opportunity to ask for information on any difficult points in the lecture. A lithographed summary of the substance of the lecture, extending perhaps to two octavo pages, is also furnished to each studying room for the use of its pupils.

The lecture, as we have said, commences at half-past eight o'clock; it lasts an hour and a half; the hour of writing up the notes brings us to eleven. The young men are now relieved by a change of occupation, and employ themselves (still in their places in the rooms of study) at drawing. A certain number, detached from the rest, are sent to the physical and chemical laboratories. The rotation is such as to admit each student once a month to two or three hours' work at a furnace for chemistry, and once in two months to make experiments in electricity, or other similar subjects. In this way, either at their drawing or in the laboratories, they spend three hours, and at two o'clock go to their dinner in the refectories below, and after dinner are free to amuse themselves in the court-yard, the library, the fencing and the billiard rooms, till five. At five they return to the studying rooms, and for two hours, on Mondays and Fridays, they may employ themselves on any work they please (*étude libre;*) on Tuesday there is a lecture in French literature, and on Thursday in German; at seven o'clock they commence a lesson, which lasts till nine, in landscape and figure drawing, or they

do exercises in French writing or in German; at nine they go down to supper; at half-past nine they have to answer to a roll-call in their bedrooms, and at ten all the lights are put out.

Wednesday is a half-holiday, and the pupils are allowed to leave the school after two o'clock, and be absent till ten at night. The morning is occupied either in study, at the pleasure of the students, or in set exercises till eleven, when there is a lecture of one hour and a half, followed, as usual, by an hour of special study on the subject of the lecture. On Sunday they are allowed to be absent almost the whole day till ten P. M. There is no chapel, and apparently no common religious observance of any kind in the school.

Such is a general sketch of the ordinary employment of the day; a couple of hours of preparatory study before breakfast, a lecture on the differential calculus, on descriptive geometry, on chemistry, or natural philosophy, followed by an hour's work at notes; scientific drawing till dinner; recreation; and general study, or some lighter lecture in the evening. Were we merely to count the hours, we should find a result of eleven or eleven and a half hours of work for every day but Wednesday, and of seven and a half hours for that day. It is to be presumed, however, that though absolute idleness, sleeping, or reading any book not authorized for purposes of study, is strictly prohibited, and when detected, punished, nevertheless the strain on the attention during the hours of drawing and the lectures of the evening is by no means extreme. Landscape and figure drawing, the lecture in French literature, and probably that in German, may fairly be regarded as something like recreation. Such, at least, was the account given us of the lectures on literary subjects, and it agrees with the indifference to literature which marks the school. Of wholesome out-of-door recreation, there certainly seems to be a considerable want. There is nothing either of the English love of games, or of the skillful athletic gymnastics of the German schools.

The method of teaching is peculiar. The plan by which a vast number of students are collected as auditors of professorial lectures is one pursued in many academical institutions, at the Scotch universities, and in Germany. Large classes attend the lectures in Greek, in Latin, and in mathematics at Glasgow; they listen to the professor's explanations, take notes, are occasionally questioned, and do all the harder work in their private lodgings. Such a system of course deserves in the fullest sense the epithet of voluntary; a diligent student may make much of it; but there is nothing to compel an idle one to give any attention.

It seems to have been one especial object pursued in the Polytechnic to give to this plan of instruction, so lax in itself, the utmost possible stringency, and to accumulate upon it every attainable subsidiary appliance, every available safeguard against idleness. Questions are expressly put *vivâ voce* by the professor before his lecture; there is a subsequent hour of study devoted to the subject; there is the opportunity for explanation to individual students; the exaction of notes written out in full form; the professor also gives exercises to the students to write during their hours of general study, which he examines, and marks; general vivâ voce examinations (*interrogations générales*,) conducted by the professors and *répétiteurs*, follow the termination of each course of lectures; and lastly, one of the most important and peculiar parts of the method, we have what are called the *interrogations particulières*. After every five or six lectures in each subject, each student is called up for special questioning by one of the *répétiteurs*. The rooms in which these continual examinations are held have been described. They occupy one entire story of the building; each holds about six or eight pupils, with the *répétiteurs*. Every evening, except Wednesday, they are filled with these little classes, and busy with these close and personal questionings. A brief notice, at the utmost of twenty-four hours, is served upon the students who are thus to be called up. Generally, after they have had a certain number of lectures, they may expect that their time is at hand, but the precise hour of the summons can not be counted upon. The scheme is continually varied, and it defies, we are told, the efforts of the ablest young analysts to detect the law which it follows.

It will be seen at once that such a system, where, though nominally professorial, so. little is left to the student's own voluntary action, where the ordinary study and *reading*, as it is called in our English universities (here such an expression is unknown) is subjected to such unceasing superintendence and surveillance, and to so much careful assistance, requires an immense staff of teachers. At the Polytechnic, for a maximum of 350 pupils, a body of fifteen professors and twenty-four *répétiteurs*, are employed, all solely in actual instruction, and in no way burdened with any part of the charge of the discipline or the finance, or even with the great yearly examinations for the passage from the first to the second division, and for the entrance to the public services.

With a provision of one instructor to every eight students, it is probable that in England we should avoid any system of large classes, from the fear of the inferior pupils being unable to keep

pace with the more advanced. We should have numerous small classes, and should endeavor, above all things, to obtain the advantage of equality of attainment in the pupils composing them.

The French, on the other hand, make it their first object to secure one able principal teacher in each subject, a professor whom they burden with very few lectures. And to meet the educational difficulty thus created, to keep the whole large class of listeners up to the prescribed point, they call in this numerous and busily employed corps of assistants to *repeat*, to go over the professor's work afresh, to whip in, as it were, the stragglers and hurry up the loiterers. Certainly, one would think, a difficult task with a class of 170 freshmen in such work as the integral and differential calculus. It is one, however, in which they are aided by a stimulus which evidently acts most powerfully on the students of the Polytechnic School. During the two years of their stay, the prospect of their final admission to the public services can rarely be absent from the thoughts even of the least energetic and forethinking of the young men. Upon their place in the last class list will depend their fortune for life. A high position will secure them not only reputation, but the certainty of lucrative employment; will put it in their power to select which service they please, and in whichever they choose will secure them favorable notice. Let it be remembered that fifty-three of these one hundred and seventy are free scholars, born of parents too poor to pay 40*l.* a year for their instruction, to whom industry must be at all times a necessity, and industry during their two years at the Polytechnic the best conceivable expenditure, the most certainly remunerative investment of their pains and labor. The place on the final class list is obviously the prize for which this race of two years' length has to be run. What is it determines that place? Not by any means a final struggle before the winning-post, but steady effort and diligence from first to last throughout the course. For the order of the class list is not solely determined by success in the examination after which it is drawn up, but by the result of previous trials and previous work during the whole stay at the school.

For, during the whole time, every written exercise set by the professor, every drawing, the result of every *interrogation particulière* by the *répétiteurs*, and of each general interrogation by the professors and *répétiteurs*, is carefully marked, and a credit placed according to the name of the student and reserved for his benefit in the last general account. The marks obtained in the examination which closes the first year of study form a large element

in this last calculation. It had been found that the work of the first year was often neglected: the evil was quickly remedied by this expedient. The student, it would seem, must feel that he is gaining or losing in his banking account, so to call it, by every day's work; every portion of his studies will tell directly for or against him in the final competition, upon which so much depends.

Such is the powerful mechanism by which the French nation forces out of the mass of boys attending their ordinary schools the talent and the science which they need for their civil and military services. The efforts made for admission to this great scientific school of the public services, the struggle for the first places at the exit from it, must be more than enough, it is thought, to establish the habits of hard work, to accumulate the information and attainment, and almost to create the ability which the nation requires for the general good.

We may now follow the student through his course of two years' study. The first year's work may be mainly divided into three portions of unequal length; two of them of about four months each (with an additional fortnight of private study and examination,) are mainly given to hard lecturing, whilst the third portion of two months is devoted to private study and to the examinations.

In accordance with this arrangement of the year, the four hardest subjects are thus distributed. Analysis and descriptive geometry, the staple work of the school—its Latin, as M. de Barante called it—come in the first four months; there is then a pause for private study and a general examination in these two subjects (*interrogations générales* as distinct from the *interrogations particulières* of the *répétiteurs*.) This brings us to the middle of March. Analysis and geometry are then laid aside for the rest of the year, and for the next portion of four months the pupils work at mechanics and geodesy, private study and a general examination completing this course also. Important lectures on physics and chemistry run on during both these periods, and are similarly closed by private study and a general examination. The less telling evening classes of French literature and German end at the beginning of June, and landscape and figure drawing only last half the year. It may be observed also, that, as a general rule, there is on each day one, and only one, really difficult lecture. This is immediately preceded and followed by private study, but then comes something lighter, as a relief, such as drawing or work in the laboratories.

The chief feature in the third portion of the year is the complete break in the lectures for general private study (*étude libre*,) a month

or six weeks before the closing examination at the end of the year. The immediate prospect of this prevents any undue relaxing of the work; and it is curious to observe here how private efforts and enforced system are combined together, for even the private efforts are thus systematized and directed. The closing examination of the first year begins on the 1st and ends on the 25th of September.

The total number of lectures in each branch of study, with the dates when they respectively commence and finish, and the period when the general examinations (*interrogations générales*) take place, are exhibited in the following tables, and we should add that the interval between the close of each course and the commencement of the chief yearly examination is devoted to free study.

TABLE FOR THE SECOND OR LOWER DIVISION, FOLLOWING THE FIRST YEAR'S COURSE OF STUDY.

Subject of Study.	No. of Lectures.	Course of Lectures.		General Examinations. *Interrogations Générales.*		Annual Examination.
		Commenced.	Finished.	Commenced.	Finished.	
Analysis,	48	3rd Nov.	25th Feb.	13th March.	18th March.	Begins on the 1st Sept., and ends on the 25th Sept.
Mechanics and Machines,	40	21st March.	29th June.	24th July.	2nd August.	
Descriptive Geometry,	38	3rd Nov.	3rd March.	13th March.	18th March.	
Physics,	34	2nd "	28th June.	10th July.	19th July.	
Chemistry,	38	5th "	17th "	10th "	19th "	
Goedesy,	35	20th March	30th "	24th "	2nd August.	
French Literature,	30	8th Nov.	6th "			
German,	30	2nd "				
Figure and Landscape Drawing,	50	4th "	15th " 28th April.			
Total,	343					

The work of the second year is almost identical in its general plan with that of the first. A continuation of analysis with mechanics in place of descriptive geometry is the work of the first four months, then comes the private study and the *interrogations générales*, and then again, from the middle of March to the middle of July, work of a more professional character, stereotomy, the art of war and topography, forms the natural completion of the pupil's studies. Chemistry and physics follow the same course as during the first year, and terminate with the private study and the general examination at the beginning of August. The evening lectures in French literature and German end about the middle of June, and those in figure and landscape drawing at the beginning of May. The last portion is again given to private study and the great Final Examination.

TABLE FOR THE FIRST OR UPPER DIVISION, FOLLOWING THE SECOND YEAR'S COURSE OF STUDY.

Subject of Study.	No. of Lectures.	Course of Lectures.		General Examinations. *Interrogations Générales.*		Annual Examination.
		Commenced.	Finished.	Commenced.	Finished.	
Analysis, ...	32	11th Nov.	3rd March.	13th March.	18th March.	Begins on the 10th Sept. and ends on the 10th Oct.
Mechanics and Machines, ...	42	10th "	2nd "	13th "	18th "	
Stereotomy, ...	32	20th March.	26th June.	10th July.	19th July.	
Physics, ...	36	12 Nov.	29th "	24th "	2nd Aug.	
Chemistry, ...	38	14th "	28th "	24th July.	2nd "	
Architecture and Construction, ...	40	10th "	8th "	.....	.....	
Military Art and Fortification, ...	20	21st March.	21st "	10th "	19th July.	
Topography, ...	10	3rd Jan.				
French Literature, ...	30	11th Nov.	9th "			
German, ...	30	14th "	19th "			
Figure and Landscape Drawing, ...	48	12th "	2nd May.			
Total, ...	358					

V. THE EXAMINATIONS, PARTICULARLY THAT OF THE FIRST YEAR AND THE FINAL ONE.

We have now brought the pupil nearly to the end of his career, but must previously say a few words about his examinations, the chief epochs which mark his progress, and the last of which fixes his position almost for life. For this purpose it is necessary to recapitulate briefly what has been said in different places of the whole examinatorial system of the Polytechnic School.

1. All the professors require the students in their studying rooms, to answer questions in writing on the courses as they go through them: a different question is given to each student, and every third question is of such a nature as to involve a numerical example in the reply.

These questions are given in the proportion of one to about every four lectures, and the replies after being examined by the professor or *répétiteur*, are indorsed with a credit, varying from 0 to 20, and the paper is then given back to the student, to be produced at the close of the year.

2. Credits are assigned to the students for their ordinary manipulations in chemistry and physics, during the first year; and at the close of each year, for their manipulations, in chemistry alone, before the examiners.

3. The *répétiteurs* examine, (in the *interrogations particulières*,) every ten or fourteen days, from six to eight students during a sitting of two hours, on the subject of study lectured on since the previous examination of the same kind. All these students must continue present, and at the close the *répétiteur* assigns to each a

previous examination of the same kind. All these students must continue present, and at the close the *répétiteur* assigns to each a credit entirely dependent on the manner in which each has replied. The professors and captains inspectors are occasionally present at these examinations, which are discontinued at certain periods according to the instructions of the director of studies.

4. At different intervals of time, from a fortnight to a month, as may happen, after the close of the course in each branch of study, general examinations (*interrogations générales*) are made by the professors and *répétiteurs*. From four to six students are examined together for at least two hours, and at the conclusion the professor makes known to the director of studies the credit he has granted to each student for the manner in which he has passed his examination.

Such may be called the minor or ordinary examinations. But there is an annual closing examination at the end of each year, which we will now describe. The first year's annual examination commences on the 1st and ends on the 25th September. It is carried on by special examiners, (a different set from those who conduct the entrance examinations,) and not by the professors. These give to every student a credit between 0 and 20 in each branch of study, according to the manner in which he replies.

The following table shows the co-efficients of influence allowed to the different studies of the first year, subdivided also among the particular classes of examination to which the student has been subjected. The component parts of the co-efficients as well as the co-efficients themselves, slightly vary from year to year, dependent on the number of examinations :—

TABLE I.—FIRST YEAR'S COURSE OF STUDIES: SECOND DIVISION.

Nature of Study.	Total Co-efficients.	Co-efficient of Influence awarded to							
		Written Answers to Professors' Questions.	Examinations by *Répétiteurs*. (*Int. Part.*)	General Examination. (*Int. Gén.*)	Manipulations.		Sheets of notes on descriptive Geometry.	Graphical Representations and Drawing.	First Annual Examination.	Total Co-efficients.
					Ordinary.	At Examinations.				
Analysis,	56	9	10	9	..	..	..	..	28	56
Mechanics,	60	7	9	8	..	..	..	14	22	60
Descriptive Geometry,	48	..	7	7	..	..	4	12	18	48
Geodesy,	39	6	5	7	..	..	..	3	18	39
Physics,	45	6	9	7	2	..	..	..	21	45
Chemistry,	45	5	9	7	4	2	..	..	18	45
French Literature,	12	12	..	..	..	..	..	..	..	12
German Language,	10	2	3	..	..	..	..	..	5	10
Drawing,	10	..	..	..	..	..	..	10	..	10
Shading and Tinting Plans,	3	..	..	..	..	..	..	3	..	3

At the conclusion of this examination the director of studies pre

pares a statement for each student, exhibiting the credits he has obtained at each of the preceding examinations in each subject, multiplied by the co-efficient of influence, and the sum of the products represents the numerical account of the student's credit in each branch of study.

As the process is somewhat intricate, we append the following example, to show the nature of the calculation performed, in order to ascertain the amount of credits due to each student:—

REPORT OF THE CREDITS GAINED IN THE FIRST YEAR'S COURSE OF STUDY BY M. N., STUDENT AT THE POLYTECHNIC SCHOOL.

Subject of Examination.	Co-efficient of Influence.	Nature of Examination or Proof.	Credit obtained by the Student.	Co-efficients of Influence.	Product.	Sum of Products.	Mean Credit in each Subject of the Course.
Analysis,	56	Written answers to Professors' questions,	17.16	9	154.44	845.81	15.09
		Examinations by *répétiteurs*					
		(*interrogations particulières,*)	15.47	10	154.70		
		General Examination (*interrogations générales,*)	13.71	9	123.39		
		Annual Examination,	14.75	28	413.28		
Mechanics,	60	Written answers to Professors' questions,	13.45	7	94.15	664.13	11.07
		Examinations by *répétiteurs,*	12.72	9	114.48		
		General examination,	11.37	8	90.96		
		Graphical representations and drawing,	5.61	14	78.54		
		Annual examination,	13.00	22	286.00		
Descriptive Geometry,	48	Examinations by *répétiteurs,*	17.15	7	120.05	633.15	13.19
		General examination,	11.72	7	82.04		
		Sheets of notes,	12.45	4	49.80		
		Graphical rep. and drawing,	11.88	12	142.76		
		Annual examination,	13.25	18	238.50		
Geodesy,	39	Written answers to Professors' questions,	9.16	6	54.96	229.01	5.87
		Examinations by *répétiteurs,*	7.85	5	39.25		
		General examination,	5.74	7	40.18		
		Graphical rep. and drawing,	4.36	3	13.08		
		Annual examination,	4.53	1	81.54		
Physics,	45	Written answers to Professors' questions,	2.76	6	16.56	112.21	2.49
		Examinations by *répétiteurs,*	3.54	9	31.86		
		General examination,	3.15	7	22.05		
		Ordinary manipulation,	1.55	2	3.10		
		Annual examination,	1.84	21	38.84		
Chemistry,	45	Written answers to Professors' questions,	2.46	5	12.30	131.16	2.91
		Examinations by *répétiteurs,*	3.25	9	29.95		
		General examination,	2.47	7	17.29		
		Ordinary manipulation,	2.26	4	9.04		
		Manipulation at examination,	1.58	2	3.16		
		Annual examination,	3.34	18	60.12		
French Literature,	12	Written answers to Professors' questions,	5.64	12	67.68	67.68	5.64
German Language,	10	Written answers to Professors' questions,	6.57	2	13.14	55.92	5.59
		Examinations by *répétiteurs,*	4.86	3	14.58		
		Annual examination,	5.64	5	28.20		
Drawing,	10	Graphical representations and drawing,	4.36	10	43.60	43.60	4.36
Shading and Tinting Plans,	3	Graphical representations and drawing,	3.86	3	11.58	11.58	3.86
					Sum,	10)70.07	
					General Mean Credit, =	(7.00)	

It is important to remark that any student whose *mean credit*, given in the eighth column of the preceding table, in any branch of study does not exceed *three*, or whose *general mean credit* for the whole of the studies being the arithmetical mean of all the values recorded in the eighth column, and given at the bottom in the example, does not exceed six, is *considered to possess an insufficient amount of instruction to warrant his being permitted to pass into the first division for the second year's course.* He is accordingly excluded from the school, unless he has been prevented from pursuing his studies by illness, in which case, when the facts are thoroughly established, he will be allowed a second year's study in the second division, comprising the first year's course of study.

We now pass to the second annual or great final examination for admission to the public services, remarking only that in the *interrogations générales* of the second year the principal subjects of both years are included.

The final examinations for admission into the public service commence about the 10th September, and last about one month. They are conducted by the same examiners who examined at the close of the first year. These are five in number, and appointed by the minister of war. One of these takes analysis; a second, mechanics; a third, descriptive geometry and geodesy; the fourth, physics; and the fifth, chemistry.

The examination in military art and topography is conducted by a captain of engineers specially appointed for the purpose; and in the same manner the examination in German is carried on by a professor, usually a civilian, specially but not permanently appointed.

The questions are oral, and extend over the whole course of study pursued during the two years. Each student is taken separately for one hour and a quarter on different days by each of the five examiners; each examiner examines about eight students daily.

A table, very similar to that already given, is prepared under the superintendence of the Director of studies for every student, to ascertain the numerical amount of his credits in each branch of study, the co-efficients of influences for the particular subject of study and nature of examination being extracted from a table similar to that in page 80, and when these tables have all been completed, a general list of all the students is made out, arranged in the order of their merits.

Formerly, conduct was permitted to exercise some slight influence on their position, but that is no longer the case.

The same regulations exist, as regards the minimum amount of

credit that will entitle the students to enter into the public service, as have already been stated above in reference to the passage from the first to the second year's course of study.

TABLE II. SECOND YEAR'S COURSE OF STUDY: FIRST DIVISION.

	Total Co-efficients.	Co-efficient of Influence awarded to										
		Result of previous Year's Examination.	Written answers to Professors' Questions.	Examinations by *Répétiteurs*. (*Int. Part.*)	General Examinations. (*Int. Gén.*)	Manipulation.		Sketches and Notes in Architecture.	Graphical Representations and Drawing.	Examination in Architecture.	Second Annual or Final Examination.	Total Co-efficients.
						Ordinary.	At Examinations.					
Analysis,	81	28	8	10	9	....	....	.....	.....	....	26	81
Mechanics,	92	25	8	12	9	....	....	.....	10	....	28	92
Descriptive Geometry,	36	36	.....	.....	.....	....	....	.....	.....	....	.....	36
Geodesy,	37	.....	6	5	7	....	....	.....	1	....	18	37
Physics,	68	23	5	10	8	....	....	.....	.....	....	22	68
Chemistry,	68	20	5	10	8	4	2	.....	.....	....	19	68
Architecture,	36	.....	.....	.....	.....	....	....	12	14	10	.....	36
Military art and Topography,	25	.....	.....	3	5	....	....	.....	9	....	8	25
French Literature,	18	6	12	.....	.....	....	....	.....	.....	....	.....	18
German,	15	5	2	3	.....	....	....	.....	.....	....	.....	15
Drawing,	15	5	.....	.....	.....	....	....	.....	10	....	.....	15
Shading and Tinting,	5	2	.....	.....	.....	....	....	.....	3	....	.....	5

From the preceding tables and explanations, it will be apparent that, as the whole of the students for each year are compelled to follow precisely the same course of study, the system of professorial instruction, combined with the constant tutelage and supervision exercised by the *répétiteurs*, and the examinations (*interrogations particulières*) of the *répétiteurs*, at short intervals of time, have for their principal object the keeping alive in the minds of the students the information which has been communicated to them. As a stimulus to continuous and unceasing exertion, it will be seen by an inspection of the tables of the co-efficients of influence, that the manner in which the students acquit themselves from day to day, and from week to week, is made an element, and a very important one, in determining their final position in the list arranged according to merit, exceeding as it does in most instances the influence exerted on their classification by their final examination at the close of each year. This principle thus recognizes not only their knowledge at the end of each year, but also the manner in which they have proved it to the professors and *répétiteurs* in the course of the year; and with reference to the second year's study, the final result of the first year's classification exercises an influence amounting to

about one-third of the whole, in the final classification at the end of the second year.

It follows also, that as the examinations at the end of each year are made by examiners, otherwise unconnected with the school, and not by the professors belonging to it, the positions of the students in the classified list is partly dependent on the judgment of the professors with whom they are constantly in communication, and partly on the public examiners, whom they meet only in the examination rooms.*

The examiners of the students are not frequently changed, and practically the same may be said of the examiners for admission.

The students at the head of the list have generally since the wars of the first Empire entered into the civil rather than into the military services, the former being much better remunerated.

The services are usually selected by preference, nearly in the following order:—

The Roads and Bridges (*Ponts et chaussées*) and Mines (*Mines*,) - - - - } very nearly on an equality.

Powder and Saltpetre (*Poudres et Salpêtres.*)

Naval Architects (*Génie maritime.*)

Engineers (*Génie militaire.*)

The Artillery (*Artillerie de terre*,) and the Staff Corps (*Etat Major*,) } very nearly on an equality.

The Hydographical Corps (*Ingénieurs Hydrographes.*)

Subjects of Study.	Per-centage of influence exercised on the position of the Students.							
	During the 1st Year.		During the 2nd Year.			In the Classified List at the end of 2nd year.	
	By Professors and *Répétiteurs.*	By Examiners.	By the results of the first Year's Examination.	By Professors and *Répétiteurs.*	By Examiners.	By Professors and *Répétiteurs.*	By Examiners.
Analysis,	50.0	50.0	34.5	32.5	33.0	49.75	50.25
Mechanics,	63.2	36.7	27.2	42.4	30.4	59.6	40.40
Descriptive Geometry,	62.5	37.5	100.0	0.0	0.0	62.5	37.5
Geodesy,	53.8	46.2	0.0	51.4	48.6	*51.4	48.6
Physics,	53.3	46.7	33.8	33.8	32.4	51.8	48.2
Chemistry,	60.0	40.0	29.4	43.2	27.4	60.8	39.2
Architecture,	.....	.....	0.0	100.0	0.0	100.0	100.0
Military Art and Topography,	.....	.....	0.0	68.0	32.0	68.0	32.0
French Literature,	100.0	0.0	33.3	66.7	0.0	100.0	0.0
German Language,	100.0	0.0	33.3	33.3	33.4	66.7	33.3
Drawing,	100.0	0.0	33.3	66.7	0.0	100.0	0.0
Shading and Tinting Plans,	100.0	0.0	40.0	60.0	0.0 *	100.0 * When taught in the 2nd year.	0.0

* The influence exercised in the various branches of study, and consequently in the position of the students in the list classified according to merit, by the professors and *répétiteurs* on the one hand, and by the examiners on the other, as in the table above.

Tobacco Department (*Administration des Tabacs.*)
Telegraph Department (*Lignes Télégraphiques.*)
Navy (*Marine.*)
Marine Artillery (*Artillerie de mer.*)

Such, at least, is the result of a comparison of the selections made by the students during eight different years.

This preference of the civil to the military services has been the subject of frequent complaints on the part of the military authorities to the minister of war.

No steps have, however, been taken by the French government to prevent the *free* choice of a profession being granted to the most successful students.

We have now followed the student at the Polytechnic to the end of his school career. He is then to pass to his particular School of Application, in which (as the name implies) he is taught to apply his science to practice. It is difficult to state precisely the amount of such science which the highest pupils may be thought to possess on leaving; the best idea of it will be gained by reference to the programmes of the most important of the lectures. It is also needless to dwell again on the main features of the school—the emulation called forth, the minute method, the great prizes offered for sustained labor. We must, however, make some remarks on these points before concluding our account, so far as they bear on the subject of military education.

VI. GENERAL REMARKS.

1. Keeping out of sight for the moment some defects both in the principles and details of the education of this school, the method of teaching adopted seems to us excellent, and worthy of careful study. In this remark we allude principally to the skillful combination of two methods which have been generally thought incompatible; for it unites the well-prepared lecture of a German professor, with the close personal questioning of a first-rate English school or college lecture. But besides this, its whole system is admirably adapted for the class of pupils it educates.

These pupils are generally not of the wealthy classes; they are able, and struggling for a position in life. On all these grounds their own assistance in the work may be calculated upon. Yet they are not left to themselves to make the most of their professors' lectures. The aid of *répétiteurs*, even more valuable in its constant "prudent interrogations," than in the explanations afforded, is joined to the stimulus given by marking every step of proficiency, and by making all tell on the last general account. But though the routine and method of the school are so elaborate, play is given to the individual freedom of the pupils in their private work, and this is managed so skillfully that the private work is made immediately to precede the final examination, on which mainly depends the pupil's place for life. Thus from first to last they are carried on by their system without being cramped by it; every circumstance favorable to study is made the most of; rigorous habit, mental readiness,

the power of working with others, and the power of working for themselves, the ambition for immediate and permanent success, all the objects and all the methods which students ever have in view, support and stimulate those of the Polytechnic in their two years' career.

2. The mainspring, however, of the school's energy is the competition amongst the pupils themselves, and this could hardly exist without the great prizes offered to the successful. This advantage, added to the general impulse of the early days of the Empire, has no doubt powerfully contributed to the great position of the school. It has made it a kind of university of the *élite* mathematicians, and as in England young men look to the prizes of the universities, and the professions to which they lead, as their best opening in life, so in France, ever since the first revolution, the corresponding class has inclined to the active and chiefly military career which is offered by the great competitive school of the country.

3. A preparatory school of this remarkable character can not but exercise a very powerful influence over those three-fourths of its pupils who leave it to enter the army. The obvious question is whether the attempt is not made to teach more than is either necessary or desirable for military purposes, and to this suspicion may be added the fact that the civil prizes being more in request than the military, many of those who enter the army do so in the first instance reluctantly, and that the pupils at the bottom of the list appear to be often such marked failures as to imply either great superficiality or premature exhaustion.

4. In studying the Polytechnic School we have had these points constantly brought before us, and feeling the difficulty of discussing them fully, we beg to invite attention to the evidence sent us in reply to some questions which we addressed on the subject to some distinguished scientific officers and civilians connected with the school. We will give briefly the result of our own inquiries.

5. The complaint of General Paixhans has been quoted. He urges that a considerable proportion of the army pupils are mere *queues de promotion*, and quite insufficient to form *le corps et surtout la tête* of troops *d'élite*.

Other not inconsistent complaints we heard ourselves, of the mental exhaustion and the excessively abstract tendencies of many of the military pupils of the school.

6. Such are the complaints. There is certainly reason to think that, with regard to the twenty or thirty lowest pupils on the list, those of General Paixhans are well founded. These are the *breaks down*, and we are at first surprised that, entering as they must do,* with high attain-

* The students are selected, by a competitive examination, out of a very large number of candidates, as will be seen from the following table, extracted from the yearly calendars:—

Year.	Candidates who inscribed their Names.	Candidates examined.	Candidates admitted to the Polytechnic.	Year.	Candidates who inscribed their Names.	Candidates examined.	Candidates admitted to the Polytechnic.
1832	567	468	183	1839	530	531	135
1833	367	304	110	.....	.....	.....	.....
1834	627	541	150	1842	709	559	137
1835	729	633	154	1843	802	559	166
.....	.....	.....	.....	1844	746	531	143
1837	629	508	137	1845	780	559	136
1838	533	410	131				

Giving an average of one student for four candidates *examined*, so that it is impossible to imagine that there is any lack of ability in those selected.

A similar result appears to follow from some other more recent statistics.

ments, they should fall so low as the marks in the tables (with which we are most liberally supplied) prove to be the case.

At the same time, we believe that no teaching ever has provided or will provide against many failures out of one hundred and seventy pupils, even among those who promised well at first: and if the standard of the majority of pupils is high at the Polytechnique, and the point reached by the first few *very* high, it is no reproach that the descent amongst the last few should be very rapid.

With regard to the assertion, that the teaching is excessive and leads too much to abstract pursuits for soldiers, it may be partially true. Perhaps the general passion for science has led to an overstrained teaching for the army, even for its scientific corps; and yet would it be allowed by officers of the highest scientific ability, either in the French or the English army, that less science is required for the greatest emergencies of military than for those of civil engineering, or for the theory of projectiles than for working the department of saltpetre?

It may, however, be true that an attempt is made at the Polytechnic to exact *from all* attainments which can only be reached by *a few*.

7. With this deduction, we must express our opinion strongly in favor of the influence of the Polytechnic on the French army. We admit that in some instances pupils who have failed in their attempt at civil prizes enter the army unwillingly, but they are generally soon penetrated with its *esprit de corps*, and they carry into it talent which it would not otherwise have obtained. Cases of overwork no doubt occur, as in the early training for every profession, but (following the evidence we have received) we have no reason to think them so numerous as to balance the advantage of vigorous, thoughtful study directed early towards a profession which, however practical, is eminently benefited by it. "It can not be said," was the verdict of one well fitted to express an opinion, "that there is too much science in the French army."

8. Assuming, however, the value of the scientific results produced in the French army by the Polytechnic, it by no means follows that a similar institution would be desirable in another country. Without much discussion it may be safely said that the whole history and nature of the institution—the offspring of a national passion for system and of revolutionary excitement—make it thoroughly peculiar to France.

9. Some obvious defects must be noticed. The curious rule of forbidding the use of *all* books whatever is a very exaggerated attempt to make the pupil to rely entirely on the professors and *répétiteurs*. The exclusive practice of *oral* examination also seems to us a defect. Certainly every examination should give a pupil an opportunity of showing such

Year.	Number of Candidates who inscribed their Names.	Number declared admissible to the Second Examination.	Number admitted.
1852	510	216	202
1853	494	222	217
1854	519	238	170
1855	544	232	170

In judging, however, of these numbers, it should be borne in mind that a very large number of the candidates who succeed have tried more than once; the successful of this year have been among the unsuccessful of last year, so that the proportion of individuals who succeed to individuals who fail, is, of course, considerably larger than one to four. Of the 170 candidates admitted in November, 1855, 117 had put down their names for the examination of 1854, and 53 only had not been previously inscribed. Of the 117 who put down their names, 19 had withdrawn without being examined at all, 71 had been rejected on the preliminary examination, 27 had been unsuccessful at that of the second degree; 98 of the 170 came up for the second time to the examination.

valuable qualities as readiness and power of expression; but an examination solely oral appears to us an uncertain test of depth or accuracy of knowledge; and however impartial or practiced an examiner may be, it is impossible that questions put orally can present exactly the same amount of difficulty, and so be equally fair, to the several competitors.

At the same time, although in all great competing examinations the chief part of the work (in our opinion) should be *written*, the constant oral cross-questioning of the minor examinations at the Polytechnic, appeared to be one of the most stimulating and effective parts of their system.

10. A more serious objection than any we have named lies against the exclusive use of mathematical and scientific training, to the neglect of all other, as almost the only instrument of education. The spirit of the school, as shown especially by its entrance examinations, is opposed to any literary study. This is a peculiar evil in forming characters for a liberal profession like the army. Such a plan may indeed produce striking results, if the sole object is to create distinguished mathematicians, though even then the acuteness in one direction is often accompanied by an unbalanced and extravagant judgment in another. But a great school should form the whole and not merely a part of the man; and as doing this, as strengthening the whole mind, instead of forcing on one or two of its faculties—as giving, in a word, what is justly called a *liberal* education—we are persuaded that the system of cultivating the taste for historical and other similar studies, as well as for mere science, is based on a sounder principle than that which has produced the brilliant results of the Polytechnic.

11. It may be added, in connection with the above remark, that as the entrance examination at the Polytechnic influences extensively the teaching of the great French schools, and is itself almost solely mathematical, it tends to diffuse a narrow and exclusive pursuit of science, which is very alien from the spirit of English teaching.

12. We may sum up our remarks on the Polytechnic School thus:—

Regarded simply as a great Mathematical and Scientific School, its results in producing eminent men of science have been extraordinary. It has been the great (and a truly great) Mathematical University of France.

Regarded again as a Preparatory School for the public works, it has given a very high scientific education to civil engineers, whose scientific education in other countries (and amongst ourselves) is believed to be much slighter and more accidental.

Regarded as a school for the scientific corps of the army, its peculiar mode of uniting in one course of competition candidates for civil and military services, has probably raised scientific thought to a higher point in the French than in any other army.

Regarded as a system of teaching, the method it pursues in developing the talents of its pupils appears to us the best we have ever studied.

It is in its studies and some of its main principles that the example of the Polytechnic School may be of most value. In forming or improving any military school, we can not shut our eyes to the successful working at the Polytechnic of the principle, which it was the first of all schools to initiate, the making great public prizes the reward and stimulus of the pupil's exertions. We may observe how the state has here encouraged talent by bestowing so largely assistance upon all successful, but poor pupils, during their school career. We may derive some lessons from its method of teaching, though the attempt to imitate it might be unwise. Meanwhile, without emulating the long established scientific prestige of the Polytechnic, we have probably amongst ourselves abundant materials for a military scientific education, at least as sound as that given at this great School.

NOTE.

In addition to the Schools of Application for Artillery and Engineers at Metz, and of Infantry and Cavalry at St. Cyr, of which a pretty full account will be given, the following Public Services are supplied by the Polytechnic School.

GUNPOWDER AND SALTPETRE.—(*Poudres et Salpêtres.*)

In France the manufacture of gunpowder is solely in the hands of the Government. The pupils of the Polytechnic who enter the gunpowder and saltpetre service, are sent in succession to different powder-mills and saltpetre refineries, so as to gain a thorough acquaintance with all the details of the manufacture.

On first entering the service they are named *élèves des poudres.* They afterwards rise successively to the rank of assistant-commissary, commissary of the third, of the second, and of the first class.

NAVY.—(*Marine.*)

A small number of the pupils of the Polytechnic enter the Navy. They receive the rank of *élève de première classe*, from the date of their admission.

They are sent to the ports to serve afloat. After two years' service they may be promoted to the rank of *enseigne de vaisseau*, on passing the necessary examinations, on the same terms precisely as the *élèves de première classe* of the Naval School.

MARINE ARTILLERY.—(*Artillerie de la Marine.*)

The French marine artillery differs from the English corps of the same name, in not serving afloat. Its duties are confined to the ports and to the colonies. It is governed by the same rules and ordinances as the artillery of the army.

The foundries of La Villeneuve, Rochefort, Ruelle, Névers, and Saint Gervais are under its direction.

The officers of the marine artillery are liable to be sent on board ship to study naval gunnery, so as to be in a position to report upon alterations or improvements in this science.

NAVAL ARCHITECTS.—(*Génie Maritime.*)

The naval architects are charged with the construction and repair of vessels of war, and with the manufacture of all the machinery required in the ports and dockyards. The factories of Indret and La Chaussade are under their direction.

The pupils of the Polytechnic enter the corps of naval architects with the rank of *élève du Génie Maritime.* They are sent to the School of Application of Naval Architects at L'Orient. After two years' instruction they undergo an examination, and, if successful, they are promoted to the rank of sub-architect of the third class, so far as vacancies admit. They may be advanced to the second class after a service of two years.

HYDROGRAPHERS.—(*Ingénieurs Hydrographes.*)

The hydrographers are stationed at Paris. They are sent to the coast to make surveys, and the time so spent reckons as a campaign in determining their pension. On their return to Paris they are employed in the construction of maps and charts.

The hydrographers have the same rank and advantage as the naval architects.

On leaving the Polytechnic, the pupils enter the corps of hydrographers with the rank of *élève hydrographe.* After two years' service, and one season employed on the coast, they become sub-hydrographers without further examination.

ROADS AND BRIDGES.—GOVERNMENT CIVIL ENGINEERS.—(*Ponts et Chaussées.*)

The Polytechnic furnishes exclusively the pupils for the Government Civil Engineer Corps. On leaving the Polytechnic, the pupils enter the School of Application in Paris. The course of instruction here extends over a period of three years. It commences each year on the first of November, and lasts till the 1st of April. After the final examination, the pupils are arranged according to the results of the examination and the amount of work performed.

The pupils enter the college with the rank of *élève de troisième classe.* They rise successively to the second and to the first class, on making the requisite progress in their studies.

From the 1st of May to the 1st of November the *élèves* of the second and the third class are sent on duty into the provinces. The *élèves* of the first class who have completed their three years' course of instruction, are employed in the duties of ordinary engineers, or are detached on special missions. In about three years after quitting the college, they may be appointed ordinary engineers of the second class.

The engineers of the *Ponts et Chaussées* prepare the projects and plans, and direct the execution of the works for the construction, preservation, and repair of high roads, and of the bridges and other structures connected with these roads, with navigable rivers, canals, seaports, lighthouses, &c. They are charged with the superintendence of railways, of works for draining marshes, and operations affecting water-courses; they report upon applications to erect factories driven by water. Under certain circumstances, they share with the Mining Engineers the duty of inspecting steam-engines.

Permission is not unfrequently granted to the engineers of the *Ponts et Chaussées* to accept private employment. They receive leave of absence for a certain time, retaining their rank and place in their corps, but without pay.

MINING ENGINEERS.—(*Mines.*)

The Mining School of Application is organized almost exactly on the same plan as that of the *Ponts et Chaussées:* like the latter, it is in Paris.

The course of instruction, which lasts three years, consists of lectures, drawing, chemical manipulation and analysis, visits to manufactories, geological excursions, and the preparation of projects for mines and machines. Journeys are made by the pupils, during the second half of the last two years of the course, into the mineral districts of France or foreign countries for the purpose of studying the practical details of mining. These journeys last one hundred days at least. The pupils are required to examine carefully the railroads and the geological features of the countries they pass through, and to keep a journal of facts and observations. In the final examination, marks are given for every part of their work.

The mining engineers, when stationed in the departments, are charged to see that the laws and ordinances relating to mines, quarries, and factories are properly observed, and to encourage, either directly or by their advice, the extension of all branches of industry connected with the extraction and treatment of minerals.

One of their principal duties is the superintendence of mines and quarries, in the three-fold regard of safety of the workmen, preservation of the soil, and economical extraction of the minerals.

They exercise a special control over all machines designed for the production of steam, and over railways, as far as regards the metal and fuel.

The instructors in the School of Application in Paris, and in the School of Mines at St. Etienne, are exclusively taken from the members of the corps.

Like the engineers of the *Ponts et Chaussées*, the mining engineers obtain permission to undertake private employment.

TOBACCO DEPARTMENT.—(*Administration des Tabacs.*)

The pupils who enter the tobacco service, commence, on quitting the Polytechnic, with the rank of *élève de 2e classe.* They study, in the manufactory at

Paris, chemistry, physics, and mechanics, as applied to the preparation of tobacco. They make themselves acquainted at the same time with the details of the manufacture and with the accounts and correspondence.

They are generally promoted to the rank of *élève de* 1re *classe* in two years. They rise afterwards successively to the rank of sub-inspector, inspector, and director.

After completing their instruction at the manufactory of Paris, the *élèves* are sent to tobacco manufactories in other parts of France.

Promotion in the tobacco service does not follow altogether by seniority. Knowledge of the manufacture and attention to their duties are much considered, as the interests of the treasury are involved in the good management of the service.

TELEGRAPHS.—(*Lignes Télégraphiques.*)

On entering the telegraphic service the pupils of the Polytechnic receive the rank of *élève inspecteur.*

They pass the first year at the central office. During the six winter months they study, under two professors, the composition of signals, and the regulations which insure their correctness and dispatch, the working of telegraphs and the manner of repairing them, the theory of the mode of tracing lines and of determining the height of the towers, electro-magnetism and its application to the electic telegraph. During the summer months they make tours of inspection. They assist in the execution of works, and practice leveling and the laying down of lines.

At the end of the year the *élèves inspecteurs* undergo an examination, and, if there are vacancies, are appointed provisional inspectors. After a year in this rank they may be appointed inspectors either in France or Algeria.

Each inspector has charge of a district containing from twelve to fifteen stations. He is obliged to make a tour of inspection once a month of at least ten days' duration.

After a certain number of years' service the inspector rises to the rank of director. Besides their other duties, the directors exercise a general superintendence over the inspectors.

PROGRAMMES OF THE PRINCIPAL COURSES OF INSTRUCTION

OF THE IMPERIAL POLYTECHNIC SCHOOL DURING THE TWO YEARS OF STUDY.

I. ANALYSIS.—*FIRST YEAR.*

DIFFERENTIAL CALCULUS.

LESSONS 1—9. *Derivatives and Differentials of Functions of a Single Variable.*

INDICATION of the original problems which led geometers to the discovery of the infinitesimal calculus.

Use of infinitesimals; condition, subject to which, two infinitely small quantities may be substituted for one another. Indication in simple cases of the advantage of such substitution.

On the different orders of infinitely small quantities. Infinitely small quantities of a certain order may be neglected in respect of those of an inferior order. The infinitely small increment of a function is in general of the same order as the corresponding increment of the variable, that is to say, their ratio has a finite limit.

Definitions of the derivative and differential of a function of a single variable. Tangents and normals to plane curves, whose equation in linear or polar co-ordinates is given.

A function is increasing or decreasing, according as its derivative is positive or negative. If the derivative is zero for all values of the variable, the function is constant. Concavity and convexity of curves; points of inflection.

Principle of function of functions. Differentiation of inverse functions.

Differentials of the sums, products, quotients, and powers of functions, whose differentials are known. General theorem for the differentiation of functions composed of several functions.

Differentials of exponential and logarithmic functions.

Differentials of direct and inverse circular functions.

Differentiation of implicit functions.

Tangents to curves of double curvature. Normal plane.

Differential of the area and arc of a plane curve, in terms of rectilinear and polar co-ordinates.

Differential of the arc of a curve of double curvature.

Applications to the cycloid, the spiral of Archimedes, the logarithmic spiral, the curve whose normal, sub-normal, or tangent, is constant; the curve whose normal passes through a fixed point; the curve whose arc is proportional to the angle which it subtends at a given point.

Derivatives and differentials of different orders of functions of one variable. Notation adopted.

Remarks upon the singular points of plane curves.

LESSONS—10—13. *Derivatives and Differentials of Functions of Several Variables.*

Partial derivatives and differentials of functions of several variables. The order in which two or any number of differentiations is effected does not influence the result.

Total differentials. Symbolical formula for representing the total differential of the n^{th} order of a function of several independent variables.

Total differentials of different orders of a function; several dependent varia-

bles. Case where these variables are linear functions of the independent variables.

The infinitesimal increment of a function of several variables may in general be regarded as a linear function of the increments assigned to the variables. Exceptional cases.

Tangent and normal planes to curved surfaces.

LESSONS 14—18. *Analytical Applications of the Differential Calculus.*

Development of F $(x + h,)$ according to ascending powers of h. Limits within which the remainder is confined on stopping at any assigned power of h.

Development of F $(x,)$ according to powers of x or $x—a$; a being a quantity arbitrarily assumed. Application to the functions sin $(x,)$ cos x, a^x, $(1 + x^m)$ and log. $(1 + x.)$ Numerical applications. Representation of cos x and sin x by imaginary exponential quantities.

Developments of $\cos^m x$ and $\sin^m x$ in terms of sines and curves of multiples of x.

Development of F $(x + h, y + k,)$ according to powers of h and k. Development of F (x, y) according to powers of x and y. Expression for the remainder. Theorem on homogeneous functions.

Maxima and minima of functions of a single variable; of functions of several variables, whether independent or connected by given equations. How to discriminate between maxima and minima values in the case of one and two independent variables.

True values of functions, which upon a particular supposition assume one or another of the forms

$$\frac{0}{0},\ \frac{\infty}{\infty},\ \infty + 0,\ 0^0,\ 4^\infty$$

LESSONS 19—23. *Geometrical Applications. Curvature of Plane Curves.*

Definition of the curvature of a plane curve at any point. Circle of curvature. Center of curvature. This center is the point where two infinitely near normals meet.

Radius of curvature with rectilinear and polar co-ordinates. Change of the independent variable.

Contacts of different orders of plane curves. Osculating curves of a given kind. Osculating straight line. Osculating circle. It is identical with the circle of curvature.

Application of the method of infinitesimals to the determination of the radius of curvature of certain curves geometrically defined. Ellipse, cycloid, epicycloid, &c.

Evolutes of plane curves. Value of the arc of the evolute. Equation to the involute of a curve. Application to the circle. Evolutes considered as envelops. On envelops in general. Application to caustics.

LESSONS 14—17. *Geometrical Applications continued. Curvature of Lines of Double Curvature and of Surfaces.*

Osculating plane of a curve of double curvature. It may be considered as passing through three points infinitely near to one another, or as drawn through a tangent parallel to the tangent infinitely near to the former. Center and radius of curvature of a curve of double curvature. Osculating circle. Application to the helix.

Radii of curvature of normal sections of a surface. Maximum and minimum radii. Relations between these and that of any section, normal or oblique.

Use of the indicatrix for the demonstration of the preceding results Conjugate tangents. Definition of the lines of curvature. Lines of curvature of certain simple surfaces. Surface of revolution. Developable surfaces. Differential equation of lines of curvature in general.

LESSON 28. *Cylindrical, Conical, Conoidal surfaces, and Surfaces of Revolution.*

Equations of these surfaces in finite terms. Differential equations of the same deduced from their characteristic geometrical properties.

INTEGRAL CALCULUS.

LESSONS 29—34. *Integration of Functions of a Single Variable.*

Object of the integral calculus. There always exists a function which has a given function for its derivative.

Indefinite integrals. Definite integrals. Notation. Integration by separation, by substitution, by parts.

Integration of rational differentials, integer or fractional, in the several cases which may present themselves. Integration of the algebraical differentials, which contain a radical of the second degree of the form $\sqrt{c+bx+cx^2}$. Different transformations which render the differential rational. Reduction of the radical to one of the forms

$$\sqrt{x^2+x^2},\ \sqrt{a^2-x^2},\ \sqrt{x^2-a^2}.$$

Integration of the algebraical differentials which contain two radicals of the form

$$\sqrt{a+x},\ \sqrt{b+x},$$

or any number of monomials affected with fractional indices. Application to the expressions

$$\frac{x^m dx}{\sqrt{1-x^2}},\ \frac{dx}{x^m\sqrt{1-x^2}},\ \frac{x^m dx}{\sqrt{ax-x}}.$$

Integration of the differentials

$$\mathrm{F}(\log x)\ \frac{dx}{x},\ \mathrm{F}\sin^{-1}x\frac{dx}{\sqrt{1-x^2}},\ x(\log x^n)\,dx,\ x^m e^{ax}\,dx,\ (\sin^{-1}x^m)\,dx.$$

Integration of the differentials $e^{ax}\sin bx dx$ and $e^{ax}\cos bx dx$.

Integration of $(\sin x^m.)(\cos x^n)\,dx$.

Integration by series. Application to the expression

$$\frac{dx}{\sqrt{ax-x^2}\,\sqrt{1-bx}}.$$

Application of integration by series to the development of functions, the development of whose derivatives is given; $\tan^{-1}x$, $\sin^{-1}x$, $\log(1+x)$.

LESSONS 35—38. *Geometrical Applications.*

Quadrature of certain curves. Circle, hyperbola, cycloid, logarithmic spiral, &c.

Rectification of curves by rectilinear or polar co-ordinates. Examples. Numerical applications.

Cubic content of solids of revolution. Quadrature of their surfaces.

Cubic content of solids in general, with rectilinear or polar co-ordinates. Numerical applications.

Quadrature of any curved surfaces expressed by rectangular co-ordinates. Application to the sphere.

LESSONS 39—42. *Mechanical Applications.*

General formula for the determination of the center of gravity of solids, curved or plane surfaces, and arcs of curves. Various applications.

Guldin's theorem.

Volume of the truncated cylinder.

General formula which represent the components of the attraction of a body upon a material point, upon the supposition that the action upon each element varies inversely as the square of the distance. Attraction of a spherical shell on an external or internal point.

Definition of moments of inertia. How to calculate the moment of inertia of a body in relation to a straight line, when the moment in relation to a parallel straight line is known. How to represent the moments of inertia of a body relative to the straight lines which pass through a given point by means of the radii vectores of an ellipsoid. What is meant by the *principal axes of inertia.*

Determination of the principal moments of inertia of certain homogeneous bodies, sphere, ellipsoid, prism, &c.

LESSONS 43—45. *Calculus of Differences.*

Calculation of differences of different orders of a function of one variable by means of values of the function corresponding to equidistant values of the variable.

Expression for any one of the values of the function by means of the first, and its differences. Numerical applications; construction of tables representing a function whose differences beyond a certain order may be neglected. Application to the theory of interpolation. Formulæ for approximation by quadratures. Numerical exercises relative to the area of equilateral hyperbola or the calculation of a logarithm.

LESSONS 46—48. *Revision.*

General reflections on the subjects contained in the preceding course.

ANALYSIS.—*SECOND YEAR.*

CONTINUATION OF THE INTEGRAL CALCULUS.

LESSONS 1—2. *Definite Integrals.*

Differentiation of a definite integral with respect to a parameter in it, which is made to vary. Geometrical demostration of the formula. Integration under the sign of integration. Application to the determination of certain definite integrals.

Determination of the integrals $\int \frac{\sin ax}{x}\,dx$, and $\int \frac{\cos bx \sin ax}{x}\,dx$, between the limits o and x. Remarkable discontinuity which these integrals present.

Determination of $\int e^{-x^2}\,dx$ and $\int e^{-x^2} \cos mx dx$ between the limits 0 and ∞.

LESSONS 3. *Integration of Differentials containing several Variables.*

Condition that an expression of the form $M\,dx + N\,dy$ in which M and N are given functions of x and y may be an exact differential of two independent variables x and y. When this condition is satisfied, to find the function.

Extension of this theory to the case of three variables.

LESSONS 4—6. *Integration of Differential Equations of the First Order.*

Differential equations of the first order with two variables. Problem in geometry to which these equations correspond. What is meant by their integral. This integral always exists, and its expression contains an arbitrary constant.

Integration of the equation $M\,dx + N\,dy = 0$ when its first member is an exact differential. Whatever the functions M and N may be there always exists a factor μ, such that $\mu\,(M\,dx + N\,dy)$ is an exact differential.

Integration of homogeneous equations. Their general integral represents a system of similar curves. The equation $(a + b\,x + c\,y)\,dx + (a' + b'\,x + c'\,y)\,dy = c$, may be rendered homogeneous. Particular case where the method fails. How the integration may be effected in such case.

Integration of the linear equation of the first order $\frac{dy}{dx} + P\,y = Q$, where P and Q denote functions of x. Examples.

Remarks on the integration of equations of the first order which contain a higher power than the first of $\frac{dy}{dx}$. Case in which it may be resolved in respect of $\frac{dy}{dx}$. Case in which it may be resolved in respect of x or y.

Integrations of the equation $y = x\frac{dy}{dx} + \phi\left(\frac{dy}{dx}\right)$. Its general integral represents a system of straight lines. A particular solution represents the envelop of this system.

Solution of various problems in geometry which lead to differential equations of the first order.

LESSONS 7—8. *Integration of Differential Equations of Orders superior to the First.*

The general integral of an equation of the m order contains m arbitrary constants.

(*The demonstration is made to depend on the consideration of infinitely small quantities.*)

Integration of the equation $\frac{d^m y}{dx^m} = \phi(x)$.

Integration of the equation $\frac{d^2 y}{dx^2} = \phi\left(y, \frac{dy}{dx}\right)$.

How this is reduced to an equation of the first order. Solution of various problems in geometry which conduct to differential equations of the second order.

LESSONS 9—10. *On Linear Equations.*

When a linear equation of the m^{th} order contains no term independent of the unknown function and its derivatives, the sum of any number whatever of

particular integrals multiplied by arbitrary constants is also an integral. From this the conclusion is drawn that the general integral of this equation is deducible from the knowledge of m particular integrals.

Application to linear equations with constant co-efficients. Their integration is made to depend on the resolution of an algebraical equation. Case where this equation has imaginary roots. Case where it has equal roots. The general integral of a linear equation of any order, which contains a term independent of the function, may be reduced by the aid of quadratures to the integration of the same equation with this term omitted.

LESSON 11. *Simultaneous Equations.*

General considerations on the integration of simultaneous equations. It may be made to depend on the integrations of a single differential equation. Integration of a system of two simultaneous linear equations of the first order.

LESSON 12. *Integrations of Equations by Series.*

Development of the unknown function of the variable x according to the powers of $x-a$. In certain cases only a particular integral is obtained. If the equation is linear, the general integral may be deduced from it by the variation of constants.

LESSONS 13—16. *Partial Differential Equations.*

Elimination of the arbitrary functions which enter into an equation by means of partial derivatives. Integration of an equation of partial differences with two independent variables, in the case where it is linear in respect to the derivatives of the unknown function. The general integral contains an arbitrary function.

Indication of the geometrical problem, of which the partial differential equation expresses analytically the enunciation. Integration of the partial differential equations to cylindrical, conical, conoidal surfaces of revolution. Determination of the arbitrary functions.

Integration of the equation $\frac{d^2 u}{d y^2} = a^2 \frac{d^2 u}{d x^2}$. The general integral contains two arbitrary functions. Determination of these functions.

LESSONS 17—23. *Applications to Mechanics.*

Equation to the catenary.

Vertical motion of a heavy particle, taking into account the variation of gravity according to the distance from the center of the earth. Vertical motion of a heavy point in a resisting medium, the resistance being supposed proportional to the square of the velocity.

Motion of a heavy point compelled to remain in a circle or cycloid. Simple pendulum. Indication of the analytical problem to which we are led in investigating the motion of a free point.

Motion of projectiles in a vacuum. Calculation of the longitudinal and transversal vibrations of cords. Longitudinal vibrations of elastic rods. Vibration of gases in cylindical tubes.

LESSONS 24—26. *Applications to Astronomy.*

Calculation of the force which attracts the planets, deduced from Kepler's laws. Numerical data of the question.

Calculation of the relative motion of two points attracting one another, according to the inverse square of the distance.

Determination of the masses of the earth and of the planets accompanied by satellites. Numerical applications.

LESSONS 27—30.

Elements of the calculus of probabilities and social arithmetic.

General principles of the calculus of chances. Simple probability, compound probability, partial probability, total probability. Repeated trials. Enunciation of Bernouilli's theorem (without proof.)

Mathematical expectation. Applications to various cases, and especially to lotteries.

Tables of population and mortality. Mean life annuities, life interests, assurances, &c.

LESSONS 31—32. *Revision.*

General reflections on the subjects comprised in the course.

II. DESCRIPTIVE GEOMETRY AND STEREOTOMY.

General Arrangements.

The pupils take in the lecture-room notes and sketches upon sheets, which are presented to the professor and the "répétiteurs" at each interrogation. The care with which these notes are taken is determined by "marks," of which account is taken in arranging the pupils in order of merit.

The plans are made according to programmes, of which the conditions are different for different pupils. The drawings are in general accompanied with decimal scales, expressing a simple ratio to the meter. They carry inscriptions written conformably to the admitted models, and are, when necessary, accompanied with verbal descriptions.

In the graphic exercises of the first part of the course, the principal object is to familiarize the pupils with the different kinds of geometrical drawing, such as elevations and shaded sections, oblique projections and various kinds of perspective. The pupils are also accustomed to different constructions useful in stereotomy.

The subjects for graphic exercises in stereotomy are taken from roofs, vaults, and staircases. Skew and oblique arches are the subject of detailed plans.

FIRST YEAR.

DESCRIPTIVE GEOMETRY.—GEOMETRICAL DRAWING.

LESSONS 1—3 *Revision and Completion of the Subjects of Descriptive Geometry comprised in the Programme for Admission into the School.*

Object of geometrical drawing. Methods of projection. Representation of points, lines, planes, cones, cylinders, and surfaces of revolution. Construction of tangent planes to surfaces, of curves, of intersection of surfaces, of their tangents and their assymplotes.

Osculating plane of a curve of double curvature. A curve in general cuts its osculating plane.

When the generating line of a cylinder or a cone becomes a tangent to the directrix, the cylinder or cone in general has an edge of regression along this

generating line. The osculating plane of the directrix at the point of contact touches the surface along this edge.

Projections of curves of double curvature; infinite branches and their assymptotes, inflections, nodes, cusps, &c.

Change of planes of projection.

Reduction of scale; transposition.

Advantage and employment of curves of error; their irrelevant solutions.

Lessons 4—6. *Modes of Representation for the Complete Definition of Objects.*

Representation by plans, sections, and elevation.

Projection by the method of contours. Representation of a point, a line, and a plane; questions relative to the straight line and plane. Representation of cones and cylinders; tangent planes to these surfaces.

Lessons 7—11. *Modes of Representation which are not enough in themselves to define objects completely*

Isometrical and other kinds of perspective.

Oblique projections.

Conical perspective: vanishing points; scales of perspective; method of squares; perspective of curved lines; diverse applications. Choice of the point of sight. Rules for putting an elevation in perspective. Rule for determining the point of sight of a given picture, and for passing from the perspective to the plan as far as that is possible. Perspective of reflected images. Notions on panoramas.

Lessons 12—13. *Representations with Shadows.*

General observations on envelops and characteristics.

A developable surface is the envolop of the position of a movable plane; it is composed of two sheets which meet. It may be considered as generated by a straight line, which moves so as to remain always a tangent to a fixed curve.

Theory of shade and shadow, of the penumbra, of the brilliant point, of curves of equal intensity, of bright and dark edges.

Atmospheric light: direction of the principal atmospheric ray. Notions on the degradation of tints; construction of curves of equal tint.

Influence of light reflected by neighboring bodies.

Received convention in geometrical drawing on the direction of the luminous ray, &c.

Perspective of shadows.

Lessons 14—15. *Construction of Lines of Shadows and of Perspective of Surfaces.*

Use of circumscribed cones and cylinders, and of the normal parallel to a given straight line.

General method of construction of lines of shadow and of perspective of surfaces by plane sections and auxiliary cylindrical or conical surfaces.

Construction of lines of shadow and perspective of a surface of revolution.

The curve of contact of a cone circumscribed about a surface of the second degree is a plane curve. Its plane is parallel to the diametral plane, conjugate to the diameter passing through the summit of the cone. The curve of contact of a cylinder circumscribed about a surface of the second degree is a plane

curve, and situated in the diametral plane conjugate to the diameter parallel to the axis of the cylinder.

The plane parallel sections of a surface of the second degree are similar curves. The locus of their centers is the diameter conjugate to that one of the secant planes which passes through the center of the surface.

General study of surfaces with reference to the geometrical constructions to which their use gives rise.

LESSON 16. *Complementary Notions on Developable Surfaces.*

Development of a developable surface; construction of transformed curves and their tangents. Developable surface; an envelop of the osculating planes of a curve. The osculating plane of a curve at a given point may be constructed by considering it as the edge of regression of a developable surface; this construction presents some uncertainty in practice. Notions on the helix and the developable helicoid.

Approximate development of a segment of an undevelopable surface.

LESSONS 17—18. *Hyperbolic Paraboloid.*

Double mode of generation of the paraboloid by straight lines; plane-directers; tangent planes, vertex, axis, principal planes; representation of this surface. Construction of the tangent plane parallel to a given plane. Construction of plane sections and of curves of contact, of cones, and circumscribed cylinders.

Scalene paraboloid. Isosceles paraboloid.

Identity of the paraboloid with one of the five surfaces of the second degree studied in analytical geometry.

Re-statement without demonstration of the properties of this surface found by analysis, principally as regards its generation by the conic sections.

LESSONS 19—20. *General Properties of Warped or Ruled Surfaces.*

Principal modes of generation of warped surfaces. When two warped surfaces touch in three points of a common generatrix, they touch each other in every point of this straight line. Every plane passing through a generatrix touches the surface at one point in this line. The tangent plane at infinity is the plane-directer to all the paraboloids of "raccordement."

Construction of the tangent planes and curves of contact of circumscribed cones and cylinders. When two infinitely near generatrices of a warped surface are in the same plane, all the curves of contact of the circumscribed cones and cylinders pass through their point of concourse.

The normals to a warped surface along a generatrix form an isosceles paraboloid. The name of central point of a generatrix is given to the point where it is met by the straight line upon which is measured its shortest distance from the adjoining generatrix. The locus of these points forms the line of striction of the surface. The vertex of the normal paraboloid along a generating line is situated at the central point. If the point of contact of a plane touching a warped surface moves along a generatrix, beginning from the central point, the tangent of the angle which the tangent plane makes with its primitive position is proportional to the length described by the point of contact. The tangent

plane at the central point is perpendicular to the tangent plane at infinity upon the same generatrix. Construction of the line of striction by aid of this property.

LESSONS 21—22. *Ruled Surfaces with plane-directers Conoids.*

The plane-directer of the surface is also so to all the paraboloids of "raccordement." Construction of the tangent planes and curves of contact of the circumscribed cones and cylinders.

The line of striction of the surface is its curve of contact with a circumscribed cylinder perpendicular to the directer-plane. Determination of the nature of the plane sections.

The lines of striction of the scalene paraboloid are parabolas; those of the isosceles paraboloid are straight lines.

Construction of the tangent plane parallel to a given plane.

Conoid: discussion of the curves of contact of the circumscribed cones and cylinders.

Right conoid. Conoid whose intersection with a torus of the same height, whose axis is its rectilinear directrix, has for its projection upon the directer-plane two arcs of Archimedes' spiral. Construction of the tangents to this curve of intersection.

LESSONS 23—25. *Ruled Surfaces which have not a Directer-Plane. Hyperboloid. Surface of the "biais passe."*

Directer-cone: its advantages for constructing the tangent plane parallel to a given plane, and for determining the nature of the plane sections. The tangent planes to the points of the surface, situated at infinity, are respectively parallel to the tangent plane of the directer-cone. Developable surface which is the envelope of these tangent planes at infinity. Construction of a paraboloid of *raccordement* to a ruled surface defined by two directrices and a directrix cone.

Hyperboloid; double mode of generation by straight lines; center; asymptotic cone.

Scalene hyperboloid; hyperboloid of revolution. Identity of the hyperboloid with one of the five surfaces of the second degree studied in analytical geometry.

Re-statement without demonstration of the properties of this surface, found by analysis, principally as to what regards the axis, the vertices, the principal planes, and the generation by conic sections.

Hyperboloid of *raccordement* to a ruled surface along a generatrix; all their centers are in the same plane. Transformation of a hyperboloid of *raccordement.*

Surface of the *biais passé.* Construction of a hyperboloid of *raccordement;* its transformation into a paraboloid.

Construction of the tangent plane at a given point.

LESSONS 26—28. *Curvature of Surfaces. Lines of Curvature.*

Re-statement without proof of the formula of Euler given in the course of analysis.

There exists an infinity of surfaces of the second degree, which at one of their vertices osculate any surface whatever at a given point.

In the tangent plane, at a point of a surface, there exists a conic section, whose diameters are proportional to the square roots of the radii of curvature of the normal sections to which they are tangents. This curve is called the indicatrix. It is defined in form and position, but not in magnitude. The normal sections tangential to the axes of the indicatrix are called the principal sections.

The indicatrix an ellipse; convex surfaces; umbilici; line of spherical curvatures.

The indicatrix a hyperbola; surfaces with opposite curvatures.

The assymplotes of the indicatrix have a contact of the second order with the surface, and of the first order with the section of the surface by its tangent plane.

A ruled surface has contrary curvatures at every point. The second assymplotes of the indicatrices of all the points of the same generatrix form a hyperboloid, if the surface has not directer-plane,—a paraboloid, if it have one.

Curvature of developable surfaces.

There exists upon every surface two systems of orthogonal lines, such that every straight line subject to move by gliding over either of them, and remaining normal to the surface, will engender a developable surface. These lines are called lines of curvature.

The two lines of curvature which cross at a point, are tangents to the principal sections of the surface at that point.

Remarks upon the lines of curvature of developable surfaces, and surfaces of revolution.

Determination of the radii of curvature, and assymplotes of the indicatrix at a point of a surface of revolution.

LESSONS 29—30. *Division of Curves of Apparent Contour, and of Separation of Light and Shadow into Real and Virtual Parts.*

When a cone is circumscribed about a surface, at any point whatever of the curve of contact, the tangent to this curve and the generatrix of the cone are parallel to two conjugate diameters of the indicatrix.

Surfaces, as they are considered in shadows, envelop opaque bodies, and the curve of contact of a circumscribed cone, only forms a separation of light and shadow, for a luminous point at the summit of the cone, when the generatrices of this cone are exterior. This line is thus sometimes real and sometimes virtual.

Upon a convex surface, the curve of separation of light and shade is either all real or all virtual. Upon a surface with contrary curvatures, this curve presents generally a succession of real and virtual parts: the curve of shadow cast from the surface upon itself presents a like succession. These curves meet tangentially, and the transition from the real to the virtual parts upon one and the other, take place at their points of contact in such a way that the real part of the curve of shadow continues the real part of the curve of separation of light and shade. The circumscribed cones have edges of regression along the generatrices, which correspond to the points of transition.

The lines of visible contour present analogous circumstances.

General method of determining the position of the transition points. Special method for a surface of revolution.

LESSONS 31—34. *Ruled Helicoidal Surfaces.*

Surface of the thread of the triangular screw; generation, representation, sections by planes and conical cylinders.

Construction of the tangent plane at a given point, or parallel to a given plane. The axis is the line of striction.

Construction of lines of shadow and perspective: their infinite branches, their assymplotes. Determination of the osculating hyperboloid along a generatrix.

Representation and shading of the screw with a triangular thread and its nut.

Surface of the thread of the square screw; generation, sections by planes and conical cylinders; tangent planes; curve of contact of a circumscribed cone.

The curve of contact of a circumscribed cylinder is a helix whose *step* is half that of the surface. Determination of the osculating paraboloid. At any point whatever of the surface, the absolute lengths of the radii of curvature are equal.

Representation and shading of the screw with a square thread, and of its nut.

Observations on the general ruled helicoidal surface, and on the surface of intrados of the winding staircase.

LESSON 35. *Different Helicoidal Surfaces.*

Saint-Giles screw, worm-shaped screw and helicoidal surfaces to any generatrix. Every tangent to the meridian generatrix describes a screw surface with triangular thread, which is circumscribed about the surface, along a helix, and may be used to resolve the problems of tangent planes, circumscribed cylinders, &c.

Helicoid of the open screw, its generation, tangent planes.

LESSONS 36—37. *Topographical Surfaces.*

Approximate representation of a surface by the figured horizontal projections of a series of equidistant horizontal sections. This method of representation is especially adapted to topographical surfaces, that is to say, surfaces which a vertical line can only meet in one point.

Lines of greatest slope. Trace of a line of equal slope between two given points.

Intersection of a plane and a surface, of two surfaces, of a straight line and a surface.

Tangent planes, cones, and cylinders circumscribed about topographical surfaces.

Use of a topographical surface to replace a table of double-entry when the function of two variables, which it represents, is continuous. It is often possible, by a suitable anamorphosis, to make an advantageous transformation in the curves of level.

LESSON 38. *Revision.*

Review of the different methods of geometrical drawing. Advantages and disadvantages of each.

Comparison of the different kinds of surfaces, *résumé* of their general properties.

Object, method, and spirit of descriptive geometry.

SECOND YEAR.

STEREOTOMY.—WOOD-WORK.

LESSONS 1—4. *Generalities.*

Notions on the mode of action of forces in carpentry. Resistance of a piece of wood to a longitudinal effort and to a transversal effort. Distinction between resistance to flexure and resistance to rupture. Beams.

Advantages of the triangular system, St. Andrew's cross.

LESSONS 5—8. *Roofs.*

Ordinary composition of roofs.

Distribution of pressures in the different parts of a girded roof.

Design of the different parts of roofs, &c., &c.

LESSONS 9—10. *Staircases.*

MASONRY.

LESSONS 11—12. *Generalities.*

Notions on the settlement of vaulted roofs. Principal forms of vaults, *en berceau*, &c., &c.

Distribution of the pressures, &c.

Division of the intrados. Nature of the surfaces at the joints, &c., &c.

LESSONS 13—15. *Berceaux and descentes.*

LESSONS 16—22. *Skew Arches.*

Study of the general problem of skew arches.

First solution. Straight arches *en échelon.*

Second solution: Orthogonal *appareil.* True and principal properties of the orthogonal trajectories of the parallel sections of an elliptical or circular cylinder. Right conoid, having for directrices the axis of the circular cylinder and an orthogonal trajectory. The intersection of this conoid by a cylinder about the same axis is an orthogonal trajectory for a series of parallel sections.

Third solution: helicoidal. Determination of the angular elevation at which the surfaces of the beds become normal to the head planes; construction in the orthogonal and helicoidal *appareil* of the curves of junction upon the heads, and the angles which they form with the curves of intrados. Cutting of the stones in these different constructions. Broken helicoidal *appareil*, for very long skew arches.

Helicoidal *trompes* at the angles of straight arches; *voussures* or widenings, which it is necessary to substitute near the heads at the intrados of an arch with a considerable skew; case where the skew is not the same for the two heads. Orthogonal trajectories of the converging sections of a cylinder.

LESSONS 23—25. *Conical Intrados—Intrados of Revolution.*

Skew *trompe* in the angle. Suggestions on the general problem of conical skew vaulted roofs.

Spherical domes, &c.

LESSONS 26—27. *Intrados, a Ruled Surface.*

Winding staircases, &c., &c.

LESSON 28. *Helicodial Intrados.*

Staircase on the Saint-Giles screw.

LESSONS 29—31. *Composite Vaulted Roofs.*

Various descriptions of vaults.

Suggestions on vaulted roofs with polygonal edges and with ogival edges.

LESSON 32. *Revision.*

Spirit and method of stereotomy.

Degree of exactness necessary. Approximate solutions. Case where it is proper to employ calculation in aid of graphical constructions.

Review and comparison of different *appareils.*

MECHANICS AND MACHINES.

GENERAL ARRANGEMENTS.

The pupils execute during the two years of study:—

1. Various drawings or plans of models in relief, representing the essential and internal organs of machines, such as articulations of connecting rods, winch-handles and fly-wheels, grease-boxes, eccentrics worked by cams or circles giving motion to rods; the play of slides, &c.; cylinders of steam-engines, condenser, pistons, and various suckers; Archimedes' screw, and other parts of machines.

The sketches of the plan drawings are traced by hand and figured. The drawings in their finished state are washed and colored according to the table of conventional tints; they all carry a scale suitably divided.

2. A drawing of wheel-work by the method of development, and tracing the curves of teeth by arcs of circles from which they are developed. This drawing represents, of the natural size, or on any other scale of size considered suitable to show the nature of the partial actions only, a small number of teeth either in development or projection; the entire wheel-work is represented by the usual method of projection, where in drawings on a small scale the teeth are replaced by truncated pyramids with a trapezoidal base.

3. Finally, numerical exercises concerning the loss of work due to the prejudicial resistances in various machines, the gauging of holes, orifices, &c.

Models in relief, or drawings on a large scale, of the machines or elements of the machines mentioned in the course, assist in explaining the lessons. They are brought back, as often as found necessary, under the eyes of the students. When possible, lithographic sketches of the machines, or the elements of the machines, which ought to enter into the course, are distributed among the pupils.

The pupils, divided into sections, pay their first visit to the engine factories towards the end of their first year of study; they make one or more additional visits at the end of the second year.

FIRST YEAR.

PART I. KINEMATICS.—PRELIMINARY ELEMENTARY MOVEMENTS OF INVARIABLE POINTS AND SYSTEMS.

Lessons 1—2.

Object of kinematics, under the geometrical and experimental point of view. Its principal divisions.

Re-statement of the notions relative to the motion of a point, its geometrical representation, and more especially the determination of its velocity.

Simultaneous Velocities of a Point and the Increments of its Velocities.

Ratio of the elementary displacement and the velocity of a point to the displacement, and velocity of its projection upon a straight line or plane. Use of infinitesimals to determine these ratios. Example:—Oscillatory motion of the projection upon a fixed axis of a point moving uniformly upon the circumference of a circle.

Analogous considerations for polar co-ordinates. Relations of the velocity of a point, of its velocity of revolution and its angular velocity about a fixed pole; of its velocity in the direction of the radius vector; of the velocity of increase of the area which this radius describes.

Simple Motions of Solids, or Rigid Systems.

1. Motion of rectilinear or curvilinear translation; simultaneous displacements, and velocities of its different points.

2. Motion of rotation about a fixed axis; relation of the velocities of different points to the angular velocity.

Geometrical notions and theorems relative to the *instantaneous center* of rotation of a body of invariable figure and movable in one plane, or to the *instantaneous axis* of rotation of a rigid system situated in space, and movable parallel to a fixed plane. Relation of the velocities of different points to their common angular velocity. Use of the instantaneous center of rotation for tracing tangents; examples—and amongst others—that of the plane curve described by a point in a straight line of given length, whose extremities slide upon two fixed lines. Rolling of a curve upon another fixed curve in a plane. Descartes' theorems upon the intersection of the normals at the successive points of contact: cycloids, epicycloids, involutes, and evolutes. Extension of the preceding motions to the instantaneous axis of rotation of a rigid system movable about a fixed point.

COMPOSITION OF MOTIONS.

Lessons 3—6 *Composition of the Velocities of a Point.*

Polygon of velocities. Example of movements observed relatively to the earth. Particular cases; composition of velocities taken along three axes; composition of the velocity of a point round a fixed pole, and its velocity along the radius vector. Method of Roberval for tracing tangents.

Composition of the Simple Motions of a Solid System.

Composition of any number of translatory displacements of a solid. Composition of two rotations about two intersecting axes. Composition of any number of rotations about axes cutting one another at the same point; parallelopiped and polygon of rotations. Composition of two simultaneous rotations about parallel axes; case where the rotations are equal and of opposite kinds. Decomposition of a rotation about an axis into an equal rotation about any axis whatever parallel to the first, and a translation perpendicular to the direction of this axis. Direct and geometrical decomposition of the most general motions of a body into a rotation about, and a translation along, an axis called the *instantaneous axis.* Composition of any two motions whatever. Every movement of an invariable system is at each instant of time decomposable into three movements of rotation, and three movements of tranlation with respect to three axes, which are neither parallel nor lying in the same plane, but otherwise arbitrarily chosen.

Relative or Apparent Motions.

Relative motion of two points whose absolute motions are given graphically *à priori.* Trajectory of the relative motions, relative velocities, and displacements upon curves or upon the direction of the mutual distance of the two points; use of the parallelogram to determine its amount. Relative motion of a point in motion in respect of a body turning about a fixed axis; relative motion of two bodies which turn about parallel or converging axes, and in general of two rigid bodies or systems impelled by any motions whatever. How this problem is immediately reduced to that of the composition of given motions.

The most general continued motion of an invariable figure in a plane is an *epicycloidal* motion, in which the instantaneous center describes a curve fixed in relation to absolute space, and traces relatively to the proposed figure a movable curve, which is rigidly connected with that figure and draws it along with it in its motion of rolling upon the other fixed curve. Case of space or spherical figures.

ON THE ACCELERATED MOTION OF A POINT.

Lessons 7—9. *Accelerated Rectilinear Motion.*

Re-statement of the motions acquired relatively to the acceleration in the variable rectilinear motion of a point. Brief indication of the solution of six problems arising out of the investigation of the laws of the motion in terms of the space, time, velocity, and accelerating force. For the most part these solutions may be brought to depend on exact or approximate quadratures. Numerical exercises.

Accelerated Curvilinear Motions.

Re-statement of the notions acquired relative to the composition of accelerating forces; the resulting acceleration, the normal and tangential acceleration animating a point in motion on a curve. The total acceleration of a point upon an axis or plane is the projection upon this axis or plane of the acceleration of the moving body in space. In uniform curvilinear motion the total or resultant acceleration becomes normal to the curve. Particular case of the circle; value of the normal acceleration in terms of the velocity of revolution or the angular

velocity of the radius vector. Case of any curve whatever; geometrical expression of the total or resultant acceleration.

Accelerated Compound and Relative Motions.

Geometrical investigation of the simple and compound accelerations arising out of the hypothesis in which the motion of any system of points whatever is referred to another system of invariable form, but also in motion, Geometrical and elementary explanations of the results obtained by means of the transformation of co-ordinates.

Examples or Exercises chosen from among the following Questions:—

Projection of circular and uniform motion upon a fixed straight line or plane; motion of a circle which rolls uniformly on a straight line; comparison of the motions of the planets relatively to each other, treating them as circular and uniform; comparison of the accelerating force on the moon with that of bodies which fall to the earth.

GEOMETRICAL THEORY AND APPLICATION OF MECHANISMS OR CONTRIVANCES FOR THE TRANSFORMATION OF MOTION.

Lessons 10—19.

Succinct notions on the classification of elementary motions and organs for transmission of motion in machines after Monge and Hachette, Lanz and Bétancourt.

The most essential details upon this subject are set forth in the following order, and made clear by outline drawings previously distributed among the pupils.

Organs fitted to regulate the direction of the circular or rectilinear motion of certain pieces.

Axle; trunnions, gudgeons; pivots and bearings; couplings of axes; adjustment of wheels and of their arms. Joints with hinges, &c.; sheaves and pulleys; chains, ropes, and straps; means of securing them to the necks. Grooves and tongue-pieces. Eyelet-holes sliding along rectilinear or curvilinear rods. Advantages and disadvantages of these different systems of guides under the point of view of accuracy.

Rapid indication of some of their applications to drawbridges and to the movable frames or wagons of saw-works and railways.

Transmission at a Distance of Rectilinear Motion in a determinate Direction and Ratio.

Inclined plane or wedge guiding a vertical rod. Wedge applied to presses. Rods, winch-handles, &c. Disposition of drums or pulleys in the same plane or in different planes; geometrical problem on this subject. Fixed and movable pulleys. Blocks to pulleys. Simple and differential wheel and axle moved by cords. Transmission through a liquid. Ratios of velocities in these different organs.

Direct Transformation of circular progressive motion into progressive and intermittent rectilinear motion.

Rod conducted between guides: 1°, by the simple contact of a wheel; 2°, by cross-straps or chains; 3°, by a projecting cam; 4°, by means of a helicoidal

groove set upon the cylindrical axis of the wheel. To-and-fro movement, and heart-shaped or continuous cam, waves, and eccentrics. Simple screw and nut. Left and right handed screws; differential screw of Prony, called the micrometric screw. Ratio of the velocities in these different organs.

The example of the cam and pile-driver will be particularly insisted upon; 1°, in the case where this cam and the extremity of the rod have any continuous form given by a simple geometrical drawing; 2°, in the case where this form is defined geometrically by the condition, that the velocity is to be transmitted in an invariable ratio, as takes place for cams in the form of epicycloids or involutes of circles.

Transformation of a circular progressive motion into another similar to the first.

1°, by contact of cylinders or cones, the two axes being situated in the same plane; 2°, by straps, cords, or endless chains, the axes being in the same situation; 3°, by cams, teeth, and grooves, at very slight intervals; 4°, by the Dutch or universal joint. Case, where the axes are not situated in the same plane; use of an intermediate axis with beveled wheels or a train of pulleys; idea of White or Hooke's joint in its improved form. Endless screw specially employed in the case of two axes at right angles to one another. Combinations or groupings of wheels. Idea of differential wheels. Relations of velocities in the most important of these systems of transmission.

Transformation of circular progressive Motion into rectilinear or alternating circular motion.

Ordinary circular eccentric. Eccentrics with closed waves or cams. Examples and graphical exercises in the class-rooms relative to the alternate action of the traveling frames of saw-mills, of the slides or entrance valves of steam-engines. Cams for working hammers and bellows.

Transformation of alternating circular motion into alternating rectilinear motion, or into intermittent and progressive circular motion.

Pump rods with or without circular sectors, &c. Examples taken from large exhausting pumps, fire-engines, and common pumps. Suggestions as to the best arrangement of the parts. Lagarousse's lever, &c. Application of the principle relative to the instantaneous center of rotation to give the relations of the velocities in certain simple cases.

Transformation of alternating circular or rectilinear motions into progressive circular motion.

The knife-grinder's treadle. System of great machines worked with connecting rods, fly-wheel, &c. Watt's parallelogram, and the simplest modifications of it for steamboats, for instance. The most favorable proportions for avoiding the deviation of piston-rods. Simplification of parts in the modern steam-engines of Maudsley, Cavé, &c. Variable ratios of the velocities.

Of organs for effecting a sudden change of motion.

Suspendors or moderators, &c. Dead wheels and pulleys, &c. Mechanisms for stretching cords or straps, and make them change pulleys during the motion. Brakes to windmills, carriages, &c., &c. Case where the axes are rendered

movable. Means for changing the directions and velocity of the motions. Coupled and alternate pulleys; alternate cones; castors moving by friction and rotation upon a plate or turning-cone; eccentric and orrery wheels. Means of changing the motion suddenly and by intervals; wheels with a detent pile-drivers; Dobo's escapement for diminishing the shock, &c.

Geometrical Drawing of Wheel-work.

General condition which the teeth of toothed wheels must satisfy. Consequence resulting from this for the determination of the form of the teeth of one of two wheels, when the form of the teeth of the other wheel is given.

Cylindrical action of toothed wheels or toothed wheels with parallel axes. External engagement of the teeth; internal engagement. Particular systems of toothed wheels; lantern wheels, flange wheels, involutes of circles. Reciprocity of action; case where the action can not be rendered reciprocal. Pothook action. Details as to the form and dimensions given in practice to the teeth and the spaces which separate them.

Conical action of toothed wheels, or toothed wheels with converging axes. Practical approximate method of reducing the construction of a conical to that of a cylindrical engagement of toothed wheels.

Means of observation and apparatus proper for discovering experimentally the law of any given movement.

Simple methods practiced by Galileo and Coulomb in their experiments relative to the inclined plane and the motion of bodies sliding down it. Various means of observing and discovering the law of the translatory and rotatory motion of a body according as the motion is slow or rapid. Determination of the angular velocity, &c. The counter in machines. Apparatus of Mattei and Grobert for assigning the initial velocity of projectiles (musket balls.) Colonel Beaufoy's pendulum apparatus. Chronometrical apparatus for continuous indications by means of a pencil. Eytelwein's apparatus with bands, and its simplest modifications. Apparatus with cylinders or revolving disks. Use of the tuning-fork for measuring with precision very small fractions of time.

(The principal sorts of the apparatus above described are made to act under the eyes of the pupils.)

PART II.—EQUILIBRIUM OF FORCES APPLIED TO MATERIAL SYSTEMS.

Lesson 21.

Résumé of the notions acquired upon the subject of forces, and their effects on material points.

Principle of inertia, notion of force, of its direction, of its intensity. Principle of the equality of action and reaction. What is meant by the force of inertia? Principle of the independence and composition of the effects of forces. Forces proportional to the acceleration which they produce on the same body. Composition of forces. Relation between the accelerating force, the pressure, and the mass. Definition of the work done by a force. The work done by the resultant is equal to the sum of the works done by the components. Moment of a force in relation to an axis deduced from the consideration of the work of the force applied to a point turning about a fixed line. The moment of the re-

sultant of several forces applied to a point is equal to the sum of the moments of the components. Corresponding propositions of geometry.

LESSONS 22—25.

Succinct Notions upon the Constitution of Solid Bodies.

Every body or system of bodies may be regarded as a combination of material points isolated or at a distance, subject to equal and opposite mutual actions. Interior and exterior forces. Example of two molecules subject to their reciprocal actions alternately, attractive and repulsive, when the forces applied draw them out of their position of natural equilibrium. Different degrees of natural solidity, stability, or elasticity; they can only be appreciated by experience.

Equilibrium of any Systems whatever of Material Points.

General theorem of the virtual work of forces applied to any system whatever of material points. It is applicable to every finite portion of the system, provided regard be had to the actions exercised by the molecules exterior to the part under consideration. Determination of the sum of the virtual works of the equal and reciprocal actions of two material points. Demonstration of the six general equations of equilibrium of any system whatever. They comprise implicitly *every* equation deduced from a virtual movement compatible with the pre-supposed solidification of the system.

Theorem on the virtual work in the case of systems where one supposes ideal connections, such as the invariability of the distance of certain points of the system from one another, and the condition that certain of them are to remain upon curves either fixed or moving without friction.

Equilibrium of Solid Bodies.

The six general equations of equilibrium are sufficient as conditions of the equilibrium of a solid body. Theory of moments and couples.

APPLICATIONS.

LESSONS 26—29. *Equilibrium of Heavy Systems.*

Recapitulation of some indispensable notions for the experimental determination of the center of gravity of solids when the law of their densities is unknown. Re-statement of the theorem relative to the work done by gravity upon a system of bodies connected or otherwise. In machines supposed without friction submitted, with the exception of their supports, to the action of gravity alone, the positions of stable or unstable equilibrium correspond to the highest or lowest points of the curve which would be described by the center of gravity of the system when made to move. Influence of defect of centering in its wheels, upon the equilibrium of a machine. Case where the center of gravity always remaining at the same height the equilibrium is neutral. Examples relative to the most simple drawbridges, &c.

Equilibrium of Jointed Systems.

Equilibrium of the funicular polygon deduced from direct geometrical considerations: Varignon's theorem giving the law of the tensions by another

polygon whose sides are parallel and proportional to the forces acting upon the vertices of the funicular polygon. Case of suspension bridges; investigation of the curve which defines the boundary of the suspension chain; tensions at the extremities.

Equilibrium of systems of jointed rigid bodies without friction. Determination of the pressure upon the supports and the mutual actions at the joints.

Equilibrium and stability of solid bodies submitted to the action of stretching or compressing forces.

Permanent resistance and limiting resistance of prisms to longitudinal extension and compression. Equilibrium and stability of a heavy solid placed upon a horizontal plane and submitted to the action of forces which tend to overset it. Resultant pressure and mean pressure; hypothetical distribution of the elements of the pressure on the base of support. Conditions of stability, regard being had to the limit of resistance of solid materials, co-efficient of stability deduced from it.

PART III.—ON THE WORK DONE BY FORCES IN MACHINES.

LESSONS 30—39. *General Notions.*

Principle of work in the motion of a material point. Extension of this principle to the case of any material system whatever in motion. Considerations relative to mechanical work in various operations, such as the lifting of weights, sawing, planing, &c. It is the true measure of the productive activity of forces in industrial works. It may always be calculated either rigorously or approximately when the mathematical or experimental law which connects the force with the spaces described is given. Uniform work, periodical work, mean work, for the unit of time. Horse-power unit. Examples and various exercises, such as the calculation of the work corresponding to the elasticity of gases on the hypothesis of Mariotte's law, the elongation of a metallic prism, &c.

Dynamometrical Apparatus.

Dynamometer of traction by a band or rotating disc or register. Dynamometer of rotation with simple spring, with band or register. Dynamometer of rotation with multiple springs and with register for the axles of powerful machines. Improved indicator of Watt.

(These pieces of apparatus are made to act under the eyes of the pupils.)

Work of Animal Prime Movers upon Machines.

Results of experience as to the values of the daily work which animal motors can supply under different circumstances without exceeding the fatigue which sleep and nourishment are capable of repairing.

Theory of the Transmission of Work in Machines.

Principal resistance. Secondary resistances. Two manners in which bodies perform the duty of motors. Ratio of work done to work expended always inferior to unity. Different parts of machines; receiver; organs of transmission; tools as machines.

Calculation of the Work due to the passive resistances in machines.

Résumé of the notions previously acquired on friction. Application to the inclined plane, to the printing-press, to guides or grooves, to the screw with a square thread; different cases of uniform motion being impossible under the action of forces of given directions. Friction of trunnions, pivots, eccentrics, and insertions of winch-handles. Prony's dynamometrical brake; conditions of its application. Resistance to rolling; its laws according to experiment. Use of rollers and friction-wheels; their practical inconveniences.

Mixed friction of toothed wheels; the Dobo escapement: friction of the teeth in the endless screw.

Stiffness and friction of cords. Results of experience. Friction of cords and straps running round drums. Different applications; brakes; transmission by cords, endless straps, or chains.

Examples and exercises; effects of passive resistances in the capstan, the crane, pulleys, &c.

LESSON 40. *Revision.*

SECOND YEAR.

PART I.—DYNAMICS.—DYNAMICS OF A MATERIAL POINT.

LESSONS 1—2. *Completion of the Notions acquired on this Subject.*

Differential equations of the motion of a material point submitted to the continued action of one or more forces. The acceleration of the projection of a point upon any axis or plane is due to the projection of the forces on this axis or plane. The acceleration along the trajectory is due to the tangential force. Relation of the curvature to the centripetal force. Introduction of the force of inertia into the preceding enunciations.

The increase of the quantity of motion projected upon an axis or taken along the trajectory is equal to the impulsion of the projected resultant, or to that of the tangential force. The total impulsion of a force is got by methods of calculation and of experiment analogous to those which relate to *work*. The increase of the moment of the quantity of motion in relation to any axis is equal to the total moment of the impulsions of the forces during the same interval of time; direct geometrical demonstration of this theorem. In decomposing the velocity of the moving body into a velocity in the plane passing through the axis of the moments, and a velocity of revolution perpendicular to this plane, we may replace the moment of the quantity of motion in space by the quantity of motion of revolution. Particular case known under the name of the principle of areas.

Extension of the preceding theorems to the case of relative motions. Apparent forces which must be combined with the real ones that the relative motion of a point may be assimilated to an absolute motion. Particular case of relative equilibrium. Influence of the motion of the earth upon the accelerating force of gravity.

DYNAMICS OF ANY MATERIAL SYSTEMS.

LESSONS 3—8.

Principle or general rule which reduces questions in dynamics to questions in equilibrium by the addition of the forces of inertia to the forces which really

act on the system. Equation of virtual work which expresses this equilibrium; it comprises in general the external and internal forces.

General Theorems.

These theorems, four in number, are founded upon the principle of the equality of action and reaction applied to internal forces. They may be deduced from the preceding rule, but the three last are obtained more simply by extending to a system of material points analogous theorems established for isolated material points.

General theorem of the motion of the center of gravity of a system. Particular case called *principle of the conservation of the motion of the center of gravity.*

General theorem on the quantities of motion and impulsions of exterior forces projected on any axis.

General theorems of moments of quantities of motion and impulsions of exterior forces, projected on any axis whatever.

General theorems of the moments of quantities of motion and impulsions of exterior forces about any axis. Analogy of these two theorems with the equations of the equilibrium of a solid, in which the forces are replaced by impulsions and quantities of motion.

Composition of impulsions, of quantities of motion, or the areas which represent them. All the equations which can be obtained by the application of the two theorems relative to quantities of motion and impulsions, reduce themselves to six distinct equations. Particular case called *principle of the conservation of areas.* Fixed plane of the resulting moment of the quantities of motion called *plane of maximum areas.*

General theorem of work and *vis viva.* Part which appertains to the interior forces in this theorem. Particular case called principle of the conservation of *vires vivæ*, where the sum of the elements of work done by the exterior and interior forces is the differential of a function of the co-ordinates of different points of the system. Application of the theorem of work to the stability of the equilibrium of heavy systems.

Extension of the preceding theorems to the case of relative motions. Particular case of relative equilibrium. Motion of any material system relative to axes always passing through the center of gravity, and moving parallel to themselves. Invariable plane of Laplace. Relation between the absolute *vis viva* of a material system, and that which would be due to its motion, referred to the system of movable axes above indicated.

Examples and Applications.

The following examples, amongst others, to be taken as applications or subjects of exercises relative to the general principles which precede.

Walking. Recoil of guns. Eolypile. Flight of rockets.

Pressure of fluid veins, resistance of mediums, &c. Direct collision of bodies more or less hard, elastic, or penetrable. Exchange of quantities of motion. Loss of *vis viva* under different hypotheses. Influence of vibrations and permanent molecular displacements.

Pile driving; advantage of large rammers. Comparison of effects of the

shocks and of simple pressures due to the weight of the construction. Oblique collision, and ricochet. Data furnished by experiment.

Oscillations of a vertical elastic prism suspended to a fixed point, and loaded with a weight, neglecting the inertia, and the weight of the material parts of this prism. Case of a sudden blow. What is meant by the "*resistance vive*" of a prism to rupture? Results of experiments.

Work developed by powder upon projectiles, estimated according to the *vis viva* which it impresses on them, as well as upon the gun and the gases upon hypothesis of a mean velocity.

SPECIAL DYNAMICS OF SOLID BODIES.

LESSONS 9—12. *Simple Rotation of an invariable Solid about its Axis.*

In applying to this case the first general rule of dynamics, the theorem of the moments of the quantities of motion, and the theorem of work, we are led to the notion of the moment of inertia; explanation of the origin of this name. The angular acceleration is equal to the sum of the moments of the exterior forces divided by the moment of inertia about the axis of rotation. Sum of the moments of the quantities of motion relative to this axis. *Vis viva* of a solid simply turning about an axis. What is meant by *radius of gyration?*

Remind of the geometrical properties of moments of inertia, of the ellipsoid which represents them, of the principal axes at any point, of those which are referred to the center of gravity.

Pressure which a rotating body exercises on its supports. Reduction of the centrifugal and tangential forces of inertia to a force which is the force of inertia of the entire mass accumulated at the center of gravity, and a couple.

Particular case where the forces of inertia have a single resultant; different examples. Center of percussion. Compound pendulum; length of the corresponding simple pendulum. Center of oscillation; reciprocity of the centers or axes of suspension and oscillation. Pressure upon the axis. Influence of the medium; experience proves that the resistance, varying with the velocity, changes the extent of the oscillations, but does not sensibly affect the time. Experimental determination of the center of oscillation and the moment of inertia about an axis.

Motion of an invariable Solid subject to certain Forces.

General notions on this subject. Motion of the center of gravity; motion of rotation about this point.

LESSONS 13—19. *Various Applications.*

Motion of a homogeneous sphere or cylinder rolling upon an inclined plane, taking friction into account.

Motion of a pulley with its axis horizontal, solicited by two weights suspended vertically to a thread or fine string passing round the neck of the pulley, the axle of which rests upon movable wheels. Atwood's machine serving to demonstrate the laws of the communication of motion.

Motion of a horizontal wheel and axle acted on by a weight suspended vertically to a cord rolled round the axle, or upon a drum with the same axis, and presenting an eccentric mass. To take account of the variable friction of the

bearings, and the stiffness of the cord, with recourse, if necessary, to approximation by quadratures. Oscillations of the torsion balance.

Balistic pendulum. Condition that there may be no shock on the axis. Experimental determination of the direction in which the percussion should take place.

Theory of Huyghen's conical pendulum considered as a regulator of machinery. How to take account of the inertia and friction of the jointed rods, as well as of the force necessary to move the regulating lever, &c.; appreciation of the degree of sensibility of the ball apparatus with a given uniform velocity.

Windlass with fly-wheel. Dynamical properties of the fly-wheel. Reduced formulæ for a crank with single or double action. Advantages and disadvantages of eccentric masses. Tendency of the tangential forces of inertia to break the arms. Numerical examples and computations.

Mutual action of rotating bodies connected by straps or toothed wheels in varying motion.

The wedge and punching-press. Stamping screw or lever used in coining, cams, lifting a pile or a hammer. To take account of the friction during the blow, and afterwards to estimate the loss of *vis viva* in cases which admit of it.

PART II.—SPECIAL MECHANICS OF FLUIDS.—HYDROSTATICS.

Lessons 20—22.

Principle of the equality of pressure in all directions. Propagation of the pressures from the surface to the interior of a fluid, and upon the sides of the vessel. Equations of equilibrium for any set of forces. Pressure exerted in the containing orifices. Measure of the pressure upon a plain portion of surface inclined or vertical (sluice-gate, embankments, &c.) Center of push or pressure. Pressure against the surfaces of a cylindrical tube. Effect, and resistance to oppose to the pressure. Manometer and piezometer. Equilibrium of a body plunged in a heavy fluid or floating at its surface. Stability of floating bodies. Metacenter. Laws of the pressure in the different atmospheric strata.

HYDRAULICS.

Lessons 23—27. *Flow of Fluids through small Orifices.*

Study of the phenomena which accompany this flow in the case of a thin envelop and a liquid kept at a constant level. Conditions of this constancy in the level, and the permanence of the motion in general. Motion of the lines of fluid; form; contraction; reversal and discontinuity of liquid veins. Fundamental formulæ for liquids and gases based upon the principle of *vis viva*, and Bernouilli's hypothesis of parallel sections or Borda's of contiguous threads. Torricelli's theorem relative to small orifices. What is called the theoretical expenditure, effective expenditure, and co-efficient of geometrical contraction. Co-efficient deduced from the effective expenditure. Its variations with the volume of the fluid contents, and the form of the inner surfaces of the reservoir. Results of the experiments of Michelotti, Borda, Bossut, &c. Phenomenon of adjutages. Venturi's experiments; influence of atmospheric pressure; loss of *vis viva*; reduction of the velocity and augmentation of the expenditure. Results of experience relative to the co-efficient of expenditure, the form and range of the parabolic jets, showing the initial *vis viva*, and the loss of *vis viva*.

Large orifices.—Sluice holes and floodgates; reservoirs or open orifices; expenditure; practical formulæ and results of experiment. Influence of the proximity of the sides and the walls. Arrangement to avoid the effects of contraction or the losses of *vis viva*.

Flow through conducting Pipes and open Canals.

Practical formulæ relative to the case of uniform sections of great length. Measure of the pressures at different points of a conduit-pipe. Expression for the losses of effect due to corners and obstructions. Flow of gases. Principal methods of measuring the volume consumed adopted in practice. Floats. Pitot's tube. Woltman's mill. Register mill in air or gas. Waste in such instruments. Modulus and scale for water-supply.

PART III.—DIFFERENT MACHINES CONSIDERED IN THE STATE OF MOTION.

LESSON 28. *General Considerations. Résumé of the Notions acquired on this Subject.*

Equation of *vis viva*, and transmission of work in machines, account being taken of the different causes of power and resistance. Physical constitution of machines; *receiver*, *communicators*, and *operator*. Influence of the weights, of frictions, of shocks, and any changes in the *vis viva*. Parts with continuous or uniform motion, with alternating or oscillating motion. Laws of the motion on starting from rest, and when the stationary condition is established. The positions to which the maximum and minimum of the *vis viva* correspond are those in which there is equilibrium between all the forces, exclusive of the forces of inertia. Advantage of uniform or periodic motion. General methods for regulating the motion; symmetrical distribution of the masses and strains; flys and various regulators. Brakes and moderators; their inconveniences. Object and real advantages of machines.

LESSONS 27—35. *Hydraulic Wheels.*

Vertical wheels with float-boards, with curved ladles, and with spouts. Figure of the surface of the fluid in these latter. Horizontal wheels working by float-boards, buckets, and reaction. Turbines. Description, play, and useful effects compared according to the results of experiment. Vertical wheels of windmills and steamboats. Screw propeller.

Windmills.

Description. Result of Coulomb's observations.

On the principal kinds of Pumps.

Special organs of pumps. Valves and pistons, force pump, sucking pump; limit to the rise of the water. Sucking and force pump. Dynamical effects. Indication as to the losses of *vis viva* and the waste in different pumps. Explanation of the hydraulic ram. Air vessel. Fire pumps. Double action pumps.

Various Hydraulic Machines.

Hydraulic press. Water engine. Exhausting machines; *norias;* under and overshot wheels; Archimedes' screw, construction and experimental data.

Lessons 36—39. *Steam Engines.*

Succinct description of the principal kinds of steam-engine with or without detent. Effects and advantages of the detent. Condenser. Air Pump. Furnace and feeding-pump.

Variable detent. Formulæ and experimental results.

Lessons 40—42. *Revision.*

Reflections on the totality of the subjects of the course.

IV. PHYSICS.—*FIRST YEAR.*

GENERAL PROPERTIES OF BODIES.—HYDROSTATICS.—HYDRODYNAMICS.

Lessons 1—5. *Preliminary Notions.*

Definitions of physics. Phenomena. Physical laws. Experiments are designed to make them spring out of the phenomena. Method of induction. Physical theories; different character of the experimental and mathematical methods.

General Properties of Bodies.

Extension. Measure of lengths. Vernier. Cathetometer. Micrometer screw. Spherometer. Dividing engine.

Divisibility. Porosity. Ideas generally received on the molecular constitution of bodies. These conceptions, which are purely hypothetical, must not be confounded with physical laws. Elasticity. Mobility. Inertia. Forces; their equilibrium, their effects, their numerical estimation.

Weight or Gravity.

Direction of gravity Plumb-line. Relation between the direction of gravity and the surface of still water.

Weight. Center of gravity.

Experimental study of the motion produced by weight. In vacuum, all bodies fall with the same velocity. Disturbing influence of the air. Inclined plane of Galileo. Atwood's machine. To prove by experiment; 1° the law of the spaces described; 2° the law of velocities. Morin's self-registering apparatus with revolving cylinder.

Law of the independence of the effect produced by a force upon a body, and the motion anteriorily acquired by this body. Law of the independence of the effects of forces which act simultaneously upon the same body. Experimental demonstration and generalization of these laws. Law of the equality of action and reaction.

Mass. Acceleration. For equal masses the forces are as the accelerations which they produce. Relation between the force, mass, and acceleration. Collision.

General laws of uniformly accelerated motion. Formulæ.

Pendulum. Law of the isochronism of small oscillations and law of the lengths deduced from observation.

Method of coincidences or beats. Use of the pendulum as the measure of time. Simple pendulum; formulæ. Compound pendulum: the laws of the oscillations of a compound pendulum are the same as the laws of the oscillations of a simple pendulum whose length may be calculated.

Determination by means of the pendulum of the acceleration produced by gravity. This acceleration is independent of the nature of the body.

Remark that the formulæ for the motion of oscillation apply to the comparison of forces of any kind, that may be regarded as constant and parallel to themselves in all positions of the oscillating body.

Identity of gravity and universal attraction.

Measure of weights. Balance. Conditions to be attended to in making it. Absolute sensibility; proportional sensibility. Method of double weighing. Details of the precautions necessary in order to obtain an exact weight.

Different States of Bodies. Hydrostatics.

Solids. Cohesion. Transmission of external pressures.

Elasticity. The true laws of elasticity are unknown. Empirical laws in certain simple cases, and for a very small action. Elasticity of compression, extension, torsion. Experimental determination of the co-efficients of elasticity. Limits of elasticity. Limits of tenacity.

Ductility. Temper. Cold hammering. Annealing.

Liquids. Fluidity. Viscosity. Physical laws which form the basis of hydrostatics:—1° the transmission of external pressures is equal in all directions; 2° the pressure exercised in the interior of a liquid upon an element of a surface is normal to that element, and independent (as to amount) of its direction. These principles are demonstrated by the experimental verification of the consequences drawn from them.

Application to heavy liquids. Free surface, and surface *de niveau*. Pressure upon the parts of the containing vessel, and upon the bottom in particular; hydrostatic paradox; verificatory experiments. Haldat's apparatus. Hydrostatic press.

Application to immersed or floating bodies (principle of Archimedes;) verificatory experiments. (In treating of the equilibrium of floating bodies, the conditions of stability are not gone into.)

Superposed liquids.

Communicating vessels. Water level. Spirit level; its use in instruments.

Densities of solids and liquids. Anemometers.

Compressibility of liquids. Piezometer. Correction due to the compressibility of the solid envelop.

Gas. Expansibility. Other properties common to liquids and gases. Principle of the equal transmission of pressures in all directions. Weight of gases. Pressure due to weight (principle of Archimedes.) Weight of body in air and in vacuum. Aerostation.

Superposed liquids and gases.

Communicating vessels. Barometer.

Detailed construction of barometer. Barometers of Fortin, Gay-Lussac, Bunten. Indication of the corrections necessary.

Mariotte's law. Regnault's experiments.

Manometer with atmospheric air—with compressed air. Bourdon's manometer.

Law of the mixture of gases.

Air pump. Condensing pump.

Primary Notions of Hydrodynamics.

Toricelli's principle. Mariotte's vessel and syphon. Uniform flow of liquids. The same of gases.

Molecular Phenomena.

Cohesion of liquids. Adhesion of liquids to solids. Capillary phenomena. Apparent attractions and repulsions of floating bodies.

Adhesion of drops.

Molecular actions intervene as disturbing forces in the phenomena of the equilibrium and motion of liquids.

HEAT.

EFFECTS OF HEAT ON BODIES.

LESSONS 6—9. *Generalities.*

General effects. Arbitrary choice of one of these effects to define the thermometric condition of a body. Conventional adoption of a thermometer. Definition of temperature.

Dilating Effects.

Definition of the co-efficients of linear, superficial, and cubic dilatation. Approximate relation between the numerical values of these three co-efficients. The value of the co-efficient of dilatation depends upon the thermometric substance and the temperature selected as the zero point. It becomes nearly independent of the zero point when the co-efficient is very small.

Relation between volume, density, and temperature. Linear dilatation of solid bodies. Ramsden's instrument. Cubical dilatation of liquids. Dulong and Petit's experiments on mercury. Discussion. Regnault's experiments.

Cubical dilatation of solids and of other liquids when that of mercury is given.

Relations between the volume, density, and elasticity of a gas, and its temperature.

Cubical dilatation of gases. Experiments of Gay-Lussac, Rudberg, and M. Regnault. Advantage of varying the methods of experimenting in these delicate researches.

Methods based upon the changes of volume under a constant pressure, and upon the changes of pressure for a constant volume.

The disagreement of these two methods is due to deviations from the law of Mariotte.

The constancy of the co-efficients of dilatation previously defined is only approximately true.

Necessity of employing two different co-efficients of dilatation according as consideration is being had to the variations of volume to a given pressure, or of pressure to a given volume.

Empirical formulæ for the dilatation of liquids.

Graphical constructions.

LESSON 10. *Thermometers.*

Construction of thermometers. Mercurial thermometer. Details of construction. Fixed points. Different scales; their relation. Arbitrary scales.

Change which takes place in the zero point. Different precautions to be observed in using the mercurial thermometer.

General want of comparability of mercurial thermometers with tubes of different material.

Air thermometers. They are comparable with one another within the limits of the errors of experiment, whatever the nature of the tube employed. This property entitles the air thermometer to a preference for all accurate measures. Comparison of the air and mercurial thermometers.

THERMOSCOPE, DIFFERENTIAL THERMOMETER, PYROMETERS, BREGUET'S THERMOMETER.

Lessons 11—13. *Changes of State produced by Heat.*

Exposition of the phenomena which accompany the liquefaction of solids and the solidification of liquids. Constancy of the temperature whilst the phenomenon is going on.

Sudden melting and freezing. Persistance of the liquid state beneath the melting point.

Influence of pressure.

Exposition of the phenomena which accompany the conversion of liquids or solids into vapor, and the inverse passage from the gaseous to the liquid or solid state. Constancy of the temperatures whilst the phenomenon is going on.

Influence of pressure.

Phenomena of ebullition in free space. Augmentation of the temperature and pressure in a confined space. Papin's digester.

Properties of vapors in spaces and in gases. Saturated vapors. Their tension does not depend upon the space which they occupy, but only upon their temperature.

Effects of a diminution or increase of pressure without change of temperature; the same without change of pressure. Effects of lowering the temperature in a limited region of space occupied by vapor.

Tension of a saturated vapor at the boiling point of its liquid.

Measure of the tensions of the vapor of water. Experiments of Dalton, Gay-Lussac, Dulong, and Arago, and of M. Regnault.

Tables of the tensions of steam. Empirical formulæ. Graphical constructions.

It is assumed that non-saturated vapors are subject to the same laws as gases.

APPLICATIONS. CORRECTION OF THE BOILING POINT IN THE CONSTRUCTION OF THERMOMETERS. BAROMETRICAL THERMOMETERS.

Lessons 14—16. *Various Applications of the Laws previously established.*

A phenomenon can not always be separated from the accessory phenomena which concur with it in producing the final result. Necessity of corrections to render complex results comparable *inter se*.

Density of solids when regard is had to the temperature and weight of the gases displaced by them.

Precautions to be attended to in the experiments. Empirical formulæ for the

density of liquids. Maximum density of water. The temperature corresponding to the maximum must be determined graphically, or by interpolation.

Corrections for measures of capacity, for barometric measures.

The uncertainty of the corrections can not, in any considerable degree, affect the densities of solids and liquids.

Density of gases. Biot and Arago's experiments. Special difficulties of the question. The uncertainty of the corrections may sensibly affect the results. Regnault's method.

The same method may be applied to the determination of the co-efficient of dilatation for gases.

Density of vapors. Definition founded on the hypothetical application of the same laws to gases and vapors. Formulæ. Experimental method of Gay-Lussac and of Dumas. Corrections. Comparison of the two methods. Necessity of conducting the experiments at a distance from the saturation point. Latour's experiments. Relations between the weight and volume of a gas, and its temperatures; between the weight and volume of a gas mixed with vapors, and its temperature. Various problems.

Hygrometry. Chemical hygrometry. Hygrometry by the dew-point. Psychrometry.

PROPAGATION OF HEAT.

Lessons 17—18. *Propagation at a Distance.*

Rapid propagation of heat at a distance, in vacuum, in gases, in certain liquid or solid mediums. Experiments which establish this.

Rays of heat. Velocity of propagation. Intensity of heat received at a distance. Intensity of heat received or emitted obliquely. Emitting power, power of absorption, reflection, diffusion. The emitting and absorbing power are expressible by the same number in terms of their proper units respectively.

Analysis of calorific radiations by absorption. Different effects of deathermanous or thermochroic medium. Different influences of increasing thicknesses of the combination of different mediums. Radiations proceeding from different sources, various effects of different mediums on these radiations.

The calorific radiations emanating from different sources, have all the characters of differently colored heterogeneous rays of light.

THEORY OF RADIATION AND OF THE DYNAMICAL EQUILIBRIUM OF TEMPERATURES. APPARENT REFLECTION OF COLD.

Lesson 19. *Law of Cooling.*

Definition of the rate of cooling. Many causes may conspire in the cooling of a body.

Cooling in space. Newton's law only an approximation. Experimental investigation of the true law. Method to be followed in this investigation. The velocity of cooling is not a *datum* directly observable. It must be deduced provisionally from an empirical relation between the temperature and the time. Preliminary experiments. Course of the definitive experiments. Elementary experimental laws.

Hypothetical form of the function which expresses the velocity of cooling. To determine by means of the preceding experimental laws the unknown form

of the function which expresses the law of radiation. Relation between the temperatures and the times. This relation only contains data immediately observable, and may be verified *à posteriori*.

The contents which enter into the preceding relation depend upon thermometric constants and the nature of the radiating surface.

The contact of a gas modifies the law of cooling.

Lessons 20—21. *Propagation by Contact.*

Slow propagation of heat in the interior of bodies, in solids, liquids, and gases. Confirmatory experiments. Hypothesis of partial radiation. Theoretical law resulting from this hypothesis upon the decrease of temperatures in a solid limited by two indefinite parallel planes maintained at constant temperatures. Determination of the co-efficient of conductibility by the experimental realization of these conditions. This experiment determines a numerical value of the co-efficients; it is not of a nature to serve as a check upon the theoretical principles. Enunciation of the law resulting from the same theoretical principles upon the decrease of temperatures in a thin bar heated at one end.

CALORIMETRY.

Lessons 22—23. *Specific Heats.*

Comparison of the quantities of heat. The quantities of heat are not proportioned to the temperatures. Definitions of the unity of heat. General method of mixtures to estimate the quantities of heat. Experimental precautions and corrections.

Application of the general method of mixtures. Specific heats of solids and liquids. Law of the specific heat of atoms. Heat absorbed by expansion, restored by the compression of bodies. Experiments on gases. Specific heats of gases under constant pressure. Measure of specific heats of gases under constant pressure. Special difficulties of the question. Succinct indication of one of the methods. Specific heats to a constant volume.

Lesson 24. *Latent Heat.*

Component heat of liquids absorbed into the *latent* state during fusion, restored to the *free* state during solidification.

Influence of the viscous state. Latent heat of ice. Ice calorimeter; its defects.

Component heat of vapors, absorbed into the latent state during vaporization, restored to the free state during condensation. Measure of the latent heat of vapors. Regnault's experiments.

Empirical laws on the latent heat of vaporization.

Applications of Calorimetry.

Means of producing heat or cold; 1, by changes in density; 2, by changes of state. Freezing mixtures. Vaporization of liquids. Condensation of vapors.

Steam-boilers. Warming by hot air and hot water. Various problems. Sensations produced by a jet of vapor.

Different physical and chemical sources of heat; percussion, friction, chemical combinations, animal heat, natural heat of the globe, solar heat, &c. It will be

remarked that mechanical work may become a source of heat, and heat a source of mechanical work.

STATICAL ELECTRICITY.—MAGNETISM.—STATICAL ELECTRICITY.

LESSONS 25—27.

General phenomena. Distinction of bodies into conductors and non-conductors. Distinction of electricity into two kinds. Separation of the two electricities by friction. Hypothesis of electric fluids. Effects of vacuum of gases and vapors of points. Electrical attractions and repulsions. Electrization by influence. Case where the influenced body is already electrized. Sparks; power of points. Electrization by influence preceding the motion of light bodies.

Electroscopes.

Electrical machines of Van-Marum, Nairne, Armstrong.

Condenser. Accumulation of electricity upon its surface. Leyden jar. Batteries. Electrical discharges. Effects of electricity.

Condensing electroscope. Electrophorus.

Velocity of statical electricity.

Atmospherical electricity. Phenomena observed with a serene sky. Electricity of clouds. Storms. Lightning. Thunder. Effects of thunder. Return-shock. Lightning conductor.

Different sources of statical electricity.

MAGNETISM.

LESSONS 28—30.

Natural magnets. Action upon iron and steel. Artificial magnets. The attractive action appears as if it were concentrated about the extremities of magnetic bars. First idea of poles.

Direction of a magnetized bar under the earth's action. Reciprocal action of the poles of two magnets. Names given to the poles.

Phenomena of influence. Action of a magnet upon a bar of soft iron; upon a bar of steel. Coercive force. Effects of the rupture of a magnetized bar. Theoretical ideas on the constitution of magnets. More precise definition of the poles.

Action of the earth upon a magnet. The earth may be considered as a magnet. Its action may be destroyed by means of a magnet suitably placed. Astatic needles. The magnetic action of the earth is equivalent to a *couple*. Three constants define the couple of terrestrial action. Declination. Inclination. Intensity. Measure of the declination; of the inclination.

Magnetic metals. Influence of hammering, tempering, &c. Methods of magnetizing. Saturation. Loss of magnetism. Influence of heat. Magnetic lines. Armatures.

Magnetization by the earth's influence. Means of determining the magnetic state of a body.

Measure of Magnetism and Electricity.

LESSONS 31—32.

Coulomb's balance. Distribution of magnetism on a magnetized bar; distri-

bution of electricity at the surface of isolated conductors. Comparative discussion of the conditions of the two problems and the methods of experiment.

Laws of the magnetic attractions and repulsions. Law of electric attractions and repulsions. Comparative discussion of the conditions of the two problems, and the methods of experiment.

Determination of the law of magnetic attractions and repulsions by the method of oscillations.

Comparison of the magnetic intensity at different points of the earth's surface.

Lessons 33—34. *Revision.*

Considerations on the totality of the subjects of the course.

SECOND YEAR.

DYNAMICAL ELECTRICITY.—GALVANISM.

Lessons 1—2

Chemical sources of electricity. Experimental proofs. Arrangement devised by Volta to accumulate, at least in part, at the extremities of a heterogeneous conductor the electricity developed by chemical actions.

Pile. Tension at the two isolated extremities; at one single isolated extremity; at the two extremities reunited by a conductor. Continuous current of electricity. Poles. Direction of the current, &c.

Various modifications of the pile of Volta. Woollaston's pile, Münch's pile, &c. Dry piles; their application to the electroscope.

Principal effects of electricity in motion, and means of making the currents perceptible. Experiment of Oersted. Galvanoscopes.

Currents produced by heat in heterogeneous circuits. Thermo-electric piles. Thermometric graduation of thermo-electric piles.

Currents produced by the sources of statical electricity.

PROPERTIES OF CURRENTS.

Lesson 3.—1. *Chemical Actions.*

Definitions. Phenomena of decomposition and transference. Reaction of the elements transferred upon electrodes of different kinds.

Principles of electrotyping.

Causes of the variation of the current in ordinary piles; means of remedying this; Daniell's pile. Bunsen's pile.

Lessons 4—8. 2. *Mechanical Properties.*

Reciprocal actions of rectilinear or sinuous currents parallel or inclined. Reaction of a current on itself.

Reciprocal actions of helices or solenoids. Continuous rotation of currents by their mutual action; by reaction. Analogy of magnets and solenoids. Electro-dynamical theory of magnetism. Action of magnets upon currents and solenoids. Action of currents upon magnets. Experiments of Biot and Savart. Continual rotation of a current by a magnet; of a magnet by a magnet.

Action of the earth upon currents; it acts as a rectilinear current directed from east to west, perpendicularly to the magnetic meridian.

Continual rotation of a current by the action of the earth.

Astatic conductors.

Lessons 9—10. 3. *Magnetic Properties.*

Action of an interposed conductor upon iron filings.

Electro-magnets. Magnetization temporary or permanent. Principles of the electric telegraph. Electrometers. Reference to diamagnetic phenomena.

4. *Electro-motive Properties.*

Phenomena of induction by currents, by magnets. Phenomena of magnetism in motion. Induction of a current upon itself.

Induction of different orders.

Interrupted currents. Clarke's machine.

Lesson 11. 5. *Calorific Properties.*

Influence of the nature of the interposed conductor; of its section; of the intensity of the current. Unequal temperatures at the different junctions of a heterogeneous circuit.

6. *Luminous Properties.*

Incandescence of solid conductors. Spectrum of the electric light. Voltaic arc. Transfer of ponderable matter. Action of the magnet upon the Voltaic arc.

7. *Physiological Action of Currents.*

Some words on this subject. Muscles and nerves. Actions of discontinuous currents. Reotomic contrivances.

Reometry.

Compass of sines, of tangents. Experimental graduation of galvanometers.

The dynamical intensity of a current diminishes when the length of a current increases. Reostat.

Laws of the dynamical intensity of a current in a homogeneous circuit. Reduced length and resistance of a circuit. Specific co-efficients of resistance. Laws of the dynamic intensity of a current in a heterogeneous circuit.

The intensity of currents is in the inverse ratio of the total reduced length, and proportional to the sum of the electromotive forces. Formula of the pile. Discussion of the case of hydro-electric piles—thermo-electric piles. Conditions for the construction of a pile, with reference to the effects to be produced. Conditions for the construction of a galvanometer with reference to its intended application.

Laws of secondary currents in the simplest cases. The chemical intensity of a current is proportional to its dynamical intensity.

ACOUSTICS.

Lessons 12—15.

Noise, sound, quality of the sound, pitch, intensity, *timbre*. A state of vibration in a solid, liquid, or gaseous body is accompanied with the production of sound.

The pitch depends on the number of vibrations. Unison. Instruments for

counting the vibrations:—1st. Graphic method. 2nd. Toothed wheels. 3rd. Lever. Feeling of concord. Musical scale. Gamut. Limit of appreciable sounds.

Study of vibrating motions in solids. Vibrating cords. Vibrations transversal, longitudinal. Experimental laws. Sonometer.

Spontaneous division of a cord into segments. Fundamental sounds. Harmonic sounds.

Staight and curved rods. Transversal and longitudinal vibrations. Experimental laws. Division into segments. Nodes. Ventral segments. Membranes.

Plane and curved plates. The vibrations divide them into "*concamerations.*" Nodal lines. Harmonic sounds.

Study of the vibrations in liquids and in gases.

Theoretical ideas upon the propagation of a vibratory motion in indefinite elastic media, on an indefinite cylindrical tube. Waves of condensation of dilatation. Progressive nodes and ventral divisions. Laws of the intensities of sound. Direct measure of the velocity of the propagation of sound in water. Measure of the velocity of the propagation of sound in air. Formulæ without demonstration. Comparison of the formulæ with experiment.

Sonorous waves reflected in an indefinite medium.

Fixed nodes and ventral divisions. Sonorous waves reflected in closed and open tubes. Fixed nodes and ventral divisions; the vibratory state and density thereat.

Series of sounds afforded by the same tube. Effect of holes.

Sonorous reflected waves in rods. Series of sounds afforded by the same rod vibrating longitudinally. Indirect measure of the velocity of sound in gases, liquids, and solids.

Experiments on the communication of vibrating motion in heterogeneous mediums, on the general direction of the vibrating motion communicated.

Intensification of sounds. Interferences. Beats. Different stringed and wind instruments. Means of setting them in vibration.

A few words on the organs of voice and hearing. Incompleteness of our knowledge on this subject.

OPTICS.

Lessons 16—17. *Propagation of Light.*

Propagation of light in a straight line. Rays of light. Geometrical theory of shadows. Velocity of light. Rœmer's observations. Laws of intensity of light. Photometers of Bouguer, Rumford. Intensity of oblique rays. Comparison of illuminating powers. Total brightness. Intrinsic brightness.

Reflection.

Reflection of light: its laws. Experimental demonstration. Images formed by one or more plane mirrors. To ascertain if a looking-glass has its two faces parallel.

Spherical mirrors. Foci, formulæ. Discussion. Images by reflection. Measure of the radius of a spherical mirror.

Definition of caustics by reflection. Definition of the two spherical aberrations in mirrors.

Woollaston's goniometer.

Lesson 18. *Refraction.*

Refraction of light in homogeneous mediums. Descartes' law. Experimental demonstration for solids and liquids.

Inverse return of the rays. Successive refractions. Indices of transmission in terms of the principal indices. Consequences of Descartes' law. Total reflection. Manner of observing it.

Irregular refractions. Mirage.

Refraction is always accompanied with the accessory phenomenon of dispersion.

Geometrical consequences of the law of refraction. Focus of a plane surface. Focus of a medium bounded by two parallel plane surfaces; by two plane surfaces inclined in the form of a prism.

Foci of a spherical surface; of a medium limited by two spherical surfaces. Lenses.

Formula for lenses. Discussion. Varieties of lenses. Optic center. Images. Measure of the focal distance of lenses.

Definition of caustics by refraction. Definition of the two spherical aberrations of a lens.

Lessons 19—20. *Dispersion.*

Unequal refrangibility of the differently colored rays which compose white light. Analysis of heterogeneous light by the prisms. Newton's method. Solar spectrum. Homogeneity of the different colors. Second refraction of a homogeneous pencil. Experiment with crossed prisms. Precautions to be attended to in the experiments. The spectrum, obtained by Newton's method, differs from the spectrum produced at the focus of a lens placed between the prism and the picture, according to the method of Fraunhofer. Reasons of the comparative purity of this latter spectrum. Fraunhofer's lines. Different spectra of different sources of heterogeneous light. Marginal iridescence of a large pencil of natural light traversing a prism. Dispersion of light by lenses. Iridescence of focal images. Recomposition of light, by means of a prism at the focus of a spherical mirror or a lens, by the rapid rotation of a plane mirror, by the rotation of a disk with party-colored sectors. Compound colors.

Chemical and calorific radiations accompany luminous radiations.

Analysis of light by absorption. Characteristic action of transparent colored mediums upon different sorts of compound light. Different influences of increasing thickness. Effects of differently colored mediums upon heterogeneous light. Effects of differently colored mediums upon homogeneous rays separated by the prism.

Lesson 21. *Measure of the Indices of Refraction.*

Determination of the indices of refraction.

1. In solids. Measure of the refracting angles. Minimum of deviation. Measure of the corresponding deviation. Use of Fraunhofer's lines.

2. In liquids.

3. In gases. Special difficulties of the question. Experimental method. Biot's and Arago's experiments.

Any power whatever of the index of refraction diminished by unit is sensibly proportional to the density of the gas. Method of Dulong founded on this remark.

LESSONS 22—23. *Application of the preceding Laws.*

Rainbow. Different orders of bow.

Achromatism.

Achromatic prisms. Diasperometer achromatism of lenses; how to verify it. Definition of secondary spectra: their nature gives the means of recognizing, whether flint or crown glass predominates, in an imperfectly achromatic lens.

Instruments essentially consisting of an achromatic lens. Magic lantern; megascope; solar microscope; camera obscura; collimators.

Vision.

Summary description of the principal optical parts of the eye. They act like the lens of a camera obscura to form an image upon the retina. Distinct vision; optometers; short sight; long sight; spectacles.

Binocular vision; perspective peculiar to each eye; estimation of distances; sensation of solidity; stereoscope; estimation of magnitudes.

PERSISTENCE OF IMPRESSIONS; DIVERS EXPERIMENTS.

LESSONS 24—26. *Optical Instruments.*

Camera lucida. A lens is necessary to reduce to the same apparent distance the two objects seen simultaneously. Instruments to assist the sight; simple microscope; the magnifying power; distinctness; field; advantage of a diaphragm; it modifies the field and the brightness variously according to its position.

Woollaston's double glass; its advantages.

General principle of compound dioptrical instruments.

Compound microscope; experimental measure of its magnifying power, by means of the diaphragm, by means of the camera lucida.

Astronomical telescope; object glass; simple eye-glass. Necessity for a diaphragm; its place; the wires, their place; optic axis of a telescope. Parallax of the threads of the wires; magnifying power of the object-glass; of the eye-glass; field of view of a telescope.

Optic ring; different methods of measuring the magnifying power.

Distinctness of a telescope; night-glass.

Different distances of drawing out the eye-glass for short-sighted and long-sighted observers.

Different sorts of eye-pieces; positive eye-pieces; ordinary double eye-piece of the astronomical telescope. Ramsden's eye-piece; treble eye-piece of the terrestrial telescope. Negative eye-pieces; simple eye-piece of Galileo. Compound *ditto* of Huyghens; advantages and disadvantages of these different combinations; general principle of catadioptrical instruments.

LESSONS 27—29. *Double Refraction.*

Crystallized mediums do not all act upon light like homogeneous mediums.

Double refraction of Iceland spar: the extraordinary image turns round the ordinary image. The ordinary and extraordinary rays cross at the interior of the crystal.

Huyghens' construction; measure of the ordinary and extraordinary indices of refraction; attractive and repulsive crystals; a ray falling perpendicularly does not always bifurcate in a camera with parallel faces, nor in a prism. Definition of uniaxial and biaxial crystals.

The dispersion of the ordinary ray differs from that of the extraordinary ray.

The two rays are unequally absorbed in many colored mediums. Tourmaline.

Doubly-refracting prisms; their construction. Use of doubly-refracting prisms to measure apparent diameters, &c.

Lessons 30—31. *Polarization.*

Successive refractions in doubly-refracting prisms. Special properties of the two rays emerging from the first doubly refracting crystal. Polarization by double refraction.

Reflection from transparent media polarizes the light partially or wholly according to the incidence. Brewster's law. Reflection of polarized light from a transparent medium.

Simple refraction partially polarizes the light. Many successive refractions polarize it almost totally. Piles of glasses.

Different methods to obtain a ray of polarized light, 1st, by reflection; 2nd, by simple refraction; 3rd, by double refraction, by eliminating one of the refracted pencils;—by a screen,—by total reflection, Nicol's prism, by absoption, tourmaline.

Distinctive characters of light completely or partially polarized.

Lessons 32—34. *Theory of Undulations.*

Hypothesis of luminous undulations.

Vibratory state of a simple ray of homogeneous light. Vibratory state at the intersection of two simple rays of homogeneous light intersecting at a very small angle.

Experimental proofs in support of this hypothesis:

1st. Experiment with interferences, fringes. Their breadth is different for different colors; they give the various colors of the prism in white light. The alternately bright and dark sheets are hyperboloids of revolution. The measure of the fringes give the means of estimating the lengths of the undulations corresponding to different colors.

2nd. Colored rings of Newton, observed by reflection, by refraction. Law of the diameters; these vary in absolute length for different colors. Variously colored rings with white light. Reflected rings with a white spot at the center.

The theory of the undulations does not apply merely to theses phenomena. Explication of the laws of reflection and refraction. Definition of polarization in the system of waves. Elementary application of double refraction and the polarization which accompanies it in uniaxial crystals when the face of the crystal is parallel to the axis, and the plane of incidence normal or parallel to this axis.

Chemical and Calorific Radiations.

Chemical and calorific radiations are subject, like luminous radiations, to the laws of reflection, refraction, dispersion, double refraction, polarization, interferences.

Lessons 35—36. *Revision.*

Considerations on the totality of the subjects of the course.

MANIPULATIONS IN PHYSICS.

The practical exercises which constitute the subject of this programme will be performed in part by the pupils under the direction of the professors and *répétiteurs*, in part by the professors and *répétiteurs*, with the coöperation of the pupils.

FIRST YEAR.

Use of various instruments, designed for measuring lengths. Experiments on weight with Atwood's machine, the inclined plane, Morin's apparatus, and the pendulum.

Some experiments on elasticity.

Various verifications of the principles of hydrostatics and hydrodynamics.

Construction of aerometers.

Construction of a barometer, of a manometer. Various verifications of the law of Mariotte.

Various experiments with the air-pump.

Determination the density of solids or liquids by different methods.

Construction of a thermometer.

Experiments on the dilatation of liquids and solids by means of the ordinary thermometer and by means of the statical thermometer.

Experiments upon the dilatation of air by various methods.

Experiments upon the tension of vapors by different methods.

Determination of the density of vapors and gases by various methods.

Leading experiments on calorific radiation.

Experiments on cooling.

Determination of specific heats, heats of fusion, heats at which bodies pass into vapor.

Cooling mixtures.

Use of the chemical hygrometer, the wet bulb hygrometer.

Rehearsal of the leading experiments on magnetism.

To magnetize a needle, to reverse its poles.

Rehearsal of the principal experiments of statical electricity.

Experiments verificatory of the laws of electricity and magnetism.

Use of compasses.

SECOND YEAR.

Experiments upon the chemical actions of poles.

Leading experiments in electro-dynamics.

Leading experiments upon the magnetic properties of currents.

Experiments on induction.

Experiments on the calorific and luminous actions of currents.

Quantitative experiments on the laws of currents.

Experiments on the propagation of sound; on the vibrations of rods of plane or curved plates, membranes, sonorous tubes.

Experiments on mirrors, plane or curved.

Experiments on lenses. Experiments on the decomposition of light by the prism—by absorption. Measures of the indices of the refraction of solids. Use of the magnifying glass and microscope; measure of the magnifying power. Use of different telescopes, with and without corrections. Measure of the magnifying power. Experiments on double refraction and polarization. Experiments on interferences and colored rings.

ORGANIZATION AND CONDITION IN 1869.

The organization of the school, which is fixed by a Decree dated Nov. 30th, 1863, is of a military character. There is a staff of military officers in addition to, and quite separate from, the staff employed in the duties of instruction. The pupils wear uniform, which, however, is more civil than military in appearance. They are formed into four companies which together constitute a battalion; and, although they are not actually subject to the penal code of the army, the discipline maintained and the punishments inflicted are entirely military in character.

The military establishment remains exactly as it was in 1856, and consists of:

The Commandant, a General Officer, usually of the Artillery or the Engineers, at present a General of Artillery.

A Second Commandant, a colonel or lieutenant-colonel, chosen from among the former pupils of the school; at present a colonel of Engineers.

Three captains of Artillery and three captains of Engineers, as inspectors of studies, chosen also from former pupils of the school.

Six adjutants (*adjudants*), non-commissioned officers, usually such as have been recommended for promotion.

Slight changes have been made in the civil establishment; it now consists of:—

1. A Director of Studies, at present a colonel of Engineers.

2. Seventeen professors,* (two additional professors for history) seventeen *Répétiteurs* and assistant *Répétiteurs*, and five drawing masters. Of the 17 professors, two are at present officers of Engineers, and one an officer of Artillery; the remainder are civilians, of whom three are members of the Academy of Sciences.

3. Five examiners for admission, and five for conducting the examinations at the school. All of these at present are civilians.

4. An administrative staff consisting of a treasurer, librarian, &c.; and a medical staff.

The general control or supervision of the school is vested, under the War Department, in four great boards or councils, viz.:—

1. A Board of Administration, composed of the Commandant, the Second Commandant, the Director of Studies, two professors, two captains of the military staff, and two members of the administrative staff. This board has the superintendence of all the financial business, and all the minutiæ of the internal administration of the school.

2. A Board of Discipline, consisting of the Second Commandant, the Director of Studies, three captains of the Military Staff, and one major of the army, selected from former pupils of the school.† The duty of this board is to decide upon cases of misconduct.

3. A Board of Instruction, whose members are, the Commandant, the Second Commandant, the Director of Studies, the Examiners of Students, the Professors, and two captains of the Military Staff; and whose chief duty is to make recommendations relating to ameliorations in the studies and the programmes of admission and of instruction in the school to—

* In 1856 there were only 15 professors; there are now two additional professors for history, the study of which has been recently introduced at the school.

† Formerly two professors of the school were also members of the Council of Discipline, but the professors have now no voice in matters of discipline.

4. A Board of Improvement (*Conseil de Perfectionnement*), charged with the general control of the studies, and formed of:—

The Commandant, president,
The Second Commandant,
The Director of Studies,
Two delegates from the Naval Department,
Two delegates from the Department of Public Works,
One delegate from the Home or Finance Department,
Three delegates from the War Department,
Two members of the Academy of Sciences,
Two examiners of students,
Three professors of the school.

The delegates from the public departments are appointed by the respective ministers; the members of the Academy, the examiners, and the professors are selected by the Minister of War. The real management of the school, so far as the course of instruction is concerned, is in the hands of the *Conseil de Perfectionnement;* it will be seen that of the 18 members composing it more than half are entirely independent of the school, and are men of eminence in the various public services for which the instruction at the Polytechnic is preparatory. One of the chief duties of the Council is to see that the studies form a good preparation for those of the more special schools (*Ecoles d'Application*) for the civil and military services; and the eminent character of its members gives great weight to the recommendations they make to the Minister of War.

The annual expenses of the school, as extracted from the Budget for 1869, are as follows:—

	Francs.	Francs.
Pay of staff, professors, &c.,		331,850
Instruction, maintenance, examination of candidates, clothing, books, &c.,		321,073
Outfits for 30 new pupils at 600 francs each	18,000	
Allowances (*premières mises*) to 25 exhibitioners on admission to the military services at 750 fr. each	18,750	
		36,750
Maintenance and repair of buildings,		30,000
Total sum charged in the schools estimate,		719,673
Add regimental pay of 28 officers and non-commissioned officers employed at the school,		85,515
Total expenditure,		805,188
Deduct repayments from pupils,		237,000
Cost to the State,		568,188

Or about 22,720*l.*

The chief changes that have been made in regard to the course of instruction since 1856, may be summarized as follows:

1. The more elementary portions of chemistry and physics which are required in the entrance examination, but which were formerly repeated at the school, have been omitted. The course of instruction in these subjects is now confined to the more advanced portions which do not enter into the entrance examination.

2. The mathematical courses have in some points been slightly curtailed, and the number of lectures in French literature and German have been diminished. By the modifications thus made in the programmes, it has been found possible to shorten the whole course of study and to increase the length of the vacations.

3. The subject of "Military Art," which formerly entered into the final exam-

ination is no longer taken into consideration in determining the order of merit of the pupils. In this respect the course of instruction may be said to have even less of a military character than formerly. Topographical drawing is the single military subject which has any influence on the final classification of the pupils, and this only to a very slight extent.

4. History has been introduced as a subject of instruction. This change was made in 1862. The course comprises general history, both ancient and modern, but more especially the history of France in modern times. The introduction of this subject appears to have arisen partly from a feeling that an acquaintance with history was a necessary element of a liberal education, and partly from a wish to meet, to some extent, an objection often made to the Polytechnic course of instruction, that it was too deficient in studies of a literary character. History, however, like military art, is evidently still regarded as a subject of only secondary importance and has no influence on the final classification.

5. A diminution has been made in the number of examinations during the course, by the suppression of one of the half-yearly examinations by the professors (*interrogations générales*, as distinct from the *interrogations particulières*) in each year. Further reference will be made to this point when speaking of the examinations at the school.

6. The importance of written exercises in determining the respective merits of the pupils has been decreased, apparently from the difficulty of establishing a security that such compositions were the unaided work of the individual.

The following table shows the present course of instruction during the two years, and the alterations which have been made in the number of lectures in each subject since 1856:—

Subject.—First Year's Course.	*Lectures in*—1868.	1856.
Analysis { Differential calculus	25	28
Analysis { Integral calculus	18	20
Descriptive geometry and geometrical drawing	32	38
Mechanics and machinery	40	40
Physics, comprising heat and electricity	30	34
Chemistry:—The metals	30	38
Astronomy and geodesy	30	35
French composition and literature	25	30
History	25	0*
German	25	30
Figure and landscape drawing	48	50
Second Year's Course.		
Analysis:—Integral calculus	32	32
Stereotomy:—Geometrical drawing of constructions in timber and masonry	28	32
Mechanics:—Dynamics, hydrostatics, and machinery	40	42
Physics:—Acoustics, optics, and heat	30	36
Chemistry:—Continuation of the metals and organic chemistry	30	38
Architecture and buildings, construction of roads, canals, and railways	40	40
French composition and literature	25	30
History	25	0*
German	25	30
Military art	20	20
Topography	2	10
Figure and landscape drawing	48	48

* Introduced in 1862.

In connection with several of the courses, such as descriptive geometry, stereotomy, machinery, and architecture, much drawing is done by the pupils; hand sketches are taken of the diagrams shown in the lecture-room, and finished drawings are afterwards executed in the *salles d'étude*. In addition to this, 30 attendances of two or three hours each, distributed over the two years, are especially devoted to drawing more elaborate plans and elevations of architectural constructions and machinery. The practical applications of the theoretical instruction are limited to manipulations in the laboratory in connection with the course of lectures on chemistry and physics. Towards the close of the second year the pupils are also taken to visit some of the large manufacturing establishments in Paris, in order to gain a practical acquaintance with machinery.

All the subjects taught at the school are obligatory, but history and military art, as already stated, have no influence in determining the order of merit of the pupils in the final result.

The only instruction in practical military exercises, which is compulsory upon all, is that in drill. The pupils are exercised under arms in company drill, and are also occasionally drilled as a battalion; but very little importance is attached to this point—the only really military portion of their training. Drill goes on only for about three months in each year during the spring and summer, and even during this brief period only takes place about twice a week. By the regulations of the school the pupils should be exercised in musketry practice, but although they are armed with the Chassepot rifle this regulation is never carried out. Instruction is given in fencing and gymnastics, but attendance at both is voluntary, and scarcely more than half the pupils take advantage of it. Neither riding nor swimming are taught at the school.

The school year commences about the 1st of November, and terminates about the first of August. Some seven months of the year are given up to lectures and the ordinary routine of study; about two months are occupied with the annual examinations and private preparation for them; the remaining three months—August, September, and October—are the vacation. In addition to this long vacation, from eight to twelve days are allowed after the periodical examination, which takes place near the end of February, at the close of the first portion of each year's study.

One peculiarity in the arrangements of the school is that the subjects of each year's course are not all studied simultaneously. The lectures in the main subjects of instruction—those which, as a rule, present the most difficulty—are divided into courses which continue only during a certain portion of each year. Thus in the junior division, analysis and descriptive geometry are the mathematical subjects studied during the first three months, or three months and a half. The course in them is then concluded; an examination by the professors (*interrogation générale*) is held in these subjects, and they are laid aside for the remainder of the year, though they enter into the examination at the close of the year. Their place is then taken by a course of lectures in mechanics and geodesy. Similarly in the second year, analysis and mechanics are the subjects of the first course of lectures, at the termination of which there is an examination; and for the remainder of the year no further lectures in them are given, stereotomy and military art taking their place.

The subjects involving as a rule less difficulty—such as history, French literature, German, and drawing—are spread over the whole year, forming generally the evenings' occupation.

THE SPECIAL MILITARY SCHOOLS OF FRANCE.

SCHOOL FOR ARTILLERY AND ENGINEERS

AT METZ.

HISTORY AND GENERAL DESCRIPTION.

The first French Artillery School was founded in the time of Louis XIV. (in 1679) at Douai. It had but a short existence: and it was only in 1720 (under the Regency,) when the Royal Regiment of Artillery received a new organization, that schools of theory were permanently founded in each of the seven towns where there were garrisons of artillery. But no academy properly so called was established before that founded by D'Argenson at La Fère, in 1756, with a staff of two professors of mathematics, and two of drawing. This was transferred to Bapaume, near the Flemish frontier, in 1766, re-transferred to La Fère, and suppressed, among other schools, at the beginning of the Revolution.

Of early Engineer Schools there was only one, the very distinguished School of Mézières, near the northern frontier. This was founded in 1749, also under the ministry of D'Argenson; Monge was a professor there; and it had a very high reputation down to its suppression in the Revolution.

When the wars of the Revolution broke out, Provisional Schools for giving a brief course of rapid instruction was established at Metz for the engineers, and at Châlons-sur-Marne for the artillery. These had to supply, at a great disadvantage, the officers needed for the protection of the invaded frontier.

It was intended originally that the Polytechnic, established in 1794, should send engineers direct to the army; but it was quickly found to be a better plan to allow the pupils destined for this service first to spend some little time at Metz; which thus, in October, 1795, became a School of Application for Engineers. The artillery pupils in like manner went to Châlons. This separate system of two Schools of Application continued till 1802, when the establishment at Châlons was united with that of Metz, and Metz became what it has since continued to be, the seat of the United School of Application for the two services. The Polytechnic students who

select the *Artillerie de terre*, *Artillerie de mer*, or the *Génie militaire*, enter here to receive the special and professional instruction deemed requisite to fit them for actual employment.

The students quitting the Polytechnic in the manner described in the account of that school, at the average age of twenty-one, enter the School of Application, with the provisional rank, the uniform, and the pay of sub-lieutenants (*sous-lieutenants.*) The ordinary term of residence is two years. Under special circumstances this may be shortened; and in case of illness or want of application individual students are occasionally retained for a third year. Each new body of students, each *admission* or *promotion*, is classified at the end of the first year, and the students composing it are arranged in order of merit in accordance with the reports of the professors, but without an examination; at the close of the second year they pass a final examination before the Board of Officers, and are definitively placed in the corps they have chosen, the artillery or engineers, according to the order of merit. They are allowed to count, as regards retirement from the service and towards military decorations, four year's service on account of the two years passed at the Polytechnic School, and of the time passed in preparing for admission to it, reckoning from the day of their admission to the School of Application.

Metz is a fortified place on the Prussian frontier, the seat of war at the time of the school's first foundation; it is on the line of railway to Mannheim, about thirty miles from the point where this branch diverges from the main line to Strasburg. The Moselle flows through the town, and is employed, with its little affluent the Seille, in the military defenses. The garrison numbers 10,000 men; there is an Arsenal, a school of Pyrotechny for the manufacture of rockets, two Regimental Schools, one of Artillery and the other of Engineers. The School of Application occupies buildings erected on the site, and partly the original buildings themselves, of a suppressed Benedictine monastery. Three sides of the cloistered monastic quadrangle are devoted to the offices, lecture-rooms, galleries and halls of study. A fourth, formerly the ancient church, is converted into a *salle des manœuvres.* There is an adjoining residence for the commandant; and a separate modern building, four stories in height, affords lodging to the young men.

The *salle des manœuvres* is a large area under a lofty roof, rising to the whole height of the buildings of the quadrangle; it contains artillery of various descriptions, mortars, field and siege guns placed as in a battery, and is amply large enough to allow cannon to be

moved and exercises performed when the state of the weather may make it desirable.

The amphitheaters or lecture rooms, much on the same system as those at the Polytechnic, are two in number, one for each of the two divisions. Officers of the artillery and engineers who are in garrison, are entitled, if they please, to attend the lectures, and other officers also may be admitted by permission.

The galleries, partly on the ground floor, partly on the first floor, contain very good collections of models of artillery, ancient and modern, of sets of small arms, of tools, of locks, barrels and other portions of muskets in various stages of the process of their manufacture, of specimens of carpentry and roofing, of minerals, of models of fortifications, bridges, coffer-dams, locks, &c.

The library on the first floor has an adjoining reading room; and near it is the examination room, of which further mention will be made. The three halls of study (*salles d'étude*) on the first floor are on a different plan from those of the Polytechnic, each one being large enough to accommodate a whole division (seventy students.) Three rooms are also provided for the professors to prepare their lectures in.

The barracks, on the opposite side of the open space used for drill and exercises, form a lofty and handsome building, entered by separate staircases, the ground-floor rooms of each being assigned to a servant, who undertakes to provide attendance for all the young men lodging in the rooms above. The rooms are comfortable, mostly double-bedded, the bedroom serving also as a sitting room, and a small adjoining closet being used for washing, &c. Twenty or twenty-two appear to be thus accommodated on each staircase; there are lodgings altogether for one hundred and forty-five. A certain number of the senior sub-lieutenants would, probably, on the arrival of the new cadets from the Polytechnic, be removed to lodge in the town.

There is a riding-school adjoining the court; stables, for thirty-three horses, which are kept for the use of the pupils, and lodgings for the attendants are provided in the neighborhood.

The mere description of the buildings shows at once that the system is different in many respects from that of the Polytechnic. Young men of twenty-one and twenty-two years of age, already holding provisional commissions in the service, receiving the pay and wearing the uniform of sub-lieutenants, are naturally allowed much greater freedom of action. They live, and partly also study, not in the halls of study, but in their own rooms; they take their

meals in the town, where they frequent the *cafés* and *restaurants* of their choice. The *rappel* summons them every morning to rise and attend a roll-call at half-past five or six; military exercises, riding, or interrogations, similar to the *interrogations particulières*, require the presence of a portion of the number, but the rest are free to return to their rooms. At ten they have to attend either the day's lecture, followed by employment in the halls of study, till four o'clock P. M., or they proceed at once to the halls of study, and set to work on the drawings, designs, projects, &c., which are described hereafter in the account of the studies. From four to half-past five P. M., drill, exercises, and riding occupy a portion of the number, probably those who were not called for in the morning. After half-past five they are left to themselves.

This ordinary routine of studies is interrupted in the summer months by the occurrence of expeditions for making surveys, and for measuring and sketching machines in manufactories. The young men are sent, two together, to survey (*lever à boussole ;*) singly for the reconnaissance sketch (*lever à vue ;*) and generally, a certain number are distributed about a district not too large for an officer to make his round in it, and see each day that all are at work. The railways afford considerable facilities; the expeditions never occupy more than ten days at a time, but they may be extended as far as Strasburg.

There are no *répétiteurs* in the school; but the system of *interrogations particulières* is carried on; and an examination by the professor and an assistant professor takes place after, about, every eight or ten lectures.

THE STAFF AND GOVERNMENT.

The Staff of the Institution consists of—

1 General Officer, at present a General of Brigade of Artillery, as Commandant.
1 Colonel or Lieutenant-Colonel, Second in Command and Director of Studies, at present a Lieutenant-Colonel of Engineers.
1 Major of Artillery.
1 Major of Engineers.
5 Captains of Artillery.
8 Captains of Engineers.
1 Surgeon (*Médecin-Major.*)

The Commandant is taken alternately from the Artillery and Engineers, and the command lasts for five years only.

The Second in Command is always chosen from that arm of the service which does not supply the Commandant.

The inferior officers of each rank are taken in equal numbers from the two arms.

The Staff of Instructors is as follows:—

1 Professor of Artillery, at present a Captain of Artillery.
1 Assistant ditto also a Captain of Artillery.
1 Professor of Military Art, charged also with the Course of Military Legislation and Administration (a Captain of Engineers.)
1 Professor of Permanent Fortification and of the Attack and Defense of places (a Captain of Engineers.)
1 Assistant ditto ditto (a Captain of Engineers.)
1 Professor of the Course of Topography and Geodesy (a Captain of Engineers.
1 Professor of Sciences applied to the Military Arts.
1 Professor of Mechanics applied to Machines (a Captain of Artillery.)
1 Professor of the Course of Construction (a Captain of Engineers.)
1 Assistant ditto.
1 Professor of the German language (a civilian.)
1 Professor of Veterinary Art and Riding (a Captain of Artillery.)
1 Assistant ditto (a civilian.)
1 Drawing Master, Chief of the Drawing Department (a civilian.)

In all, nine Professors, four Assistant Professors, and one Drawing Master.

The School employs in addition an administrative staff, consisting of—

A Treasurer, } both of whom must have been Officers in the Artillery or
A Librarian, } Engineers.
A Principal Clerk.
An Assistant Librarian.
Two Storekeepers, intrusted with the *materiel* belonging to the two arms.
One skilled Mechanic.
One skilled Lithographer.
One Fencing Master.

clerks and draughtsmen are provided as required.

The school is under the general superintendence of two boards or councils, the Superior Council and the Administrative Council.

The Superior Council consists of the General Commandant, as President, the Second in Command, the Director of Studies, as Vice-President; the Major of Artillery, and the Major of Engineers, as permanent members; two Captains of the Establishment, one of each arm; two Military Professors, one of each arm; and one Captain of the Establishment; these five last being all removable at the General Inspections.

The Superior Council has the duty of drawing up the programme of the studies of the year, of suggesting changes in the regulations relating both to studies and discipline, all subject to the approval of the Minister of War; of preparing at the end of the year the classified list of the students, drawn up according to their conduct and progress in their studies, and of pointing out to the Jury of Examiners any students who should go again through the courses

of the year, and stay in consequence an additional year at the school.

When questions relating to the instruction are brought before the Superior Council, the whole body of military professors attend and take part in the proceedings, and the Council is thus said to be constituted as a Board or Council of Instruction. Improvements are here suggested, and are subsequently submitted to the Jury of Examiners, and to the Minister of War; the value to be attached, in the system of marks or credits, to each particular course of study is determined; a statement is drawn up showing what printed works, models, &c., are wanted. The budget itself, to be submitted to the Minister of War, is finally drawn up by the Superior Council in its ordinary sittings.

The Administrative Council, composed of the Second in Command as President, the two Majors of Artillery and of Engineers, one Captain and one Military Professor, and the Treasurer as Secretary without the right of voting, takes cognizance of all the financial and other business matters of the school.

SUBJECTS AND METHOD OF STUDY.

The studies at Metz consist of topography and geodesy, including military drawing and surveying under special circumstances; field fortification, military art and legislation, permanent fortification, and the attack and defense of fortified places, accompanied by a sham siege, without, however, executing the details practically on the ground; architecture, as applicable to military buildings and fortifications; the theory and practice of construction, and artillery. The programmes of these studies are inserted at length in the Appendix.

The instruction is given principally (as at the Polytechnic) by means of a series of lectures, and the knowledge which the students have acquired is first directly tested by requiring them to execute various kinds of surveys of ground, either with or without the use of instruments; to prepare drawings of buildings, workshops, and machines in full detail (plan, elevation, and sections) from the measurements they have recorded in their note-books or on their sketches, and to accompany such drawings with descriptive memoirs of all particulars and calculations that may be necessary to exhibit their purpose or efficiency; to draw up projects and lay out works of field and permanent fortification, or of those of attack or defense of a particular place on certain given data, or according to the nature of the ground; to design a military building, bridge, ma-

chine, or piece of ordnance, accompanied by estimates and descriptive memoirs, showing in what manner the instructions and conditions under which it was drawn up have been complied with; and to prepare a project for the amelioration of the works of defense of a specified portion of a fortified place known to be defective in some respects.

The instruction during the first year's residence is common to the two arms; and the time is appropriated in the following manner, namely:—

	Days.
Military art and legislation,	33
Topography and geodesy,	47
Field fortification,	39
Permanent fortification,	88
Theory and practice of construction,	77
Total,	284

The *sous-lieutenants* who complete their first year's work are allowed nearly a month's vacation during November.

The instruction given to the Artillery and Engineers during the second year's residence is not entirely the same, as will be seen by comparing the accompanying table of the year's study:—

	Artillery. Days.	Engineers. Days.
Military art and legislation,	2	2
Topography and geodesy,	28	28
Attack and defense of places,	44	44
Permanent fortification,	44	129
Artillery, machines, &c.,	81	—
Theory and practice of construction,	46	42
	245	245
Brought forward from first year,	284	284
Total,	529	529

We should not omit to state that there is a short course on the Veterinary Art.

The lectures, as before said, begin at 10 A. M., and they last usually an hour and a half, and are followed by work in the halls of study. It would appear, however, that very frequently the day's occupation consists simply of work in the halls of study (or occasionally out of the school buildings, when the students are sent on some excursion;) and, accordingly, in giving the account of the studies, a *day* or day's work will sometimes mean a lecture followed by drawing or other employment, sometimes this drawing or other employment without any lecture preceding. Taking a general

average, the proportion appears to be about two lectures to five *séances, i. e.*, sittings without lectures.

The system will be better understood by referring to the accompanying tables, which are translated from the Project for the Employment of Time for the year 1851—2, submitted for the approval of the Minister of War. The dates in the first column indicate the days of the commencement of each particular study. The school year, it should be said, begins on the 1st of December.

EMPLOYMENT OF TIME FOR THE YEARS 1851—1852.

Month and Date.	Second Division. First Year's Instruction.	Number of Attendances.	Number of Lectures before Work.	Total of Lectures.
December 1	Lectures on Military Art in			
" 2	Topography—Conventional Tints,	2	.....	.....
" 4	Study of Hill Drawing (in sepia with contour lines,)	2	.....	.....
" 6	Military Art, Plate 1 ..... 5; Plate 2 ..... 5; Plate 3 ..... 5; Plate 4 ..... 5; Plate 5 9	29	4	39
January 12	Front of Cormontaigne,	24	3	13
February 9	Project of Field Fortification, Plate 1. Plan of the whole, ... 3; Plase 2. Organization of a work, ... 8; Plate 3. Details of Construction, ... 4; Memoir, ... 4	19	5	7
March 3	Plan of Stability of Revetments, &c.	9	9	9
" 13	Study of the Drawing showing the effect,	8	1	1
" 23	Plan of a Building, Out-of-door work, ... 9; Laying down and drawing, Memoir, 23	32	.....	.....
April 29	Topographical Triangulation,	4	4	6
May 5	Defilement and Profiling on the Ground,	3	.....	.....
	Project of a Building, Sketches, ... 14; Drawing, ... 24; Memoir, ... 4; Estimate, ... 3	45	12	22
June 28	Survey with a plane-table, Out-of-door work, ... 0; Laying down and drawing, 3	13	1	.....
	One day free in case of bad weather,	1	.....	.....
July 14	To find the Variation of the Needle,	1	1	.....
" 17	Survey of Ground with the Compass, Out-of-door work, ... 8; Laying down and drawing, 2	10	1	.....
	One day free in case of bad weather,	1	.....	.....
August 2	Reconnaissance Plan—Out-of-door work,	6	1	.....
	One day free in case of bad weather,	1	.....	.....
" 10	Study of Shaded Drawing (*Hachures* and colored.)	8	1	.....
" 18	Laying down and drawing the Survey made with the Compass,	2	.....	.....
" 20	Project of Fortification on Level Ground, Plate 1 .... 6; Plate 2 .... 30; Memoir, ... 6	42	3	19
September				
October 8	Project of Fortification on Hilly Ground, Plate 1 ..... 19; Memoir, ... 3	22	8	10
Nov. 3	Last day of week,			
" 6	Leave for their Vacation,			
	There remains therefore in this division:—1st. Three free days in case of bad weather; one after each survey. 2nd. Two days at the end of the year, the 4th and 5th November. Total five free day.			
	Total of the days employed 279 + 5 days free,	284		

EMPLOYMENT OF TIME FOR THE YEAR 1851—1852.

Month and Date.	First Division. Second Year's Instruction.	Number of Attendances.	Number of Lectures before Work.	Total of Lectures.
	Brought forward,.....	284	.....	.....
December 6	Laying down the First Survey by Reconnaissance, ...	8	.....	.....
" 16	Attack and Defense:—Plate, Batteries, with Plan and Sections of Detail, ...	4	5	6
" 20	Ditto, { Plate 1 ..... 25 / Journal, ... 2 / Plate 2 ..... 13 }	40	6	20
January February 7	Designs and Constructions of Revetments, Arches, &c.,....	9	9	9
" 18	Project and Permanent Fortification in Hilly Gound, { Plate 1 ..... 19 / Memoir, ... 3 / Plate 2 ..... 8 }	30	8	19
	SPECIAL WORKS.			
	ARTILLERY. / **ENGINEERS.**			
March 25	Measurement and Drawings of a Cannon, ... 12 / Project of Fortification in hilly ground, Plate 2 *cont.*, ... 12	12	.....	.....
April 8	Measurement of a Work-shop, ... / Out-of-door Work,.....	9	30	30
" 19	Laying down the Measurement, ... 28 / Laying down the Measurement,..... 24			
May 18	/ Project of Fortification in hilly ground, Plate 3, 14			
" 24	Project for Machines,.... 14			
June 4	/ Abstracting and calculating Measurements,..... 3			
" 8	/ Plate 4, ... 11			
" 9	Questions in Artillery,.... 5	97	2	2
	1st. Measurement of *Matériel*, Gun Carriages, &c., 8 / Register of the removal of Earth, ... 3			
	Laying down ditto,..... 10 / Estimate, ... 2			
	/ Memoir, ... 2			
	/ Project for Improvements, { Plate 1 .... 30 / Plate 2 .... 6 / Memoir, ... 2 }			
July 6	2nd. Measurement of *Matériel*,..... 8			
" 15	Project for a Cannon,.... 24			
	97			
August 12	Second Reconnaissance Survey, ...	.....	.....	.....
	Out-of-door Work and Tracing of the Lines on the Reconnaissance Plan, ...	7	.....	.....
	One day free in case of bad weather, ...	1	.....	.....
" 21	Geodetical Calculations, ...	4	.....	.....
" 26	Laying down the Reconnaissance Survey, ...	8	.....	.....
September 4	Memoir on Entrenched Lines,.....	1	.....	.....
" 6	Tracing or laying out Camps,.....	1	.....	.....
" 7	Operations of a Sham Siege,.....	13	.....	.....
	One day free, ...	1	.....	.....
" 19	Preparing for the Examination,.....	.....	.....	.....
October November 1	Examination for leaving, ...	.....	.....	.....
	Total of the days employed, 522 + 7 days free.	529		

FINAL EXAMINATION.

About six weeks of free or voluntary study is allowed, immediately prior to the Final Examination, for the sub-lieutenants to prepare for their last effort.

The examination which takes place prior to their leaving the School of Application, is entirely conducted by a board of six officers, under the presidency of a general officer alternately of the artillery or engineers, the remaining members of the board consisting of a general officer of each corps and three field officers of these corps; the last three being specially charged with the duty of examining. It takes place in a room set apart for the purpose, with a small interior room in connection with it, into which the members of the board retire to deliberate at the end of each student's examination. The jury assembles each year at the period fixed by the minister of war.

The three examining members conduct the examination of the students in three different branches of study; the first more particularly relating to artillery science, the second to engineering science, and the third to mechanical science in its connection with the art of war. The whole of the students who are to leave the school are first examined in such one or other of these branches of study as may be determined on.

The student under examination is specially questioned by the examining officer in his subject, and occasionally by the president or any other member of the board that may wish to do so, for three-quarters of an hour. As soon as the examination of the student has been concluded, the board retire to the adjoining room and compare their notes of the credits they have severally awarded to the student under examination, and they also examine his drawings, sketches, and memoirs relating to the subjects on which he has been questioned, and prepared during his two years of residence in the school. They severally note the credits to which they consider him to be entitled for them, and adopt the general mean.

As soon as the examination of the whole of the students in this particular study has been finished, the examination in the next branch is commenced, so that five or six days elapse between the first and second examinations of the same student; and the same interval of time occurs between the second and third examinations.

The credit allotted to each student by the board of examiners represents, on the scale of 0 to 20, the manner in which he has replied to the questions, or executed the drawings, sketches, memoirs, &c., belonging to each course. The importance attached to each particular branch of study is estimated very nearly by the amount of time allowed for its execution divided by 20; and the definitive marks which each student obtains for that branch of study is obtained from the products of the numbers respectively repre-

senting the credit for answering, and that for the importance of the subjects on which he has been examined.

The final classification of the order of merit, in each arm of the service, is arranged after a comparison of the total of the marks obtained by each student. This total is the sum of the definitive marks gained by each student in the sciences bearing on artillery, engineering, and mechanics in connection with the art of war, for the talent displayed in drawing, sketching, and writing memoirs, and for skill in practical exercises, as determined by the results of the examination conducted by the jury of examiners, added to the marks due to the previous classification in the school, with the weight or influence equal to one-third of that allowed for the examination by the jury.

The co-efficients of influence for the present year are—

For those particularly relating to Artillery Science,.....	39.29
" " " Engineering Science,...	53.75
" " " Mechanical Science,....	43.00
For talent in drawing, sketching, writing memoirs, &c.,...	6.80
For practical exercises,.....	16.75
Previous classification in the school,.....	45.30

So that the examination conducted by the jury of examiners exercises an influence on the position of the students very nearly approaching to two-thirds of the whole amount.

It is this final classification which determines their seniority in the respective services. We were permitted to be present during the examination, which was entirely oral, of two of the *sous-lieutenants*, before the jury of examiners.

The questions were replied to with great fluency and readiness, but it seemed to us that the examination was somewhat limited for the object in view, viz., that of awarding a credit representing the progress which each student had made in the particular science on which he had been questioned, especially as that credit would have very great weight in determining the candidate's future position.*

On quitting the School of Application at Metz, the sub-lieutenants of artillery and engineers respectively join the regiments, to which they are then definitely assigned as second lieutenants, and continue to be employed in doing duty, and in receiving practical instruction with them, until they are promoted.

* The examination chamber is a small room in the school buildings, near the library, ornamented with portraits of Vauban, and of D'Argenson, under whose ministry the original schools at La Fère and Mézières were founded. At a large table under these portraits, and extending across the room, General Morin, President, and four officers, members of the jury, were seated. The sixth member sat at a small table in front, near the blackboard, at which the student stood. The Commandant, the Director of Studies, and the other officers of the school were seated also in this part of the room.

The student who was first examined was questioned partly by the examiner, partly by the

SUBSEQUENT INSTRUCTION AND EMPLOYMENT.

The lieutenants of the artillery are employed on all duties that will tend to make them efficient artillery officers, and fully acquainted with all details connected with the drill, practice, and manœuvres of the artillery, and also with the interior economy and discipline of a regiment of artillery.

After the officers of artillery are promoted to the rank of second captain, but not before, they are detached from their regiments and successively sent into the various arsenals, cannon foundries, powder mills, and small arm manufactories, pyrotechnic establishments, and workshops, in order that they may become practically acquainted with the whole of the processes connected with the manufacture and supply of artillery, rockets, small arms, powder, material of all kinds, tools, &c., and also with the construction and repair of the buildings and factories required for these purposes. Sometimes they are employed as assistants in these establishments. The inspectors of the arms of regiments are selected from among those who have become acquainted with the manufacture of small arms.

When promoted to first captains they again rejoin their regiments, so that they may not lose the qualifications and knowledge required from a good practical artillery officer.

Field-officers of artillery are employed as superintendents and directors, and captains as sub-directors, of the important works intrusted to their arm.

In time of war, the officers of artillery have the construction of their own batteries, and the direction of the ordnance in battles and sieges, together with the formation of movable bridges and passages by boats.

It must be noticed, in contradistinction to the practice which prevails in England, that the artillery and engineer services manufacture their own tools.

The young engineer officers are employed with the men of their regiments, and with them pass through courses of practical instruction in the field, in sapping, mining, field fortification, sham-sieges,

president, and gave his answers, working problems and drawing illustrations on the board as he went on. He was asked questions as to the details of the steam-engine, and as to the method of casting cannon. The German teacher of the School put him on to construe from a German book, and tried him in speaking; he succeeded just passably in both. The whole occupied about three-quarters of an hour.

The second student, after answering similar scientific questions, had opportunity given him to show his knowledge, which was considerable, of the geology of the neighborhood; and having lived in foreign countries, he was able to make a very good display of his knowledge of German, Spanish, Italian, and English.

After each examination the jury retired into the inner cabinet, by a door opening to it from behind their seats.

bridges, and castrametation. During this practical instruction one of the lieutenants belonging to each company is always present, and the captain of the company visits the work once in the course of the day.

The duties of the officers of engineers in time of peace are the construction, preservation, and repairs of fortresses and military buildings, and the command and instruction of the engineer soldiers.

In time of war, the officers of engineers are intrusted with the construction of works of permanent fortification, of the general works in the attack and defense of fortresses, and the reconnaissance connected therewith.

They *may* also be charged—

With the construction of such works of field fortifications as the commander-in-chief or the generals of division consider necessary; such as *épaulments*, trenches, redoubts, forts, blockhouses, bridge-heads, intrenched camps, as well as the opening of communications, the establishment of bridges resting on fixed supports, and the formation and destruction of roads.

After the officers of engineers have been promoted to the rank of second captain, and not before, they are mostly employed apart from their regiments, on the *état major* of the engineers in fortified towns and places, either in charge of the existing military buildings and fortifications, or with the duty of carrying on, or assisting to carry on, such new works as are in course of construction from time to time.

We have already stated that by the law in France one-third of the officers of the army is obtained from the military schools; one-third from the non-commissioned officers who have been raised to that grade from the ranks; while the remaining third is placed at the disposal of the supreme executive power. As regards the artillery and engineers this last third is in actual practice obtained, like the first third part, from the Polytechnic School, so that only one-third of the officers of those arms are promoted from among the non-commissioned officers, and these seldom rise above the rank of captain. Much attention is, however, paid to the improvement of the education of these latter officers, and we found that *four* officers of engineers and *one* officer of artillery so promoted were, by order of the minister of war, on the recommendation of the inspectors-general, passing through the School of Application at Metz, the course of instruction for them being modified on their account. And it was confidently expected that a large number of those officers who

had been promoted in this way during the war would be ordered to the School of Application at Metz.

We should not omit to mention that occasional exchanges of service take place, during the first year of residence at Metz, among the pupils destined for the artillery, and those destined for the engineers.

The pay of officers of the artillery and of the engineers is the same. A small additional allowance is granted to officers of artillery when mounted.

ARTILLERY REGIMENTAL SCHOOLS.

There are ten regimental artillery schools established in places or towns that are usually garrisoned by the troops of this arm, and one of these schools exists at Metz.

ENGINEER REGIMENTAL SCHOOLS.

The soldiers of the engineers appear to be very well taught in their regimental schools, of which there are three, one for each regiment, established at Metz, Arras, and Montpellier, where the regiments are usually in garrison. The strength of each regiment is 4,500 men.

The instruction given in these schools has for its object to afford, to its full extent, to the officers, *sous-officiers*, and soldiers of the engineers, the requisite theoretical and practical knowledge to enable them satisfactorily to fulfill the duties of their various ranks, and to qualify them for promotion to higher rank.

It is so regulated that at the end of the first year the men have learnt the nature of the service and duties of a soldier; and that at the close of the second year, the practiced sapper is cognizant of mining, and the practical miner is acquainted with sapping.

In the lowest classes the men begin with learning to read and write; this if followed by arithmetic, grammar, writing from dictation, and composition. The next subjects are special mathematics, landscape, plan, topographical and architectural drawing. We attended a class in which a corporal of sappers was explaining to the mathematical teacher (a civilian) the theory of the inclined plane, and we saw a large number of their drawings, topographical and architectural, many of which were very well executed.

The theoretical instruction is given between the months of November and March, the practical instruction in the field, (already noticed) occupies the rest of the year. The combined courses are completed in two years.

REGULATIONS AND PROGRAMMES OF INSTRUCTION

OF THE

IMPERIAL SCHOOL OF APPLICATION FOR THE ARTILLERY AND ENGINEERS AT METZ.

(*Abridged.*)

I. POLICE REGULATIONS.

THE chief Regulations for the Police of the Establishment are as follows:—

I. BARRACKS.—The Students are lodged in Barracks in the School, under the command of a Captain of the Staff, with the title of Commandant of the Quarter. They take their meals, however, out of the Barracks, in the town. They are allowed free egress and ingress from and to their Barracks, from the call at 6 in the morning to 10 at night, excepting during the hours devoted to lectures and the studies in the rooms. During these hours they must give special notice of their times of going out and coming in.

II. ORGANIZATION INTO BRIGADES AND SECTIONS.—Each Division is arranged in Brigades of thirty Students at the utmost, and each Brigade in two sections. The Students of Artillery and those of the Engineers constitute, as far as possible, separate Brigades. A Captain of the Staff is attached to each Brigade for its superintendence. The students in these Brigades and Sections are arranged in the order of merit which they held on entrance, and the first Student on the list of each Brigade and of each section of a Brigade is called its Chief. This arrangement is preserved at their messes, which are held at the Restaurateurs', each section of fifteen having its own table, and its chief being the head of the mess. Private bills or private additions to the mess are forbidden, the maximum price for the daily fare being fixed by the Commandant of the School.

III. CONDUCT OF THE STUDENTS.—All games of chance are forbidden; and any debts discovered are punished. If a Student continues long without paying such, he is reported to the Minister of War.

IV. INSPECTION OF WORK DONE WITHIN THE HOUSE.—No work or drawing may be done out of the rooms of study, except in cases of illness.

All works to be executed by the Students are considered as service ordered to be done, which must be completed at the hours and within the period fixed in the order of the day. Students who are in arrears of work at the end of their first year are required to finish them during the time of vacation.

V. SUPERINTENDENCE OF OUT-OF-DOOR WORK.—After describing facilities afforded to the Students for working in the country, and stating minutely the method to be followed, the directions add that "on bringing back their plans, Students must present their sketches, and all the notes taken by them, in their rough state, to the Officer of the Staff intrusted to inspect them. They can not begin to put their work into shape till this Officer's visa has been affixed to the sketches, notes," &c.

VI. VACATION.—There is one vacation at the end of the first year. Any class, or any single student, under punishment, may be deprived of this. Any work to which the Professor gives a mark below 7, must be considered incomplete, and to be done again. Students are kept up in vacation to finish their work; but if it is done within fifteen days, and marked by the Professor's visa, they are allowed to go away for the rest of the vacation.

Young Officers, after their final examination, are subject to all the Regulations of the School, down to the moment of their leaving the town.

II. REGULATIONS FOR ESTIMATING THE VALUE OF THE WORK EXECUTED.

The time devoted to each of the courses in the School, to the works of every kind which belong to it, to the exercises, drill, theoretical instructions, &c., is fixed in accordance with programmes approved by the Minister of War; and the Table similar to that given at pages 180—181, exhibiting the employment, is each year submitted for his approbation by the Superior Council of the School.

Every kind of work, such as the out-door operations, sketches, drawings, memoirs, calculations, interrogations, manipulations, manœuvres, drill, &c., is valued by the Professor or Officer of the Staff charged with its direction, by the product of two numbers, one representing the merit of its execution, and the other the importance of the work.

The numbers representing the merit of the execution or instruction are regulated by the scale of 0 to 20, as at the Polytechnic School.

The co-efficient of importance is found by dividing the number representing the maximum value allowed for the execution of any work by 20, the maximum credit for merit; and the number representing the maximum value, allowed for the execution of any work has reference to all the circumstances bearing upon its execution. It is regulated by the number of hours appropriated to its execution; and in estimating this number of hours, regard is had, not only to the time occupied in making the drawing, but also to that which is necessary for the calculations, essays, and sketches indispensable to its execution. The lectures are reckoned at one and a half hours, and the sittings in the Halls of Study at four and a half hours.

The number of hours inserted in the Table giving the distribution of the time employed, being insufficient for the composition of the memoirs, specifications, estimates, &c., the value given for this kind of work, of which a great part is performed out of the Halls of Study, is fixed at twice the number of hours inserted in the Table showing the distribution of the time employed.

The interrogations are the subject of a special credit, the maximum being equal to the number of hours devoted to the lectures, multiplied by one and a half hour, the length of each lecture.

The credit given for a work performed outside the school is divided into two parts: one, equal to one-third of the total credit, is in the hands of the Officer charged with the superintendence of the work, who estimates the zeal and aptitude of the student; the other, equal to two-thirds, is applied by the Professor, and given according to the merit of the work.

The sum of the credits, given for work of all kinds in a course of study, forms the maximum credit for the course.

The method of fixing the credit for the execution of works, according to the time devoted to them, is equally applicable to the exercises, practice, and drill.

When the time granted for the execution of any work has expired, the Director of Studies sends this work to the Professor for his examination, who establishes the number or credit, showing its importance, and returns it to the Director of Studies.

Every work which has been finished and examined, is marked by the Professor by a number representing its merit, which number may be fractional.

This is multiplied by the number representing its importance, and the nearest whole number resulting from this product expresses the value of the examined work.

Every unfinished work receives a provisional value, and is then returned to the person executing it, and as soon as it has been completed a second evaluation is made, but only two-thirds of the difference between the first and second evaluations is added to the first; the same principle is applied to the works which have been valued below seven, or to those which have been amended or recommenced.

Every work which has not been executed by the student is marked 0; but the grounds for its non-execution are placed before the Jury of Examination.

In the event of two papers being so similar that it is evident one must have been copied from the other, and that it is not possible to decide which has been copied from the other, both are marked 0.

And on the other hand, if it is proved that there was no complicity between the authors of the two papers, the copied paper is the only one canceled.

At the end of each year's study, the Council of the School makes a classification of the students of the two divisions.

Each of these classifications is formed of the following elements:—

1st. Notes of conduct given by the General commanding and the Colonel Second in Command.

2nd. Notes of appreciation given by the General Commanding, and the Colonel Second in Command, and by the Officers of the Staff of the School.

3rd. Tables of credits given by two Field Officers of the Artillery and Engineers on the theoretical and practical instruction with which they are charged.

4th. Tables of credits given by each Professor for the works of all kinds, interrogations, &c., of his course.

The classification of the first year comprehends all the works, drill, and practice, executed during the first year, which have been valued, as well as the notes of appreciation and of conduct.

The number appropriated to these notes at the end of the first year is equal to the moiety of the total number allowed for the two years of study.

The classification of the students of the second year presents the reunion of the works executed by them since their entrance into the school.

The maximum number of credits appropriated to all the Officers of the Staff, as a note of appreciation, is equal to one-sixth of the total of all the courses taken together.

The same number, divided into two equal parts, is assigned to the notes of appreciation given by the General commanding and the Second in Command.

Lastly, the notes of conduct given by the General commanding and the Second in Command form one-fiftieth of the total value.

For the classification of each division the Director of Studies abstracts into a Table, for each arm, all the elements which should enter into this classification. Below the name of each student are inserted all the credits which belong to him, and the total, reduced in the ratio of the maximum 20, is the definitive number of the classification of each student.

The Director of Studies appends to these Tables a report containing everything which affords a means of estimating the work, the conduct of each

student, the delays, and the causes, &c. In giving the names of the students whose credits are less than 7, he proposes, conformably with the Regulations, the measures that should be taken with regard to them.

The Superior Council of the School being assembled, the different Tables furnished by the Professors and by the Officers of the Staff, as well as those in which they are summed up, are collated, and the list of classifications for each division and for each arm is fixed separately, with the definitive numbers representing the credits.

These classified lists indicate for each arm the new rank of the Students, their rank at admission to the School of Application and of passage to the first division, the sum of the values for the works executed by them, and all the elements which would tend to enable a proper judgment to be formed of their merits and conduct.

The Superior Council adds to it, if there be any necessity for it, notes, exposing the grounds which have contributed to the principal alterations in the relative position of the Student, and points out those whose credit is less than 7, as well as those who by their bad conduct deserve to become the object of exceptional measures.

Examination for Leaving.

Each year the General commanding the School determines by lot, at least one month in advance, the order in which the examinations for the promotions in the Artillery and Engineers are to take place. The Students belonging to the same arm can change among themselves, but eight days after the lots have been drawn the list of the order of examination is definitely closed. The General commanding the School makes known at the same period the order of the examinations and the division of the subjects between these examinations.

The General commanding the School places before the General of Division, President of the Jury of Examination, the following:—

1st. The division of the subjects between the three examinations.

2nd. The order of examination of the Arms, and of the students of each Arm.

3rd. The provisional classification of the students of the first division made by the Superior Council.

4th. The particular reports relating to each student made by the General commanding the School.

5th. The list of the propositions made by the Superior Council and the proceedings of the sitting at which it was agreed to.

6th. The classification of the Students of the second Division.

7th. Tables of questions established for each course.

8th. The abstracts of the sittings of the Superior Council held since the last examination.

The Student Sub-lieutenants are successively examined in all the branches composing the theoretical and practical instruction of the School. The theoretical knowledge is grouped in three series, each of which is the object of a particular trial.

The drill and practice are executed in the presence of the Jury, who cause the command to be given to the Sub-lieutenant, in order to satisfy themselves of the amount of their instruction, and to assign marks of merit to them individually.

The subjects of the three examinations are divided in the following manner:

First. Examination, made by the Field Officer of Artillery in the—

Course of Military Art.
Course of Artillery.
Course of Veterinary Art.
Sham Siege (part relating to Artillery.)
Course of Military Law and Administration.

Second. Examination, held by the Field Officer of Engineers.

Course of Permanent Fortification and the Attack and Defense of Places.
Course of Construction.
Sham Siege (part relating to the Engineering.)

Third. Examination, held by the third Examiner, taken either from the Artillery or Engineers, in the—

Course of Mechanics.
Course of Applied Sciences.
Course of Topography and Geodesy.
German Language.

Every Student, on presenting himself before the Examiners, submits for their approbation the drawings and manuscripts relating to the subjects on which the examination is to bear. Independent of the questions which are placed before him by the Examiners, the Student Sub-lieutenant must reply to any objections or questions which the members of the Jury may think fit to address to him.

The German Master directly questions the Students, if the Jury wish it. The Professors or their Assistants must be present at the examinations relating to their course.

As soon as the examination is ended, the members of the Jury retire to an adjoining room with closed doors, to determine on the amount of marks to be given to the Student examined.

When the trials of all kinds are finished, the Jury proceed to the definitive classification of the Students belonging to each arm. In making this classification, regard is had to the following considerations:—

1st. Each examination has a co-efficient of importance equal to the sum of all the different courses which are included in it.

2nd. The co-efficient of importance for drawing is equal to the $\frac{1}{20}$ of the sum of the co-efficients of the three examinations.

3rd. The co-efficient of importance of the practice, drill, &c., is, as for the courses, the sum of the co-efficients appropriated to the works taught in the School.

By multiplying the co-efficients of importance by the mean number of marks of merit obtained by the Students in the different examinations, the definitive credit which must be assigned to each Student in the Table of Classification is obtained.

The classification of the School enters into the definitive classification for a value equal to one-third of the total number of the three examinations, without comprising the valuation of the drawings; this value is added to the credits determined above.

The Jury give an account of the proceedings of the examinations in a "*procès-verbal*" addressed to the Minister by the General acting as President.

III. PROGRAMME OF THE ARTILLERY COURSE.

FIRST PART.—INTRODUCTION.

Twenty-six Lectures common to Students of both Arms.

First Lecture.—(1.) Definition of the word Artillery. Material, personnel, science. Object and division of the course.

FIRST SECTION.—EFFECTS OF POWDER.

Ideas on the origin of powder and its use in fire-arms; mealed or pulverized powder; powder in grain. General conditions which powder ought to satisfy; action of each of its component parts. Proportion of component parts used in France. *Fulmi-ligneux.*

Considerations on the physical properties of powder. Size of the grains expressed by the number of grains to the gramme. Density of the grains and specific density of the powder; circumstances causing them to vary. Effects of damp upon powder.

Second Lecture.—(2.) Combustion of powder. Different modes of ignition of powder. Research respecting the laws of its combustion, process of observation employed, laws discovered. Influence of the density, the composition, the mode of manufacture, the damp, the tension and temperature of the surrounding gases.

Combustion of the grains of powder. Calculation applied to the spherical grain. The formula is applicable to the irregular grains of ordinary powder.

Calculation of the density of the gases of powder in a fixed space, on the hypothesis of a simultaneous ignition of the grains. Discussion of the formula obtained; influence of the density of the grains, of the duration of their combustion and of the space in which the powder is inclosed.

Inquiry into the rapidity of ignition of charges of powder. Experiments made upon trains of powder, and upon gun-barrels filled with powder. Conclusions drawn from the results obtained.

Third Lecture.—(3.) Calculation of the density of the gases of the powder on the hypothesis of successive ignition.

Results of the application of the formula to charges of a spherical and a truncated form.

Tension of the gases of powder. Impossibility of determining it by considerations of a purely theoretical nature. Experimental solution of this question. Experiments by Rumfort; description of his apparatus. Results obtained. Formula representing them. Observations on these results.

Fourth Lecture.—(4.) Effects of powder in a fixed space.

Hollow projectiles. The readiest bursting of a hollow sphere takes place in the direction of the plane of a great circle. Determination of the minimum bursting charge; law by which this charge varies with the thickness of the envelope. Influence of the fuse-hole of hollow projectiles; weakening of the envelope of the shell, diminution of the charge; loss of gas, increase of the charge. Effects of the shock of the exploding gases; means of estimating it. Influence of the vivacity of the powder in burning. Number and rapidity of the explosions.

Hollow cylinders burst more easily longitudinally than transversely. Conse-

quences of this principle relatively to the employment of a fibrous metal for the manufacture of arms. Thickness necessary to resist bursting.

Fifth Lecture.—(5.) Effects of powder in cannon.

Analytical theory of the effects of powder in cannon.

Equation of the problem. General expressions of the quantity of force exercised by the expansion of the gases,—of the density of the different sections of gas and of their tension. Differential equations of the motion of the gases, of the projectile, and of the gun. Equation of condition leading to the establishment of the general formula which determines the position of a stratum of gas in the terms of the function of its original position, and of the other data of the question. General relations between the velocity of the projectile and that of the gun.

Density of the stratum of gas at a given moment. Position of the stratum which has a maximum density.

Sixth Lecture.—(6.) Approximative solution applicable to the cases ordinarily met with in practice. Hypothesis relating to the velocity and the tension of different strata of gas.

Relations between the velocity of the projectile and that of the gun. Approximate expression of the amount of force due to the expansion of the gases; line to be followed in the execution of the arithmetical calculations. Formula serving to determine the velocity of the projectile. General considerations on the state of the gases of powder during the burning of the charge. Influence of the motions of the projectile and of the bottom of the bore on the distribution of the gases at each instant. Influence of the successive generation of the gases combined with the enlargement of the space which incloses them on their density throughout the whole duration of the phenomenon.

Seventh Lecture.—(7.) Influence of the vent and of the windage of the projectile on the effects of powder in cannon.

Determination of the loss of velocity occasioned by the windage of the projectile. Influence of the weight of the piece upon the velocity of the projectile. Influence of the weight of the projectile on tension of the gases and upon the velocities of the two bodies set in motion. Influence of the weight of the charge of powder. Charge giving the maximum of velocity. Influence of the size and density of the grains of the powder as well as other circumstances which cause a variation in the law of generation of the gases. Advantage of very rapid combustion in short pieces and of slower combustion in long ones.

Eighth Lecture.—(8.) Influence of the length of bore; circumstances which modify it; length corresponding to the maximum of velocity. Comparison of the quantities of motion of the projectile and of the gun. Trial of a formula fitted to represent their relation. Determination of this relation with the help of the balistic pendulum.

Mean pressure exercised on the projectile during its passage through the bore. Injuries produced in guns by firing; enlargement of metal and cracks; lodgment and percussion of the projectile.

Different effects of the percussion; means tried to prevent injuries (in general.) Considerations on the metals employed in the manufacture of ordnance. Charging with elongated cartridge; use of wooden bottoms and wads.

Ninth Lecture.—(9.) Examination of the proper means for measuring the effects of powder. Eprouvettes of different sorts. Experimental processes

founded on the measure of the velocity of the projectile. Grobert's rotatory machine. Process of Colonel Debooz. Process based on the employment of an electric current. Method by ranges (mentioned here by way of note.)

Balistic pendulum. Pendulum of Robins, of d'Arcy, of Hutton. Improvements introduced in France into the construction of these apparatus. Description of the pendulums in use at the present day; cannon pendulum; musket pendulum.

Tenth Lecture.—(10.) Analytical theory of the balistic pendulum.

1. Receiver pendulum; formula which gives the velocity of the projectile. Determination of the elements which enter into the formula, and the degree of approximation necessary. Simplification of the calculation of the velocities in the case of firing several times consecutively.
2. Cannon pendulum. Amount of recoil in the gun. Percussion of the knife-edges of the pendulum. Case where there is none. Means of correcting the position of the center of percussion.

Eleventh Lecture.—(11.) Examination of the effects of the recoil upon guns and their carriages. The question may be considered as resolving itself into two others.

1. Percussions of the carriage upon the points supporting it; analytical solution. Determination of the percussions and of the force of the recoil in the case of carriages on wheels, and that of mortar beds. Graphic solution of the same question by an analysis of the force which acts upon the bottom of the bore. Modification of the sketch according to the different cases presented by the direction of fire relatively to the ground.

Twelfth Lecture.—(12.) Discussion of points relating to the percussion of the carriage upon its supports, and to the force of the recoil. Influence of the elevation of the line of fire; of the inclination of the ground or of the platform; of the length of the carriage in proportion to its height and of the friction which results from the contact of the trail with the ground. Velocity of recoil of the collective apparatus. Determination of the extent of the recoil on a given ground. Recoil of the different pieces of ordnance in use. Case in which the forepart of the carriage has a tendency to be lifted up; velocity of this motion; determination of the effect resulting from it.

Thirteenth Lecture.—(13.)

2. Percussions produced by the gun upon its carriage. Determination of the amount of percussion of the breech upon the elevating screw, and of that of the trunnions upon the trunnion holes. Discussion of points relative to the effects produced. Influence of the elevation; of the dimensions of the gun, and of the proportion of its weight to that of the entire apparatus.

Effect of the elasticity of the different parts of the apparatus. It diminishes the wear of the parts struck, and renders it necessary to take into account the velocity of the parts striking.

Fourteenth Lecture.—(14.) Effects of powder in mines. Historical notices. Dimensions of the boxes containing the powder. Considerations on the effects of the expansion of the gases in an indefinite or limited compressible medium.

Definitions having reference to craters and chambers of mines. Ordinary charge of the chamber. The old rule for miners; its entire alteration. Table

relating to different kinds of medium. Overcharged chamber. Overcharged chamber or "camouflet." Limit of the effects of compression which result from the action of the chambers. Use of gun cotton. Considerations on the effects of the petard. Dimensions of the cavity reserved for the powder. Means employed or proposed to diminish the charge of powder proportioned to a given effect.

SECOND SECTION.—MOTION OF PROJECTILES IN SPACE.

Fifteenth Lecture.—(15.) Science of projectiles. Historical notices. Utility of an acquaintance with the laws of the motion of projectiles in a vacuum. Definitions relating to the trajectory. Differential equations of the motion in vacuo. Equation of the trajectory. Inclination of its elements. Velocity of the projectile at any one point. Duration of its passage. Determination of the range and of the angle of greatest range. Relations between the ranges; the initial velocities; and the angles of projection. Examination of the cases where the theory of the parabola is applicable.

Preliminary ideas on the resistance of fluids; difficulties inherent in this question. Approximative formula of the resistance, established by the help of the principle of active forces; circumstances not taken into consideration by it.

Sixteenth Lecture.—(16.) Experiments relating to the determination of the resistance of the air.

1. Case of small velocities. Rotatory apparatus; results furnished by them in the case of thin planes; their essential defect. Apparatus with rectilinear movement. Mean value of the co-efficient of the theoretical resistance in the case of thin planes; modification of this value for the case of spheres, &c.
2. Case of great velocities. Direct determination of the resistance of the air by the aid of the balistic pendulum. Experiments of Hutton, their results. Experiments made at Metz in 1839 and 1840. General expression of the resistance based upon the total of the results obtained, and containing a function of the velocity in three terms. Search after a function in two terms fit to replace in each particular case the general expression.

Seventeenth Lecture.—(17.) Theory of the motion of projectiles in the air. Differential equations of the motion. Hypothesis on the relation of the element of the trajectory to its projection. Calculations based on this hypothesis, and leading to the final equation of the arc of the trajectory. Inclination of the element of the trajectory. Velocity of the projectile at a given point. Duration of the passage.

Eighteenth Lecture.—(18.) Examination of the functions employed in the formulas of the science of projectiles. Formation of the balistic co-efficient, and the series contained in the functions. Relations of the series and the functions to each other. Arithmetical tables designed to give their values. Determination of the relation of an arc of the trajectory to its projection. Error resulting from the introduction of the constant relation in balistic calculations.

Nineteenth Lecture.—(19.) Application of balistic theories to the movement of projectiles thrown at great angles. Analysis of the trajectory, and determination of all the circumstances of the movement. Trajectory of shells considered as a single arc. Solution of several problems involved in this hypothesis. Determination of the range. Velocity corresponding to a given range

and angle of projection. Angle of projection corresponding to a known initial velocity and range. Angle of greatest range. Variation of the velocity of the projectile during the whole of its passage. Limit of velocity of projectiles falling vertically in the air.

Twentieth Lecture.—(20.) Application of balistic theories to the motion of projectiles thrown at low angles. Case where the relation of the arc to its projection can be supposed sensibly equal to unity. Problems relative to direct fire; distinction established between the angle of projection and the angle of fire. In ordinary cases in practice the angle of fire is very nearly independent of the height of the object aimed at. Relations between the angle of projection, the angle of elevation of the object aimed at, and the angle of descent. Problems relating to plunging fire. (Ricochet fire.) Determination of the initial velocity and the angle of projection for a projectile which has to pass, firstly, through two given points; secondly, through one given point, the trajectory having at this point a known direction. Case of practical impossibility.

Twenty-first Lecture.—(21.) Relations between the velocities, the spaces traversed, and the durations of passage in the rectilinear movement of projectiles. They are applicable to direct fire, and are independent of the function of the velocity which enters into the expression of the resistance of the air. Case where the resistance of the air can be supposed proportional to the square of the velocity. Establishment of balistic formulas in this hypothesis. Application of the formulas to the resolution of one of the problems connected with a plunging fire. Comparison of the results obtained with those arrived at by the use of general formulas. Indication of methods applicable to the resolution of several questions in projectiles.

Twenty-second Lecture.—(22.) Examination of disturbing causes which influence the motion of projectiles.

1. Disturbing causes acting on the projectile during its passage through the bore. Imperfections of form, such as want of straightness in the bore, faulty position of the line of sight and the trunnions.

   Influence of the windage of the projectile and of the percussions which result from it. Deviation from the original direction; its consequence in the different kinds of fire. Effect of the recoil and the vibrations of the barrel in the fire of small-arms.

   Influence of the various causes which are capable of modifying the initial velocity.

2. Disturbing causes acting upon the projectile during its passage through the air. Influence of the rotatory motion which results from the last percussion within the bore. Effects of the eccentricity of projectiles. Case where the rotation occasions no deviation. Influence of the proximity of the ground. Deviation produced by the wind (air in motion.) Influence of atmospheric changes.

THIRD SECTION.—MOTION OF CARRIAGES.

Twenty-third Lecture.—(23.) Importance of the question. Preliminary ideas. Resistance due to the motion of a carriage and determination of the effort necessary for drawing it in the case of uniform motion. Two-wheeled carriage on level ground; the effort of draught in a direction parallel to the ground; first, resistance referable to the friction of the wheels on the axle; secondly, resistance referable to their revolution upon the ground. Influence of the weight of

the carriage. Advantage of large wheels over small ones, demonstrated in the two cases of a yielding soil and a hard soil scattered over with obstacles. Expression of the power of draught necessary to overcome the two resistances united.

Twenty-fourth Lecture.—(24.) General expressions of the effort of draught necessary for two-wheeled and four-wheeled carriages; case of a locked wheel. Influence of the direction of the traces and of the inclination of the ground upon the draught. Advantage of rolling over dragging for the transport of burdens. Examination of resistances which are developed in the passage from repose to motion. Considerations on the position of the fillet in the box, and determination of the co-efficient of friction for the case of the revolution of the wheel about the axle.

Influence of the length of the nave on the frictions when the axle is thrown out of a horizontal position.

Twenty-fifth Lecture.—(25.) Turning of carriages considered successively in the case of two-wheeled and four-wheeled carriages. Center and angle of the turn in four-wheeled carriages. Calculations of the angle of the turn and of the space required by the carriage to execute a half turn. Examination of the dimensions of the carriage which influence the angle of the turn. Diameter of the fore-wheels and height of the body of the carriage; distance between the wheels and breadth of the body of the carriage; position of the point of reunion of its fore and hind parts. Examination of the circumstances favorable or unfavorable to the action of the horse. Relation between the forces to which he is subjected, and the pressure of his feet on the ground. Sliding of the feet; influence of the weight of the animal; of the co-efficient of friction; and of the direction of the traces. Lifting of the fore-hand; influence of the weight of the horse, and of the increased distance between the points on which he rests; of the position of his center of gravity; and of the direction of the traces.

Twenty-sixth Lecture.—(26.) Considerations on the mode of action of the draught-horse. Effect of his weight, and of the inclination of the traces. Effort of draught of which the horse is capable, both momentarily and continuously; results of experiments. Composition of artillery harness. Harness à limonière (with shafts and cross-bar,) or on the French system; on the German system, with pole and support. Use and discontinuance of swing bars. Arrangement of the traces. General arrangement of harness. Bât-saddle.

SECOND PART.

CLASSIFIED ACCOUNT OF SMALL ARMS AND OF ARTILLERY MATERIAL.

Twenty Lectures, of which Fourteen are common to the Students of both Arms and Six confined to Artillery Students.

FIRST SECTION.—SMALL ARMS.

Twenty-seventh Lecture.—(1.) Classification of small arms. Arms not fire-arms. Classification of hand-weapons. Considerations on the profile and outline of cutting weapons. Effect of the curve. Division of the mass. Form of the hilt.

Considerations on the profile and outline of thrusting weapons.

Position of the center of gravity; form of the point. Description of arms other than fire-arms now in use. Sabres and swords. General ideas respecting their component parts; blade, hilt, and scabbard. Regimental arms. Infantry sword. Sword-bayonet of the artillery and chasseurs, cavalry sword; peculiar requisites. Sword of cavalry of reserve, of cavalry of the line, and of light cavalry. Horse artillery sword.

Officers' and non-commissioned officers' arms. Cavalry lance. Camping axe. Side-arms in use in the navy. Sword, pike, boarding-axe, dirk.

Defensive armor. Cuirassiers and carabineers' cuirasses. Cuirass and helmet of the sapper.

Twenty-eighth Lecture.—(2.) Fire-arms. Historical notices. First attempts in fire-arms. Hand cannons. Arquebuses, culverines, &c. Poitrinal, match-lock, firelock, pistol, and blunderbuss.

Means employed successively for loading and ignition of the charge. Twisted match, wheel-lock, flint-lock, percussion-lock, (the two last mentioned here by way of note.) Classified account of fire-arms now in use. Muskets. Considerations on the weight and principal dimensions of muskets. Detailed description of the infantry musket. Action of the flint and the percussion lock.

Twenty-ninth Lecture.—(3.) Comparison of the flint and the percussion musket. Voltigeur's, dragoon's, and double-barreled musket. Gendarmerie and cavalry carbine. Cavalry and gendarmerie pistol. Arms in which precision of aim is studied. Means employed to prevent the deviations caused by the windage of the projectiles and their rotatory movement in the air. Diminution and suppression of the windage; straight grooves in the barrel, spiral grooves, rifled arms. Rotation of the ball about its axis of flight.

Principles of arrangement of rifled arms. Charge of powder and inclination of the grooves; two modes of solution, powerful charge and long spiral, weak charge and short spiral. Length of the barrel: conditions which determine it; number and form of the grooves.

Thirtieth Lecture.—(4.) Loading of rifled arms; ramming the ball home; loading at the breech. Different methods tried. Loading with a flattened ball; effect of the flattening of the ball. Examination of the successive improvements to which this idea has served as a basis. Chambered arms; use of the short bottom and the patch. Arms *à tige.* Elongation of the ball; shortening of the spiral groove; diminution of the charge; advantages resulting from it. Pointed cylindrical ball; principles of its outline; effect of the notches of the ball; superiority of this projectile over the spherical balls. Summary examination of the different models of rifled arms which have been successively in use. Versailles rifles.

Wall-piece, pattern 1831. Common rifle, pattern 1842. Wall-piece, pattern 1840. Bored-up wall-piece, pattern 1842. Pistols for officers of cavalry and gendarmerie. Rifles *à tige*, pattern 1846, and artillery carbine *à tige.* Description of these two arms. Superiority of the rifle *à tige* over the arms for precise aim previously adopted. Trial relating to a new improvement in the construction of rifled arms. Disuse of the "*tige.*" Ball with cup. Comparative notice of the fire-arms of the different European powers.

SECOND SECTION.—PROJECTILES AND CANNON.

Thirty-first Lecture.—(5.) Principles of construction of projectiles.

Considerations on the substances which may be chosen for the manufacture

of projectiles. Essential conditions, density, hardness, tenacity, cheapness. Projectiles of stone, lead, cast-iron, iron, copper, gun-metal. Forms of projectiles.

Exterior form; conditions which serve to determine it. The spherical form preferable to any other in the actual state of artillery. Advantage of elongated projectiles. Conditions relating to their use. First attempts. Interior form of hollow projectiles; howitzer shells, bombs, and grenades. Thickness of the metal; fuse-hole; charging-hole of naval hollow projectiles; lugs or handles of shells. Density of projectiles. Recapitulation of the balls; howitzer shells; shells and grenades in use, their nomenclature, dimensions, weight. Cannon-balls. Choice of metal and weights. Different arrangements for the use of shot, case-shot, canister or naval grape-shot. Spherical case; conditions relating to their use. Charge of spherical case. Bar-shot. Rescue shells.

Thirty-second Lecture.—(6.) Cannon. Historical ideas on the subject. Principle of arrangement of ancient arms and machines of war. Motive force employed; its inferiority compared to that furnished by the combustion of powder. Earliest cannon.

Historical view of the different systems of ordnance which have been successively in use in France.

1. Cannon. Calibres in use in the 16th century. Edict of Blois, 1572. Cannon employed in the reign of Louis XIV. Regulation of 1732. System of Vallière. Modifications introduced by Gribeauval in 1765. Cannon of the year XI. Cannon in use at the present day.

2. Ordnance adapted to hollow projectiles. Difficulties inseparable from the throwing of hollow projectiles; first attempts. Mortars. Double fire. Ancient calibres. Mortars in use at the present day. Stone mortar. Howitzers, their first use in the French artillery; howitzers of 1765; of the year XI. Calibres in use at the present day. Considerations on the calibres of different kinds of cannon. Siege, garrison, field, coast, and naval ordnance. Siege, garrison, field, mountain, coast, and naval howitzers. Mortars and stone mortars. Considerations on the metals which may be employed in the manufacture of cannon for siege, garrison, field, coast, and naval purposes. Interior form of ordnance.

1. Part of the bore traversed by the projectile, transverse section; trial of rifled cannon, longitudinal section.
2. Part of the bore occupied by the charge; influence of its form; the spherical, cylindrical, truncated form. Chambers of mortars; reason for their adoption. Cylindrical and truncated chambers; comparison of their effects. Spherical chamber; pyriform chamber: interior form of the naval mortar *à semelle* (cast in one piece with the bed.) Chamber of howitzers; experiments with reference to their adoption for field howitzers. Dimension. Howitzers without chamber. Chamber of carronades. Junction of the chambers with the rest of the bore: form of the bottom of the bore or of the chamber.

Thirty-third Lecture.—(7.) Vent; its object, its dimensions. Bushes inserted before casting, (*masses de lumière;*) after casting, (*grains de lumière.*) Considerations on the position of the vent relatively to the charge. Experiments made with the infantry musket, and with 24 and 16 pounder guns.

Arrangement of the vent in guns of 1732; portfire chamber. Vent of mortars. Priming pans. Windage of projectiles; conditions which determine it for the different services. Rules received with respect to ancient guns. Dimen-

sions in use at the present day. Different characteristics resulting from the windage of projectiles. Length of the bore. Question of the length of the bore considered with reference to the projectile effect of the powder. The length of ordnance is determined by considerations unconnected with this effect.

Length of bore of siege and defensive artillery, of field, coast, and naval guns. Length of bore of mortars, and of the stone mortar. Length of bore of howitzers. Thickness of metal and external outline. Cannon:—Theoretical determination of the external outline necessary for resistance to the effect of the gases of the powder. Co-efficient of resistance, its value in the guns in use. Thickness in the chase necessary for resistance to the percussions of the projectile.

Swell or moulding of the muzzle. Thickness at the position occupied by the trunnions. Thickness of metal of the different systems of cannon which have been successively in use in France. Thickness of metal in howitzers. Form resulting from the diminution of internal diameter, at the position occupied by the chamber. Exceptional form of the siege howitzer. Outline of the interior of mortars.

Thirty-fourth Lecture.—(8.) Line of sight; its object and arrangement. Considerations on the inclination of the line of sight relatively to the axis of the gun. Trunnions; object and arrangement of trunnions and their shoulders. Position of trunnions relatively to the center of gravity of the gun. Preponderance of the breech over the chase; manner of estimating it; preponderance allowed in the different guns in use. General principle serving as the basis for its adoption. Position of trunnions relatively to the axis of guns. Reasons for their depression; circumstances which cause it to vary. Trunnions of mortars; their reinforces. Dolphins of ordnance. Weight of ordnance; necessary relation between the weight of a gun, and the quantity of movement of its projectile. Conditions serving to determine the weight of the different species of cannon, howitzers, and mortars in use. Examination of the weights adopted for the pieces of ordnance of all sorts, which have been successively employed. General recapitulation of the different species of ordnance in use. Nomenclature. Dimensions, weight. Land artillery. Siege, garrison, and field guns. Siege, garrison, field, and mountain howitzers, mortars, and stone mortars. Naval artillery. Cannon, carronades, howitzers, mortars, stone mortar, blunderbuss. Observations on ordnance. Exceptional ordnance. Villantroy's howitzers. Belgian mortar of 60 c., &c. Description of the artillery petard.

THIRD SECTION.—WAR AND SIGNAL ROCKETS.

Thirty-fifth Lecture.—(9.) Historical ideas on the subject. Cause of the motion of rockets. Their exterior and interior form. Relation which should exist between the law of generation of the gases and the orifice for their escape. Measure of the tension of the gases in rockets. Results of experiments. Motion of the rocket. Variation of the velocity during its passage. Means of regulating the motion; effect of the directing stick. Influence of the wind upon the trajectory of the rocket.

Description of rockets in use.—1st. War rockets; calibres employed; body of the rocket; arrangement of the stick. Projectiles fitted to the head of the rocket; rockets without stick. 2d. Signal rockets; their calibres and composition.

FOURTH SECTION.—CARRIAGES.

Thirty-sixth Lecture.—(10.) Historical ideas on the subject. Arrangements originally in use for the service of ordnance. Successive improvements. Carriages on wheels. Introduction of limbers. General conditions which gun-carriages should satisfy.

General principles of their construction:—1st. With reference to the act of firing. 2dly. With a view to transport.

Mortar carriages. Particular requisites. Description of the carriages in use. Siege carriages; particular conditions. General arrangement of ancient siege carriages. Detailed description of the present siege carriage and its limber; its weight and different characteristics. Field carriage; particular requisites; general arrangement of the carriages employed before 1765. Field carriages of the system of Gribeauval; its defects. General arrangement and detailed description of the present field carriage and of its limber. Weight and different characteristics. Mountain carriages; particular requisites; description of the carriage and of the arrangement of its shafts (*limonière.*)

Thirty-seventh Lecture.—(11.) Garrison and coast carriages; particular requisites; object of the platform for the two systems; its principal dimensions; position of the pintle or working bolt (*cheville ouvrière.*) General arrangement of ancient garrison and coast gun-carriages. Description of the present garrison carriage; change of the carriage into a movable one on four wheels; weight and different characteristics. Replacement of the platform by a directing transom bed under certain circumstances of the service. Casemate carriage. Iron carriages; inconveniences of this kind of construction for siege purposes and on the field of battle; its advantages for the armament of coasts. Description of the coast carriage actually in use; weight and different characteristics. Naval carriages; particular requisites. General arrangement of naval carriages in use. Carriage on four small wheels for cannon. Bracket carriage (*à échantignolle,*) and carriage with double pivot platform for howitzers. Carronade carriage. Mortar bed, cast in one piece with the mortar, (*à plaque.*) Exceptional methods of construction. Depressing gun carriages for a very plunging fire. Villantroy's howitzer beds, those of the Belgian mortar of 60 c., &c.

FIFTH SECTION.—CARRIAGES AND OTHER PARTS OF AN ARTILLERY TRAIN. ARTILLERY OF FOREIGN POWERS.

Thirty-eighth Lecture.—(12.) Battery carriages. Ammunition wagon. Historical ideas on the subject. Requisites for carriages used for the transport of munitions of war. General arrangement and description of the present ammunition wagon. Principles of arrangement of the ammunition chest. Loading of the chest with munitions of various kinds. Mountain ammunition chest. Loading of the chest with howitzer ammunition and infantry cartridges.

Battery wagon; object of this carriage; patterns successively adopted. Description of the wagon, pattern 1833. Field forge; object of this carriage. Description of the forge in use. Arrangement and play of the bellows. Mountain forge. Description and loading of it.

Thirty-ninth Lecture.—(13.) Park carriages and machines.

Park wagon. General arrangement and description of the park wagon and its limber. Carriages destined to the transport of heavy burdens. Ancient gun wagon. Truck. Block carriage. General arrangement and description

of the carriage. Siege cart; its object and description. Devil carriages. Arrangement of the ancient devil carriages with perch and with screw. Devil carriage with roller. Description of the carriage and of its mechanism. Gin. General arrangement of the different patterns successively employed. Description of the gin at present in use. Handscrew; its use, general arrangement, and description.

Fortieth Lecture.—(14.) Pontoon equipages. Conditions which military pontoon equipages should satisfy. Considerations on the nature of the supports to be employed. Reserve pontoon equipage. Boat of the reserve equipage; its general form and dimensions. Description of the boat and skiff; use of the boat for navigation; its weight and different properties.

Tackle and machines employed for bridge-making. Balks, moorings, chesses, blocks, and balk collar. Framework, with movable head; different kinds of piles. Means of anchorage. Common anchor; its properties. Anchor basket and chest. Buoy. Cordage. Ideas on its arrangement and on the measure of its resistance. Capstan. Windlass. Tackling. Handscrew. Pile driver. Hand rammer. Grapnel and hooks.

General arrangement of the boat carriage. Description. Its weight and properties. Light equipage.

Forty-first Lecture.—(15.) General ideas on the artillery of the different European powers, and comparison with the French material.

Ordnance; description, species, and calibres. Gun-carriages, carriages, and other parts of the train. General arrangement; facility of movement; modes of harnessing, &c.

SIXTH SECTION.—DETAILS OF CONSTRUCTION OF GUN CARRIAGES AND ARTILLERY CARRIAGES, AND MEANS OF PRESERVATION OF MATERIAL.

Forty-second Lecture.—(16.) Knowledge of woods. Preliminary ideas. Structures and general properties of woods. Diseases and defects of woods. Description and properties of the principal substances employed in the construction of the material; uses to which the different kinds of wood are specially destined. Selection of standing timber; felling; transport; reception of woods; cubature. Cutting up in large and small sizes. Observations on the shrinking of wood. Preservation of woods. Drying in the air. Round, squared, and blocked-out timber. Preservation in store; preservation in water. Steeping. Influence of the contact of woods with other woods, and with metals.

Forty-third Lecture.—(17.) General considerations on the substances employed in the manufacture of gun and artillery carriages. Different properties of metals. Choice of kinds of wood; effects of their being dried. Classified account of axles and wheels. Axles; substance employed, their forms and dimensions. Wheels; essential requisites. Importance of the elasticity of wheels. Effects of the dishing of a wheel, form of the spokes, coupling of the spokes with the nave and the felloes. Tires. Form and number of the felloes determined by the effects of the drying. Form of the nave. Wheel-boxes.

Forty-fourth Lecture.—(18.) Means employed for the connection of the pieces which enter into the composition of gun-carriages, carriages, and other furniture of the train. Nails, clinch nails, rivets, bolts, screws, &c. Examination of the joinings employed in the construction of gun-carriages, carriages, and other furniture of the train.

General principles. Joinings of gun-carriages. Joint plates ("*rondelles d'assemblage.*") Mortar beds, siege, field, and garrison carriages.

Forty-fifth Lecture.—(19.) Joining of other carriages and furniture. Hind parts, ammunition wagon, battery wagon, forge, park wagon, block carriage, cart, devil carriage, and drays. Boat and wherry. Fore parts, particular requisites. Fore parts of the field and siege carriage, of the park wagon, devil carriage, and drays. Barrels and cases.

Forty-sixth Lecture.—(20.) Means employed for the preservation of the material. Cost price of the principal parts of the material. Ordnance, projectiles, powder, carriages, and other furniture of the train. Small-arms. Preservation of ordnance in gun-metal and cast-iron. Preservation of projectiles. Formation and counting of piles. Rust-cleaning machine. Preservation of gun-carriages, carriages, and other furniture of the train. Different methods of stacking in use. Preservation of powder and made-up ammunition; stacking in powder magazines. Means proposed for avoiding the danger of explosion. Preservation of small-arms. Armories. Preservation of iron and cut wood.

THIRD PART.

FIRE OF ORDNANCE AND PORTABLE FIRE-ARMS. EFFECTS OF PROJECTILES.

Forty-seventh Lecture.—(1.) Fire of ordnance. Kinds of fire in use with ordnance. Choice of charges of powder. Charges of powder formerly in use; their progressive reduction. Charges of field, siege, garrison, coast, and ships' cannon; of howitzers and mortars.

Arrangement of the charge. Shot cartridge for field guns. Loading of the other kinds of guns, of howitzers, mortars, and the stone mortar. Loading for fire with red-hot shot. Armaments for the service of ordnance. Methods of igniting the charges of powder; tubes formerly in use, friction tubes. Percussion system; Swedish tube. Ignition of the charge of hollow projectiles, fuses of hollow projectiles, fuse with several pipes for the fire of spherical case, hand grenade fuse. Rapidity of fire. Laying of ordnance. Principal methods of laying guns; laying them by the help of the line of sight. Determination of the elevation. Instruments in use to obtain elevations. Negative elevations, means of using them. Laying guns for fire parallel to the ground; for breaching fire at a short distance.

Forty-eighth Lecture.—(2.) Determinations of elevations by experiment; construction of practice tables. Laying guns when the axis of the trunnions is not horizontal. Laying guns with the help of the plumb-line and quadrant; plunging fire, rectification of the aim.

Fire of mortars, means for directing it in use; use of pickets, of the line, of the quadrant. Laying pieces in the case of a defective platform. Means of laying them for night-firing. Laying naval ordnance; use of the front sight. Initial velocities of projectiles with the different charges in use. Angles of sight, and point-blank ranges of ordnance. Ranges at different sights. Maximum ranges.

Forty-ninth Lecture.—(3.) Probabilities in the fire of ordnance; known laws, facts ascertained by experiment. Distribution of projectiles over an object aimed at of indefinite extent. Mean point of impact. Fire of canister; effects of the dispersion.

Fire of spherical case. Effects of the bursting of the projectile; dispersion of the balls and of the explosions. Fire of the stone mortar; use of mortars for the same purpose.

Fire of small arms: charges of powder adopted. Ball cartridge. Initial velocities of balls with the different arms. Angles of sight and point-blank ranges. Rules for fire according to distances, for muskets, carbines, and pistols. Fire of rifled arms; use of the tangent scale. Probability of the fire of small-arms; comparison of arms with smooth-bored and rifled barrels. Different means employed for the estimation of distances.

Fiftieth Lecture.—(4.) Effects of projectiles on the different substances fired at. Effects of concussion and penetration. Effects on earth. Theory of the penetration of a projectile into a resisting medium. Formula to express the penetration, based on the results of calculation and experiment. Effects of penetration into wood. Effects on metals, cast-iron, iron, lead. Effects on masonry and on rock. Application to a breaching fire delivered in a regular direction relatively to the revetment. Effects of the shock of projectiles upon living bodies. Effects of hollow projectiles bursting in different media; earth, wood. Method of bursting employed against troops.

Effects of spherical case. Incendiary effects. Effects of war rockets. Explosive rockets. Incendiary rockets. Effects of concussion.

FOURTH PART.

TRACE AND CONSTRUCTION OF BATTERIES.

Six Lectures, common to the Students of both Arms.

Fifty-first Lecture.—(1.) Definitions. Meaning attached to the word "battery." Different denominations given to batteries: first, according to the circumstances of the war in which they are employed; secondly, according to their mode of construction; thirdly, according to the kind of ordnance with which they are armed; fourthly, according to the kind of fire for which they are intended; fifthly, according to the direction of their fire.

Principles of construction. General considerations on the elements which constitute the different kinds of batteries which have reference to them. Epaulment; its length, height, and thickness in different cases. Section of the epaulment. Ground-plan of the epaulment of the different kinds of batteries; returns at its extremities. Case where the battery is in advance of a parallel. Epaulment with redans; its trace.

Embrasures opened in the epaulment; their construction in different cases; slope of the bottom; interior opening; exterior opening; form of the cheeks.

Genouillère; fixing of its height for the different kinds of fire. Limit of the obliquity of the embrasures.

Fifty-second Lecture.—(2.) *Terre-Plein;* its position relatively to the ground; its length for the different kinds of batteries. Disposition of the part unoccupied by the platforms. Terre-plein of garrison, field, coast, and barbette batteries.

Ditch; cases in which it is employed. Its position with reference to the epaulment. Depth, breadth, section, and plan of the ditch.

Communications between the battery and the works in its neighborhood; parallels or trenches; plan and construction. Communication between the battery and its ditch.

Powder magazines: their object. Discussion respecting their site and capacity with a view to the different kinds of batteries, viz., siege, garrison, and field batteries.

Traverses of *crownwork* and garrison batteries. Width between them and dimensions.

Fifty-third Lecture.—(3.) Details of construction. Different materials employed in the construction of batteries. First, materials for revetments, fascines, gabions, hurdles, sods, bags of earth, withy-bands, stakes, &c. Secondly, materials for platforms; hurtoir, sleepers, planks, beams, pickets. Construction of revetments of different kinds employed in batteries. First, revetment of the interior slope of a battery upon the natural ground. Secondly, revetment in use when the terre-plein is more or less sunken. Ordinary siege battery, battery in a parallel, battery in a crownwork. Third, revetment of the cheeks of embrasures in the different cases met with in practice; direct batteries with point-blank range; ricochet, breaching, garrison, and field batteries.

Fifty-fourth Lecture.—(4.) Construction of platforms. Ordinary siege platforms, movable platforms (*à la Prussienne,*) garrison and coast platforms, ordinary mortar platforms, platforms for coast mortars of great range. Peculiar case where the fire has to be elevated or greatly depressed. Construction of the communications from the battery to the parallel and to its fosse. Construction of powder magazines in batteries. Magazines of siege batteries, Nos. 1, 2, 3, 4. Case of breaching batteries; garrison battery and field battery. Magazines. Degree of resistance offered by blinded magazines. Modifications adopted for the strengthening of magazines whose construction is already fixed.

Fifty-fifth Lecture.—(5.) Number of workmen to be employed on the construction of the different parts of batteries: revetments, platforms, communications, powder magazines. Earthworks.

Duration of the total labor necessary for the construction of each kind of battery. Duration of the duty for the different parts of the *personnel* employed upon the construction; officers, gunners, assistants. Definitive number of workmen necessary for the construction of the different kinds of batteries. Tools of different kinds.

Simultaneous execution. Preliminary operations. Reconnaissance. Prolongations. Sketch of the plan of a battery. Formation of the working party. Transport of materials. Plan of the battery. First, battery having its terre-plein on the level of the ground. Disposition of the working party. Work of the first night, of the following day, of the second night. Second, a battery sunk outside a parallel. Third, battery in a parallel or trench of some kind already established. Day labor, night labor.

(4.) Particular case of crownwork batteries.

Fifty-sixth Lecture.—(6.) Exceptional constructions. Blinded batteries for cannon or howitzers; for mortars. Batteries of earth-bags. Batteries on stony ground, on the rock, or marshy soil. Floating batteries. Construction on sites deficient in space. Case where the fire of the place is too dangerous. Coast batteries. General arrangement.

Instruction preparatory to working at the plans of batteries. (Course.)

FIFTH PART.

UNIFORM ORGANIZATION AND SERVICE OF THE ARTILLERY.

Ten Lectures common to Students of both Arms.

FIRST SECTION.—UNIFORM ORGANIZATION OF THE ARTILLERY.

Fifty-seventh Lecture.—(1.) Historical résumé. Progress of modern artillery, from its origin down to our time. Artillery of Charles VII. and of Louis XI. Progress under Francis I. Effects of the wars of religion. Edict of Blois, 1572. Improvements by Sully. Creation by Gustavus Adolphus. State of the artillery under Louis XIV. Employment of artillery on the field of battle at the commencement of the 18th century. Regulation of 1732. Introduction of howitzers into the French artillery. Regimental pieces. Progress of the artillery in Prussia and in Austria in the Seven Years' War. Reorganization of the French artillery in 1765. Résumé of the improvements owing to Gribeauval. System of the year XI. Present system.

Historical ideas on the personnel of the artillery. State of the personnel at the commencement of the use of fire-arms. Masters and grand-masters of the artillery, &c. Personnel employed originally on the service, and the guard of ordnance. Creation by Louis XIV. Account of the successive modifications in the personnel from this epoch down to 1765. Organization of 1765. Horse artillery. Pontoneers. Artillery train. Artillery of the Imperial Guard. Organization of 1829. Present state of the personnel. Regiments of artillery. Composition of the personnel of the different kinds of batteries. Companies of pontoneers, workmen, armorers, veteran gunners. Driver-corps ("*train de parc.*") Naval artillery.

Fifty-eighth Lecture.—(2.) Committee and central depôt of artillery. Organization of artillery commands Establishments for the instruction of the personnel; artillery schools. Creation in 1679. Present schools; personnel attached to them. Central school of military pyrotechnics. Establishments for the preservation of the material. Importance of the material of artillery. Its state in France at different epochs. Artillery directions. Division of the territory of France. Personnel of the directions.

Establishments for the manufacture of the material. Ideas on the subject of their management. Arsenals; their object, management, number, personnel. Forges; their object, management, districts, personnel, inspection. Foundries for land artillery; their number, management, personnel, inspection. Naval foundries. Manufactures of arms; their special management, number, personnel, inspection. Branch of the service connected with gunpowder and saltpetre. Powder manufactories and refineries; management, personnel. Direction of the service. Establishments existing in France. Percussion cap manufactory.

SECOND SECTION.—SERVICE OF THE ARTILLERY IN THE FIELD. ORGANIZATION OF THE FIELD ARTILLERY TRAIN, ETC.

Selection of ordnance, conditions which determine it; cannon, howitzers, relation between them. Proportion of the number of pieces of ordnance to that of the combatants. Mean proportion received in France; circumstances

which may lead to a modification of it. Organization of ordnance in batteries. Account of the arrangements formerly adopted. Present system. Distribution of the batteries in the army. Principles received. Application of these principles to the artillery train of an army of a given strength. Infantry divisional batteries; cavalry divisional batteries; reserve batteries. Case of the formation of army corps. Composition and supply of batteries. Principles and details of the supply of batteries with ammunition for the guns and for the troops. Second supply distributed amongst the parks.

Fifty-ninth Lecture.—(3.) Field parks. Their composition, in carriages of all kinds. Application of the principles to the artillery train of an army of a given strength. Approximate relation of the number of the carriages and of the horses of the train to that of the pieces of ordnance. Means of renewing the supply of the parks.

Personnel of the field train. Personnel of the batteries; working companies. Companies forming part of the train. Personnel attached to the parks. Staff. Particular conditions, having reference to war in a mountainous country. Selection of pieces of ordnance. Proportion between their number and that of the combatants. Composition of some artillery trains employed in our African expeditions. Composition and supply of the mountain battery. Lading of the mules. Composition of pontoon trains. Reserve train, boats, wherries, tackle, carriages, and horses. Personnel of the train. Light train: material, personnel.

Sixtieth Lecture.—(4.) Marches of the artillery. Reception of a battery or of a park. Precautions to be taken before the departure. March at a distance from the enemy. Order of march. Distribution of the personnel; halts. Case of an accident to a carriage; ascents; descents; deep-bedded roads; passage through inhabited places; passage of bridges; of fords. Passage over ice. Night march. Transport of mountain artillery. March of pontoon trains. Transport of the trains by water; navigation by convoys; by isolated boats. Transport of ordnance, powder and projectiles in the boats. Transport of artillery trains by sea.

March in the vicinity of the enemy. Isolated convoys; rule with reference to their command; order of march; general measures of security; precautions to be taken during halts; manner of receiving an attack. Case where resistance becomes impossible; arrangements for the night.

Artillery in the march with other troops. Order of march. Relation of the different corps to each other. Exceptional difficulties which may occur on marches; privations of all kinds; bad weather; bad state of the roads; instances. March among high mountains; passes strongly occupied by the enemy; examples.

Encampments and bivouacs. Choice of ground convenient for a camp; disposition of the artillery camp. Establishment of artillery bivouacs. Disposition of the park; precautions relating to the superintendence. Different measures to be taken on arriving on the place of encampment or of bivouac. Attention to be paid to the horses: special precautions for the mules of the mountain artillery. Precautionary measures variable according to circumstances.

Sixty-first Lecture.—(5.) Artillery on the field of battle. Measures to be taken on arriving in the neighborhood of the enemy.

Choice of positions adapted for artillery.

1. Different considerations relative to the ground to be occupied; form of the ground; cultivated lands; nature of the ground; communications, &c.
2. Position of the artillery relatively to the enemy.
3. Position of the artillery relatively to the troops to be supported.

Execution of the fire. Choice of the different kinds of fire according to the nature of the object aimed at and the distance. Fire of cannon, with ball, with shot. Fire of field and mountain howitzers. Fire parallel to the ground.

Use of war rockets. General principles relating to the effects to be produced by artillery, and to the warmth of the fire. Proper use of stores; their replacement. Use of the prolong. Arrangements to be made after the engagement. Spiking and unspiking of ordnance.

Use of artillery in the principal circumstances of a campaign. General case of an offensive engagement. Part played by the artillery in supporting infantry and cavalry marching to the attack. Importance of the artillery for following up a first advantage which has been obtained. Examples. Use of the artillery in masses to strike a decisive blow. Examples. Defensive engagement.

Disposition and use of the artillery for the defense of fortified positions. Attack of entrenchments. Reconnaissance. Disposition and use of artillery; attack of lunettes by the gorge. Examples. Attack and defense of villages; disposition of the artillery under these two circumstances. Attack of squares. Importance of artillery towards preparing for it. Examples. Defense of squares; disposition of artillery. Examples. Case of a charge of cavalry upon artillery. Use of artillery in the advanced guard, in the rearguard, in a retreat.

Use of artillery in the passage of streams. Examples. Use of artillery to defend or force the passage of valleys or defiles. Examples.

THIRD SECTION.—SERVICE OF ARTILLERY IN THE ATTACK AND DEFENSE OF PLACES, AND IN THE DEFENSE OF COASTS.

Sixty-second Lecture.—(6.) Object to be attained with the use of artillery in the attack of places. Selection of ordnance, cannon, howitzers, mortars. Composition of the siege train. Method to be followed in order to determine it. Examples of trains employed in different sieges. Carriages of the train. Supply of the siege train with projectiles, powder, &c.

Personnel of the siege train; troops and staff. Transport of the siege train. Horses to be employed. Limit in either direction. Employment of watercourses. Examples. Establishment of the train before the place. Encampment of the artillery force. Organization of the parks. Workshops, powder magazines, trench-depôts. Rules relating to the direction of artillery works. Commanding officers of attack.

Sixty-third Lecture.—(7.) Considerations on the different kinds of batteries to be employed in the attack of fortified places. Position of the batteries relatively to the point to be breached. Direct battery within point-blank range; enfilading battery, for a plunging fire, for direct fire within point-blank range, for plunging fire. Mortar batteries. Composition of the different kinds of batteries. Position of the directing lines of an enfilading battery, relative positions of the cannon, the howitzers, or the mortars. Position of the batteries rela-

tively to the parallels and the rest of the trenches. Examination of the circumstances which affect the power of a plunging fire, command of the work over the battery; distance between the height of the traverses. Slope of the crests of the work.

General principles relating to the order of the works of the artillery, commencing from the opening of the trenches.

Times for the construction of the first batteries. Batteries of the first and second parallels. Use of field artillery to defend the flank of the attacks. Replacement of the fire covered by the advance of the works; batteries of the third parallel. Use of vertical fire. Mortars of 15c. Throwing of grenades. Breaching and counter batteries. Considerations relating to their position. Batteries in the covered way.

Case of a breach into an interior work. Composition of the breaching and counter batteries. Calibres to be used. Number of pieces of ordnance.

Ideas upon the operation of arming batteries. Precautions to be taken. Passage out of the parallels or trenches. March in the trenches; examples of some operations of this kind. Supply of the different kinds of batteries. Rule relating to their daily service. Firing of siege batteries. Opening of the fire. Direct fire within point-blank range. Plunging fire. Fire of mortars. Warmth of the fire by day and by night; mean consumption of material. Fire of breaching batteries. Effects to be produced. Height of the horizontal cutting, number of the vertical ones. Execution of the fire; fall of the revetment. Fire upon the counter forts. Fire to render the breach practicable; balls, shells, war-rockets, facts ascertained by experiment.

Consumption of powder and projectiles, length of the operation. Breaching fire in a very oblique direction. Fire upon masked masonry. Breach into an unreveted work. Fire of counter-batteries. Bombardment. Case where it can be employed; manner of executing it.

Occupation of the place; arrangements which must be made by the artillery. Case of raising the siege. Case of its transformation into a blockade.

Sixty-fourth Lecture.—(8.) Service of artillery in the defense of places. Object to be attained with artillery. Selection of ordnance, guns, howitzers, mortars. Use of war-rockets and arms of precise aim. Field artillery. Basis of the supply of fortified places. Projectiles, powder, small-arms, various carriages. *Personnel* of the artillery. Troops. Staff.

Measures to be taken before the siege. Reconnaissances. Arrangement of the material. Organization of the *personnel*, of the duty by local divisions, of the workshops of all sorts. Precautionary armament. Basis of its organization. Supply of ordnance. Defensive armament. General principles relating to the armament of different kinds of works. Bastions, cavaliers, demilunes, approaches, &c. Organization of the armament. Traverses, embrasures, gun-carriages to be employed. Powder magazines. Supplies. Service of pieces.

Employment of the artillery against the first works of the besiegers, against the construction and armament of batteries; against the besieging artillery. Partial disarmament in case of inferiority. Part played by artillery in sorties. Modification of the defensive armament in proportion to the progress of the attack. Last defensive armament. Principles relating to its disposition. Armament of the flanking part of the fortification. Increased use of vertical fire. Use of war-rockets against works in close proximity. Crowning batteries,

cavaliers of the trenches. Heads of saps, &c. Blinded batteries. Conditions of the establishment. Defense of breaches.

Service of artillery in the defense of coasts. General considerations on the degree of extension admissible in the armament of coasts. Principal points to be defended. Selection of ordnance intended for the armament of coast. Objects to be effected. Effects of balls (utility of large calibres;) of howitzer shells and of shells. Fire with red-hot balls. Material appropriated to the defense of coasts.

Position of coast batteries, conditions which determine it. Composition of coast batteries; their supply. Ideas upon the organization of the batteries and their small redoubts (*réduits.*) Use of the fleet and of field artillery. *Personnel* allotted to the service of artillery on the coasts.

FOURTH SECTION.—APPLICATION OF THE PRINCIPLES PREVIOUSLY SET FORTH TO THE ATTACK AND DEFENSE OF THE FORTRESS OF METZ, (SHAM SIEGE.)

Sixty-fifth Lecture.—(9.) Composition of the siege train necessary for the attack of Metz. Carriages of the train.

Supply of the train with projectiles, powder, &c. Personnel of the train, troops and staff. Transport of the siege train. Establishment of the train before the place; encampment of the artillery force. Organization of the parks. Work-shops, powder magazines and depôts.

Sixty-sixth Lecture.—(10.) Object, disposition, and armament of all the batteries from the first opening of the trenches to the capture of the place. Use of field artillery to flank the batteries, &c.

Service of artillery in the defense of the place. Supply of ordnance, projectiles, powder, small-arms, and different carriages.

Personnel of the artillery. Troops, staff. Organization of the personnel and of the duties by local divisions. Precautionary armament; supply of ordnance. Defensive armament. Armament of the different works. Service of the pieces. Last defensive armament.

Lectures Preparatory to the Labors of the Course.

1. Drawing and tracing of ordnance,	3	lessons.
2. Design for ordnance,	4	"
3. Application of the theories of the course,	1	"
4. Drawing of artillery material,	1	"
5. Tracing of batteries,	1	"

The sixth lecture of the fourth part of the course (the fifty-sixth) is partly devoted to the communication of the instructions necessary for the execution of the work of tracing plans of batteries.

Studies in connection with the Artillery Course.

The practical studies which are connected with the artillery course, are,—

1. Drawing of ordnance,	12	days.
2. The designs for ordnance,	24	"
3. The application of the theories of the artillery course,	6	"
4. The drawings of artillery material,	26	"
5. The tracing of batteries,	4	"
Total,	72	days.

The tracing of batteries is executed by the students of both arms, the other tasks by the artillery students alone.

I. DRAWING ORDNANCE (12 DAYS.)

The survey of ordnance consists in constructing accurate sketches of a gun, howitzer, and mortar, in measuring their dimensions, and in giving a description of each of the pieces drawn. It is on this occasion that the students are practiced in the management of instruments to insure precision, such as the *étoile mobile*, and the sliding compass, &c. One day is devoted to this work.

The tracing of ordnance consists in the execution of a drawing upon colombier paper, containing an exact and detailed representation of a gun, a howitzer, and a mortar, with their projectiles.

This work is performed with the help of the tables for the construction of ordnance. Eleven days are devoted to it.

Detailed Programme of the Drawing.

1. For each gun, howitzer, or mortar, a longitudinal section in the direction of the axis, and at right angles to the axis of the trunnions, and a plan parallel to the axis of the bore and of the trunnions.

Besides this, for those cannon and howitzers which have dolphins, a transverse section taken across the middle of the dolphins and the axis of the trunnions. For mortars, a transverse section made by a plane passing in front of the dolphins, the whole on a scale of one-fifth.

2. Detail of the button (comprising the cascable and breeching loop for naval ordnance) on a scale of two-fifths.

3. Detail of the tracing of a dolphin, on the scale of two-fifths.

4. Tracing of the bush of a gun, on a scale of two-fifths, and tracing of a priming-pan at the real size.

5. For garrison ordnance, in cast-iron, detail of the widening of the base ring on a scale of two-fifths.

6. Tracing of a cannon-ball, of a howitzer-shell, and of a shell, on a scale of one-fifth.

Tracing of the lugs of a shell, ring and lug at the real size.

All the parts of the drawing must be colored in uniform tints in conformity to the table of conventional colors; the annexation of the figures of measurement is not required.

This work is preceded by three or four lectures intended to make the students familiar with the tracings which they have to execute, and the solution of the problems in geometry and descriptive geometry, to which the representation on paper of pieces of ordnance and their projectiles give rise.

II. DESIGN FOR ORDNANCE (24 DAYS.)

The design for ordnance has for its object the complete determination of the nature of a projectile, and of a piece of ordnance in accordance with certain special conditions, inquiring into the laws of the motion of the projectile, and into its principal destructive effects, and the settlement of practice-tables for the

gun. The general case for treatment is that of a howitzer, which comprehends the gun and the mortar as particular cases.

The data usually adopted are,—

1. For the projectile, its weight and the quantity of powder which it is capable of containing.
2. For the piece, the initial velocity of its projectile. This operation comprises calculations, a drawing, and a memoir.

The drawing, on colombier paper, which must be figured in all its parts, contains,—

1. The tracing of the profile of the piece, as it is determined by calculation, so as to satisfy the different conditions of resistance, on a scale of one-fifth.
2. The complete tracing of the piece executed in conformity with the rules laid down for the tracing of ordnance on a scale of one-fifth.
3. Tracing of the projectile on a scale of one-fifth.
4. Tracing of the wooden bottom and of the fuse of the projectile, executed in the case of each of these objects in two figures—the one on a large scale (two-thirds, or even the size of nature,) representing the inquiry into their forms and dimensions, the other giving on a scale of one-fifth the results of this inquiry. To this is added, for the mountain howitzer, or any other howitzer for which it is admissible, a tracing of the mounted howitzer carriage.
5. The representation in drawing of the laws of the motion of the projectile, the trajectory, inclinations, remaining velocities, durations of the passage.

In addition, the scale of the elevations and that of the angles of fire, for an object of aim placed at different distances.

6. An inscription showing all the essential elements by which the projectile and the piece are distinguished.

The final tracings of the gun, the projectile, the bottom, and the fuse, must be colored in uniform tints conformably to the table of conventional colors.

As to the tracing of the profile founded upon the calculation, it should receive merely an edging of the color which represents the metal used.

PROGRAMME OF THE MEMORANDUM ON THE DESIGN FOR ORDNANCE.

INTRODUCTION.

Object of the work. Data of the Question.

A. PROJECTILE.

First Section.—Substance, Forms, and Dimensions.

1. Choice of the metal employed in the manufacture of this projectile.
2. Forms of the projectile.
3. Internal diameter.
4. External diameter.
5. Dimensions of the vent.
6. Diameters of the high and low gauges.

7. Densities of the projectile empty and filled with powder.
8. Weight of the cast-iron ball of the same calibre as the howitzer shell.

Second Section.—Minimum Bursting Charge.

9. Theoretical bursting charge for the hollow sphere.
10. Effect of the shock of the gases, and of their loss through the vent.
11. Résumé of the results arrived at in this chapter.

B. ORDNANCE.

First Section.—Metal, Calibre, and Length of Bore.

12. Choice of the metal of which the piece is to be formed.
13. Windage of the projectile and diameter of the bore.
14. Effect of the windage on the velocity of the projectile.
15. Length of the bore and charge of powder which satisfy the data of the programme.
16. Résumé of the results arrived at in this section.

Second Section.—Thickness of Metal necessary in order that the Piece may resist the Expansion of the Gases.

17. Explanation of the method employed to resolve the question of the thicknesses of metal.
18. First propulsion of the projectile, mean density of the gases after this propulsion.
19. Second propulsion of the projectile, mean density of the gases after this propulsion.
20. Third, fourth, &c., propulsions of the projectile, mean density of the gases after each of them.
21. Density and position of the strata (of gas) at the moment of the maximum of mean density.
22. Density of the last stratum for the positions which come after that of the maximum of mean density.
23. Tensions which result from the densities found.
24. Corresponding thicknesses of metal.
25. Résumé of the results obtained.

Third Section.—Profile of the Piece.

26. Inclosing curve, resulting from the calculations of the second section.
27. Modification rendered necessary by the form of the posterior part of the projectile.
28. Utility of the chamber and its dimensions.
29. Tracing of the chamber and of its junction with the bore.
30. Thickness of metal around the chamber.
31. Chase and reinforce.
32. Determination of the angle of sight.
33. Vent and base ring.
34. Minimum weight of the piece for the resistance of the carriage.

35. Approximate calculation of the weight given by the profile previously obtained. Modification of this profile, if there is any.

Fourth Section.—Trunnions, Breech, and Handles.

36. Dimensions of the trunnions and of the shoulders.
37. Tracing of the breech.
38. Base rings and other moldings.
39. Object and fixing of the preponderance of the breech.
40. Exact settlement of the position of the trunnions, definitive length of the reinforce.
41. Center of gravity of the piece; dimensions and position of the handles.
42. Means of executing the calculations indicated in the two preceding articles.
43. Table of the dimensions of the piece.

C. FIRE OF THE HOWITZER. EFFECTS OF THE PROJECTILE.

First Section.—Elements of the Charging of a Howitzer.

44. Tracing of the shot bottom.
45. Tracing of the fuse.
46. Diameter of the cartridge (or of the bag.)
47. Charge of powder for firing with ball.

Second Section.—Laws of the Motion of the Projectile. Establishment of Practice Tables.

48. Preliminary calculations.
49. Trajectory.
50. Curve of the inclinations.
51. Curve of the remaining velocities.
52. Curve of the durations of the passage.
53. Determination of the elevations for the fire at different distances.
54. Angle of fire, corresponding to the different distances of the object aimed at.
55. Angles of descent.
56. Résumé of the laws of the motion and of the practice tables.

Third Section.—Effects of the Projectile.

57. Depth of penetration in the media indicated by the programme.
58. Effects of explosion in earth.
59. Résumé of the results relating to the effects of the projectile.

NOTE.—The formulas cited in the memoir need not be accompanied by their demonstration, except in the case of the latter not having been already developed in the lessons of the artillery course. It will be sufficient to insert in this notice only the final result of the calculation relating to each formula, without entering into the details of such calculations.

The study of the design for ordnance is preceded by four lessons intended to make the students acquainted with all the details of its execution, and the substance of which is indicated in the programme of the memoir

III. APPLICATION OF THE THEORIES OF THE ARTILLERY COURSE (6 DAYS.)

This study is intended to apply to the students those theories of the course which have not found their application in the design for ordnance. It comprises the solution by arithmetical calculations of certain questions on the effects of powder, the balistic pendulum, the effects of recoil, the science of projectiles, the draught of carriages, &c. The number of the questions may vary according to their nature and the time which their solution requires. The stating of the questions and the results of the calculations are inscribed on separate papers. This study is preceded by a lesson in which the students have recalled to them the formulas which they have to employ.

IV. DRAWING OF ARTILLERY MATERIAL (26 DAYS.)

The drawing of artillery material has for its object the representation by figured sketches of a gun-carriage, carriage, or other furniture of artillery material. The sketches, on paper put together in the form of a book, and headed by a special programme for the object to be drawn, consist of plans, sections, or elevations of the object, executed on certain scales, and of detailed projections of the principal iron-work and joints. The whole fixed by the special programme in question.

All the simultaneous projections of any one part of the object drawn (fore part or hind part for carriages) must be completely figured; they are accompanied by explanatory inscriptions, with letters of reference to show the names of the pieces in wood or metal which they comprise.

Each collection of sketches must contain as well a notice in confirmation of the drawing, giving the complete description and the properties of the object to which it refers.

The students make two surveys of the same kind; eight days are allowed for each of these surveys, including the composition of the confirmatory notice.

The first survey is followed by the execution of an unfigured drawing, containing a complete representation of the object surveyed (elevation and plan,) obtained by the combination of the partial projections contained in the sketch. The drawing should be colored in the conventional uniform tints, and accompanied by an explanatory inscription, with letters of reference. Ten days are devoted to this work of composition.

V. TRACING OF BATTERIES (4 DAYS.)

This work consists in executing sketches showing, each in accordance with a separate programme, the complete plan of a battery and the essential data having reference to its construction and to its armament. The sketches, made by scale and completely figured, must comprise in the case of each battery to be represented—

1. The general plan of the battery, on the scale of $\frac{1}{200}$.
2. The sections or elevations necessary for the understanding of this plan, including the detail of the powder magazines, lines of communication, &c., on the scale of $\frac{1}{100}$.
3. An inscription giving the object of the battery, its armament, its general arrangement (*terre-plein*, embrasures, revetment, communications,

magazines, &c.,) the workmen, materials, and tools necessary for its construction, and finally the duration of the labor and its distribution by day and night.

Four days are devoted to this work, which must be executed on a half sheet of colombier paper. The separate programmes relating to each of these batteries are shown on the study orders of the rooms.

RECAPITULATIVE TABLE.—ARTILLERY STUDENTS.

Lectures.	Number of the Lectures.	Credits given for the Lectures.		Total Credits.	Number of the Questions.	Observations.
		With application at 1h 50m.	Without application at 3h.			
Division of the Course—						
First Part. Theory, Sections 1, 2, 3,.....	26	18	42	60	4	
Second Part. Description of the Material, Sections 1, 2, 3, 4, 5, 6,.....	20	30	....	30	3	
Third Part. Fire of Ordnance, ...	4	....	12	12	1	
Fourth Part. Construction of Batteries,.....	6	9	....	9	2	
Fifth Part. Organization and Service of the Artillery, Sections 1, 2, 3,.....	8	....	24	24	1	
Sham Siege,.....	2	3	....	3	....	
Lectures in preparation for the Studies,.....	9	13 50	....	13 50	....	
Totals,.....	75	73 50	78	151 50	10	

Studies.	Number of						Credits in round Numbers.	Observations.
	Sketches.	Drawings.	Memoirs.	Inventories.	In-door attendance, 1½ hours.	Out-door attendance, 1½ hours.		
Survey of Ordnance,.....	1	....	....	....	....	1	5	
Tracing of Ordnance,.....	....	1	....	....	11	....	50	
Design for Ordnance—								
Calculations, ...	....	....	....	1	10	....	45	
Drawing, ...	....	1	....	....	8	....	35	
Memoir,.....	....	....	1	....	6	....	55*	* The time is doubled for the Memoirs.
Application of Theories—								
(Artillery Question.).....	....	....	1	....	6	....	55†	† Ditto.
First Survey of Material—								
Sketch, ...	1	....	....	....	....	8	35	
Composition of Notice,...	....	1	....	....	10	....	45	
Second Survey—								
Sketch,.....	1	....	....	....	....	8	35	
Sketch of Batteries,.....	1	....	....	....	4	....	20	
Totals,.....	4	3	2	1	55	17	....	

RECAPITULATION.

Lectures,..... 150
Studies,.. ..... 380 } 530.

RECAPITULATIVE TABLE.—ENGINEER STUDENTS.

Lectures.	Number of the Lectures.	Credits for the Lectures. With application at 1h 50m.	Credits for the Lectures. Without application at 3h.	Total Credits.	Number of the Questions.	Observations.
Division of the Course—						
First Part. Theories, Sections 1, 2, 3,.....	24	....	72	72	4	
Second Part. Description of the Material, Sections 1, 2, 3, 4, 5, 6,.....	14	....	42	42	2	
Third Part. Fire of Ordnance, ...	4	....	12	12	1	
Fourth Part. Construction of Batteries,.....	6	9	....	9	1	
Fifth Part. Organization and Service of the Artillery, Sections 1, 2, 3,.....	8	....	24	24	1	
Mock Siege,.....	2	3	....	3	....	
Totals,.....	58	12	150	162	9	

Studies.	Number of Sketches.	Number of In-door Attendance.	Credit.	Observations.
Sketches of Batteries,.....	1	4	20	

RECAPITULATION.

Lectures,..... 162
Studies,..... 20 } 182. Round number, 180.

IV. PROGRAMME OF THE COURSE OF MILITARY ART AND FIELD FORTIFICATION.

The course is divided into six parts, and is made up of lectures and works of Application in the Halls of Study and on the ground.

I. LECTURES.

The 1st part contains sundry historical notices on the Organization of Armies,..... 6 Lectures.
2d part is on Tactics, ... 3 "
3d " Castrametation,..... 2 "
4th " Field Fortification,..... 16 "
5th " Military Communication,..... 10 "
6th " Strategy, ... 6 "

Total,..... 43

FIRST PART.—HISTORICAL NOTICES ON THE ORGANIZATION OF ARMIES.

The first lecture commences with explanations relating to the Greek and Roman armies; their order of battle, mode of marching; comparison of the

Roman Legion with the Greek Phalanx, and of the Roman Legion under Marius and under the Emperors.

2. Military organization of the Franks under the Kings of the first race. Consequences of the feudal system, acting on the military organization. Feudal armies. Chivalry. Crusades, and war against England. Establishment of the first standing armies. Results dependent on the introduction of fire-arms. Progress made in the Art of War and in the organization of armies, from the sixteenth century to the present time.

3. Necessity for standing armies. Their proper character. Recruiting. Promotion. Degrees of rank. Station of the officers. Various positions of military men. On the composition of armies, Infantry, Cavalry, Artillery, Engineers. *Corps d'Etat-Major.* Composition of the army during the Revolution and during the Empire. Actual formation of a French army.

General Staff. Commissariat. (*Intendance.*)—Different services dependent on it.

Relations between the strength of each of the arms that make up an army. On other corps which are not classed among the principal arms.

4, 5, 6. Summary relating to the military organization of the principal Powers of Europe.

SECOND PART—ON TACTICS.

1. Definitions. Formations. Manœuvers; character of a good manœuver. Order of battle: first, of the Infantry; second, of Cavalry; third, of the Artillery; relating to Sharpshooters (*tirailleurs.*)

2. Brief summary of the principal movements in battalion drill to pass from line to the order in columns and reciprocally. Movements in column. Movements in battle. Dispositions to be made against Cavalry.

3. Of the principal movements in line. Order of battle. Line of battle. Formation of Infantry to advance against the enemy. Action of Cavalry. Principal formations. Charges of Artillery. Use of the Three Arms.

THIRD PART.—CASTRAMETATION.

1. General principles of castrametation. Situation. Construction and disposition of barracks. Camp of a Regiment of Infantry, of Cavalry, and of a Battery of Artillery.

2. Manner of tracing a camp on the ground. Huts; details relating to their construction. Tents. Bivouacs. Screens. Kitchens and camp ovens. Choice of the site of a camp; precautions to be taken for its security. Main guards. Advanced posts. Patrols and sentinels.

FOURTH PART.—FIELD FORTIFICATION.

1. Definition of fortification in general. Object and character of field fortification; its utility demonstrated by historical examples. Napoleon's opinion. Essential principle of field fortification. Discussion on the ordinary profile of earthen entrenchments; on the dimensions to be given to the ditch in level ground.

2. Definitions relating to the trace; general principles. Redoubts.

3. On the elements of lines. Relation that should exist between the crest and the internal size of a closed work. Maximum and minimum of the sides of a square redoubt. Defects inherent to the trace of this kind of redoubt. Circular redoubts. Redoubts *en crémaillères.* Star forts. Lines with bastions.

4. Revetments of various kinds; case in which the slope of the ditch should be reveted; choice to be made of the different kinds of revetments.

5. Exterior dispositions; accessories to the defense; abattis; *trous de loups*; palisades; *chevaux de frise*, &c. Precautions to be adopted with reference to such accessories.

6. Interior dispositions; armament of musketry, artillery, barbettes, and embrasures; their advantages and disadvantages; construction of.

7. Powder magazines of different kinds. Small earthen entrenchments; palisades, carpentry, or blockhouses; advantages and disadvantages of blockhouses. African blockhouse. Closing of field-works.

8. Artificial inundations; under what circumstances they can be considered as obstacles. Positions and dimensions of dikes. Details of their execution; what advantage can be drawn from an inundation having less than five feet depth of water.

9. What is understood by the defilading of a work. The defilading of field-works should, above all things, be made to depend on their trace and situation. Definitions: dangerous ground; dangerous points. Defilement of an isolated and closed work; in what case it is practicable. Use of traverses. A partial defilement may sometimes be sufficient.

10. Continuous lines. Broken lines. Traces of redan, tenailles, cremailleres. Bastioned lines. Comparison between continuous and broken lines. Principal objections to their use. Utility of each demonstrated under certain circumstances.

11. Lines in broken ground: their form should depend on the nature of the ground. On the manner of fortifying a table-land. Expedients for defilading portions of lines. On the manner of making use of the natural obstacles of the ground; forests, scarps, marshes, water-courses, &c. Method of fortifying a house, village, an open town. Defense of a bridge or road.

12. *Têtes de pont.* Utility of small earthen entrenchments in these cases to facilitate the passage of a retreating army. Traces of a large *tête de pont.* Principal circumstances relating to the use of lines in war. Lines of circumvallation and countervallation. Frontier lines. Retrenchments against a descent. Lines that an army should make in an enemy's country, far from its base of operations. Entrenchment on the field of battle. Lines, mixed, proposed by General Rogniat.

13. Attack and defense of entrenchments, of a continuous line; of a line at intervals; of an isolated work, &c. Examples of the attack and defense of lines.

14. Instruction relating to the operations for profiling and defilading on the ground.

15. Instruction on the project of field fortification. Calculation of the dimensions of a ditch corresponding to the face of a work of a variable relief, and to be constructed in level or other ground. Details relating to traverses, small entrenchments; defensive caponnieres, and accessories to defense, &c.

16. On the construction of entrenchments. Practical operations and organization of workshops to obtain durable and solid work. Necessity, in most cases, for accelerating the construction of entrenchments. Vauban's precepts. In what manner the work must proceed to obtain a useful result; and, in the event of plenty of hands, how to finish it promptly.

FIFTH PART.—ON MILITARY COMMUNICATIONS.

1. On roads. 1 and 2, Classification of roads. Section and trace of roads in level and mountain country. Details connected with the study of a project for a road. Particular conditions relating to military roads. Execution of paved and macadamized roads. Roads for passing difficult places by the use of fascines, logs, &c. Maintenance and destruction of roads.

2. On military bridges.

3. Observations on the currents and change of form in the bed of rivers. Fords. Transverse sections, &c. Reconnaissances of rivers. Properties essential to military bridges. Relation between the buoyancy and the load in the case of floating supports. Anchorage. Construction of the abutments. Means of rendering bridges stable.

4. Construction of a bridge of boats in different ways. Bridges made of ordinary boats. Method of withdrawing a bridge of boats.

5. Raft bridge. Relation between the weight and the extrinsic load of a raft. Number of trunks of trees required for a raft bridge on a river of given dimensions. Weight of the trunk of a tree. Number and space between rafts. Construction of a raft and a bridge of rafts. Bridges of casks and trestles.

6. Rope bridges; their use. Calculations respecting the tension and diameters of ropes. Construction of a suspension bridge, and calculations relating to it.

7. Bridges on piles, carriages, gabions, &c.

8. Measures to be taken for the preservation of military bridges. Destruction of military bridges; also of masonry bridges. Reëstablishment of bridges.

9. Flying bridges. Ferry-boats, tubs, passage by fords, on the ice, by swimming.

10. Execution of the passage of rivers. Advancing and in retreating. Examples.

SIXTH PART.—STRATEGY.

1. Definition. Fundamental principles of all operations in war. In all cases there are—first, the base of operations; second, the point to be arrived at; third, the line of operations. Strategetical points and lines.

2. On marching. Preparatory and manœuvering marches. Advanced and rear guard. On provisions. System of magazines. Requisitions. Invasions. Battle. Examples.

3. On positions. War in a mountainous district. Retreats. Pursuit. Convoys. Partizans.

4. Winter quarters. Cantonments. War against irregular bands. Military reconnaissances.

5. Precis of the campaigns of the French armies.

6. Analysis of the principal campaigns of great captains.

II. PROGRAMME OF THE WORKS OF APPLICATION EXECUTED IN THE HALLS OF STUDY.

These works consist of four Plates of Drawings, two Memoirs, and a Project of Field Fortification. Of the four Plates of Drawings, two relate to Field Fortification, and two, accompanied by Memoirs, relate to Military Communications.

Plate 1.—Elements of lines. Tracing, on the scale of $\frac{1}{1000}$ of the interior crest (only) of a redan, lunette, redoubt, star fort, bastioned fort, according to particular data given to each Sous-Lieutenant. Construction on the scale of $\frac{1}{200}$ of a complete profile for each of these works, supposed to be established on level ground. Complete calculation of the deblais and remblais for one of the preceding works, according to the instructions of the Professor.

Plate 2.—Details of a field-work. Trace on the scale of $\frac{1}{200}$ of a portion of the work of which the deblais and remblais has been calculated. Graphic construction of a barbette and of a direct or oblique embrasure. Details of revetments in fascines, hurdles, turf. Pisé. Drawing of a blockhouse.

Plate 3.—Accompanied by a Memoir. Project of a portion of road on ground represented by certain lines, according to certain data.

Plate 4.—Accompanied by a Memoir. Military bridges.

1. Drawing of a portion of a bridge of boats, three openings being shown; the two first relating to the successive construction of the bridge, and the third, of the construction by portions.
2. Project for establishing a raft bridge; the width of the river; the kind of troops to pass over the bridge; the length; mean diameter of the available trunks of trees and the length and scantling of the joints being given. The drawing to exhibit a plan of two openings of the bridge, and a transverse section.
3. Tressel bridge. To draw a longitudinal elevation and a transverse section of a tressel bridge, being given the length of the top and of the feet of the tressels up and down the stream.
4. Project for the repair of a broken arch; being given the opening of the head, the elevation of the roadway of the bridge above the level of the water; the depth of the water, the rapidity of the current, the kind of troops to pass over the bridge, and the available time and the resources as regards men and materials which can be had recourse to.

Programme of the Project of Field Fortification.

This project is made by the Sub-Lieutenants, according to certain data given to each of them. It has for its object to cause them to study:—1st. The trace. 2d. The complete organization necessary for its defense. 3d. The details of construction of a field-work. In consequence, the work comprises three Plates of Drawings and a Memoir divided into three parts.

Programme of the Drawings.

Plate 1.—Plan of the whole. This plate has for its object the research of a trace and of a combination of suitable works for the fortification of a certain portion of ground under certain circumstances of war defined by particular data. Each Sub-Lieutenant receives a lithographed sheet representing the ground to be fortified, and he has to exhibit on this sheet the works he proposes, in tracing in plain lines the horizontal projections of the interior crests and superior limits of the ditch, and in dotted lines the stockades or palisades; to show in black figures at the angles of the works the relief of the interior crests; the sites of barbettes, embrasures, traverses, barriers, &c., being indicated by reference letters and explanatory notes, the lines in red showing the directions and objects of the line of fire.

Plate 2.—Organization of a work.

This plate has for its object the study of the details of the interior and exterior organization of a work of a certain form, in order to render it susceptible of making a good defense.

Each Sub-Lieutenant will draw a complete plan of such one of the works shown on Plate 1, as may be pointed out by the Professor. He will represent the ditches, parapets, embrasures, accessory defenses, small entrenchments, descents into the ditch, &c., according to the particular data furnished to him; the figures of the relief of the crests of all kinds, the deblais and remblais being marked at all the angles. The figures of the natural ground will be underlined. The same plate will contain figured profiles which have served for the determination of the complete projection of the work. Scale $\frac{1}{250}$.

Plate 3.—Details of construction.

The object of this plate is to show the composition of workshops and the manner that should be adopted in the construction of field-works, according to circumstances, for the execution of the deblais and remblais.

Each Sub-Lieutenant will indicate the manner in which the work drawn on Plate 2 should be constructed:—1st. To render it durable and solid. 2d. To arrive rapidly at a useful result, even with limited resources of workmen and tools. 3d. To finish the work in the shortest possible time, by making use of all the necessary means. A plan will show the composition of the workshops under each of these hypotheses, and the successive advancement of the work will be represented by certain profiles supposed to be made at certain periods of the construction through the center of one of the faces of the work. In these profiles a firm trace, figured with altitudes, will show the limits of the deblais and remblais at the period represented by the profiles; and in addition, by dotted lines, the final results proposed to be obtained. All these projects must be accompanied by a figured plan, showing the principal altitudes in meters. The remblais will be colored with gamboge, the undisturbed earth in bistre, and the deblais will be left white.

Programme of the Memoir.

Each Sub-Lieutenant will write at the head of his Memoir the text of the particular programme, to which he is obliged to conform in the preparation of his project, and he should add to the text of the Memoir all the sketches properly figured, which are necessary for the proper appreciation of the dispositions which are not sufficiently detailed on the Drawings.

The Memoir is divided into three parts, corresponding to the three Plates of Drawings.

FIRST PART.—CONSIDERATIONS RESPECTING THE WHOLE PROJECT.

1st. General principles, according to which it would be proper to trace the works indicated in the particular programme, such as lines at intervals, continuous lines, têtes de pont, &c.

2d. Description of the tracing in Plate 1. Reasons deduced from the form of the ground or the nature of the military operations that led to the adoption of the trace. Object of the works, and their connection with each other.

3d. Number, description, and position of the pieces of artillery composing the armament.

4th. Maximum and minimum of troops that could be employed in the defense of these works.

5th. Dispositions which should be adopted (relatively to the necessary preparations in materials and to the separation and movement of troops) for the attack and for the defense.

SECOND PART.—COMPLETE ORGANIZATION OF A WORK.

1st. Particular object of the work shown in Plate 2. Trace of the complete projections of the parapets, barbettes, ramps, embrasures, traverses, &c.

2d. Conditions that should be fulfilled by the ditch. Approximate calculation of dimensions which should be given to it, taking into account the increased means of providing for an excess or defect of the deblais.

3d. Discussion on the site and the part which might be expected from small entrenchments, accessory defenses, shutters, descents of ditches, &c.

4th. Site of powder magazines; capacity that should be given to them, suitable to the state of the munitions necessary for the armament of the work.

THIRD PART.—DETAILS OF CONSTRUCTIONS.

1st. Means of ascertaining the nature of the earth; considerations respecting relays for the transport of earth with the shovel.

2d. Description, number and disposition of the workmen in a shed for deblai and remblai, according to the nature of the ground and number of relays.

3d. Explanation of Plate 3. Organization of the sheds and conduct of the work where the duration and solidity of the work are the greatest essentials; where, on the other hand, rapidity of execution is the principal thing to be fulfilled.

4th. Which of the modes of construction exhibited in Plate 3 it would be desirable to employ for the proposed works, according to the circumstance specified in the particular programme. Calculation for this mode of construction, of the time and of the numbers of men and tools necessary for the execution of the deblais and remblais of the work given in the plate.

5th. Details of construction of the revetments, magazines, shutters, accessory defenses, artillery platforms, &c.

III. PROGRAMME OF EXTERIOR WORKS.

These works consist of an exercise in tracing out a camp, and an exercise on the profiling and defilement of field-works.

The exercise on tracing camps has no particular programme, but is preceded by a lecture given by the Professor.

Programme of Practical Exercises on the Defilement and Profiling of Field Works.

This exercise comprehends: 1st, work on the ground; 2d, a Memoir.

The work on the ground has for its object: 1st, the trace of the projections of the interior crest of a work, whose position and form are known; 2d, the determination of the relief of the interior crest; 3d, the profiling of the different parts, so that the relief of the different parts of the parapet, barbettes, traverses, &c., may all be fixed.

The Sub-Lieutenants for this kind of work are divided into groups of six or eight, employed together on the same work, each group being divided into two squads. The work may be a lunette or a redan of given dimensions, having a

parapet of three meters thick, and a natural slope of one to one. 1st. The direction of the capital will be marked out in front by two numbered pickets. 2d. The tracing will be executed by means of poles or pickets placed at all the angles, and at the extremities of the gorge; the relief will be determined by the practical methods of defilement adverted to in the lecture which preceded the work.

3d. The relief obtained by the defilement will be marked on all the poles or pickets placed at the angles, and at the extremities of the sides of the work.

4th. On each face two vertical profiles will be executed, perpendicular to the horizontal projections of its interior crest. In order that these profiles shall not interfere with those placed at the angles, they must be established at several meters distant from the extremity of each face.

5th. The profiles of the angles will be deducted by simple prolongations, and the same for the profiles of the gorge. If the homologous crests of two contiguous faces do not meet each other, they should be reconciled by joining two points taken on each of them at half a meter from the intersection of their projections.

6th. On the traverse, designed to secure the defenders from a reverse fire, two profiles are constructed, near to its extremities if its crest is a right line, but if it is bent, another profile must be set up at the junction.

7th. The data of all these profiles are, the relief of the interior crest at the point where it is encountered by the profile, the thickness of the parapet, the constant parts of every profile, and the natural slope of the ground; the portion of the slope of the traverses exposed to the view of the dominant heights should not be reveted, the others should be.

8th. At the points of intersection of the profiles with the projections of the ridges of the works, as well as at the points used for adjusting, poles or pickets are placed, on which the points belonging to the ridges are marked. These points will be joined together in each profile by twine, indicating the different planes of the work.

9th. The form and dimensions of the batteries, either of barbettes or embrasures, will be equally determined by poles or pickets placed at all their angles, and united together by twine in the manner that will be subsequently explained.

10th. For the barbette batteries, the first thing to be done is to establish and to construct the front coupé of the salient of the interior crest, and substitute an interior horizontal crest throughout the extent of the barbette for that situated in the plane of defilement. The necessary adjustments are then made between the slope of the parapet of the barbette and that of the rest of the face, and indicate by means of twine the intersections of the terre-plein of the barbette and of its slope with the different planes of the work.

11th. For the embrasures, after having determined their direction, the intersections of the cheeks and bottom, with the interior and exterior slope of the parapet, and with its slope; also the slope which terminates the interruption of the banquette throughout the extent of the battery. In the case where the platform is formed more than 0^m 4 elevated above the soil, a ramp is constructed with its slope, and the intersections with the slope from the platform are shown.

12th. After the batteries, the slope of the ends of the traverses and of the passages for entry and exit are constructed.

13th. The traverse will be finished by adjusting its different planes with

those of the parapet. In the particular case, where it was interfered with to make a passage over the banquette, it is finished by reveting the slope passing by the crest of the banquette of the work.

14th. At the passages of entry and exit from the work, the parapets will be finished by the slope of the revetment, whose intersections with the different planes of the parapets must be determined.

15th. For each squad of workmen, the distance of the salient of the work to the point on which it will be defiladed must be determined.

MEMOIR.

1st. Object of defilement—which is considered to be dangerous ground, dangerous point, plane of defilement.

2d. Position of the dangerous point relatively to the work which is to be defiladed. Practical method on the ground. Results to which it leads.

3d. On the field this method is not always applicable to an isolated work, and never is so to entrenchments of a great development, such as lines, large têtes-de-pont, &c. By what proceeding is it generally expedient to attempt to fulfill in war the indisputable condition of defilement.

RECAPITULATION FOR THE SUB-LIEUTENANTS OF ARTILLERY AND ENGINEERS.

First Lectures.—Parts of the Course.	No. of Lectures.	Credits for Lectures.			No. of Interrogations.	Observations.
		With application.	Without application.	Total.		
1st Part. Historical notions on the Organization of Armies,	6	.....	18	18	1	The number 90 is applied to the interrogations and to the obligations of the notes.
2nd Part. Tactics,	3	.....	9	9		
3rd " Castrametation,	2	.....	6	6		
4th " Field Fortification,	16	24	.....	24	2	
5th " Military Communications,	10	15	.....	15	1	
6th " Strategy,	6	.....	18	18	1	
Totals,	43	39	51	90	5	

Execution of Work.	Number of				Credits.	Observations.
	Drawings.	Memoirs.	Attendances.			
			In the Halls.	Outside.		
Drawings of Military Art,—						
Plate 1. Elements of Lines,	1	.....	4	.....	20	
" 2. Details of a Field-work,	1	.....	8	.....	35	
" 3. Project of a Road,	1	.....	8	.....	35	
Memoir,	....	1	1	.....	10	
Plate 4. Military Bridges,	1	.....	8	.....	35	
Memoir,	....	1	2	.....	20	
Project of Field Fortification,—						
Plate 1. Plan of the whole,	1	.....	3	.....	15	
" 2. Organization of a work,	1	.....	8	.....	35	
" 3. Details of Construction,	1	.....	5	.....	20	
Memoir,	....	1	3	.....	30	
Tracing of Camps,	....	.....	.....	1	5	
Tracing on the ground,	....	.....	.....	2	10	
Memoir,	....	1	1	.....	10	
Totals,	7	4	51	3	280	

RECAPITULATION OF THE CREDITS OF INFLUENCE.

Lectures,	90
Execution of Work,	280
Totals,	370

4th. Methods of defilement employed. Determination of the different planes of barbettes, of their ramps, of the profiles of the gorge, &c. Construction of embrasures.

5th. Means made use of in practice for determining the distance of the salient of the work to the dangerous point on which it is defiladed.

V.—PROGRAMME OF PERMANENT FORTIFICATION, AND THE ATTACK AND DEFENSE OF PLACES.

The course of instruction in Permanent Fortification and the Attack and Defense of Places, is divided into three parts, viz:—

		No. of Lectures to	
		Artillery.	Engineers.
The first part consists of the study of the Construction of existing Fortifications, and it is common to the two services; it comprises,.....		10	10
The second part contains the principles of the Art of Fortification, divided into three sections, of which the....	1st section relates to Fortification on level ground,.....	19	19
	2nd section relates to Fortification on hilly ground,.....	19	26
	3rd section relates to general questions of Fortifications, ...	4	5
Third part relates to the Attack and Defense of Places,.....		24	24
Total number of Lectures,.....		76	84

The first part contains a description of the various works of permanent fortification, their respective uses, and the changes that have been successively made in them, together with a short history of ancient fortification prior to the invention of powder, and the changes introduced by the use of fire-arms.

The systems of Errard, Beville, Pagan, Vauban, Cochorn, and Cormontaigne.

The first section of the second part describes the principles on which the various parts of a front of fortification on level ground, and according to Cormontaigne's system, are regulated, such as the command, relief, defilement, form, length, and material of which the various parts should be constructed; the modifications required by the absence or presence of water; the changes which are necessary as regards exterior or advanced works, and ending with a comparison of a front of fortification according to Cormontaigne, with a modification of the same system introduced by the French engineers.

The second section commences with the principles of defilement and its application under various given circumstances, proceeds with the description of an imaginary work founded on certain given data, and furnishes the data of its proposed construction. It then supplies the theory relating to mines, and their use in the attack, defense, and destruction of places, and points out the particular duties of engineers in fortified places, and the proper and most efficient manner of carrying them on.

The third section relates to the preparation of projects for the improvement of inefficiently fortified places, and to the utility, particular organization, and proper position of fortified places on a frontier line. It then explains the necessity for military law in providing for the security of fortified places and districts along the frontiers of a state.

The third part describes the various operations connected with the attack and defense of a bastioned fortification, commencing with the operations preliminary to the siege and investment of the place, and continuing to describe the

several processes to be employed in the attack of the place, with the corresponding efforts that should be made during its defense, and ending with an historical account of certain sieges.

This course requires the practical completion of the following:

Nature of the Work.	Time allowed for its completion.	Subject of the Work.	Scale.	
		1st Part.—On existing Fortifications.		Observ'ns.
Single Plate,	20 days,	Complete projection of the front of Cormontaigne without counterguard or cavalier,	1/1000	
		Three profiles of the front,	1/500	
		2d Part.—Principles of the Art of Fortification.		
Plate, No. 1,	8 "	1st Section: Fortifications on level ground.—Principal graphical constructions of the front on level ground according to particular data given to each Student.	1/1000	Common to Students of both Services.
Plate, No. 2,	28 "	Complete projection of the whole of the visible and underground parts of the same front,	1/1000	
		Three profiles of the front,	1/500	
Memoir, ...	6 "	Description of the principles of the Fortification, with a detailed discussion of the dispositions adopted in the particular case treated by the Students.		
Plate 3, ...	20 "	2d Section: Fortification on hilly ground.—Drawing of the ideal fortress and of its Tête-du-pont, with the interior entrenchments, inundation, sluices, and all necessary details to enable a proper comprehension to be had of the action of the water.		
		Drawing complete of one of the fronts of the place and its outworks, described by a particular programme. Defilement of all the works of this front and of the masonry of one of its faces,	1/500	
Memoir, ...	3 "	On the situation of the fortification; description of the imaginary fortress, and of the management of the water; explanation of the operations of defilement drawn on Plate 3.		
Plate 4, (Artillerie.)	10 "	Plan and profile of a full revetment of the escarp with its counterforts,	1/200	Artillery.
		Plan, profiles, and elevation of a revetment "en décharge."	1/200	
		Detail of a gallery and small chamber of a mine, of its tamping and mode of firing,	1/50	
Plate 4, (Engineers.)	20 "	Detailed project of one of the parts of the front of fortification defiladed in Plate 3. Plans at different height; disposition of the galleries and small chambers of mines required for blowing up the whole of the ground between two listening galleries,	1/250	
Plate 5, ...	10 "	Sections and elevations of the preceding project. Foundations, coping of vaults, dressing of cut stones, &c.,	1/125	
		Detail of a small gallery and chamber of a mine, comprised in the dispositions of Plate 4. Tamping and mode of firing.		
Avant, ...	3 "	Abstractions of measurement of a part of the preceding project,	.....	Special to Engineer Students.
Plate 6,.....	11 "	Study of the alterations in the earth of the same part of the projects, representing the four principal periods of the work, by a plan and section, with an elevation of the 4th period,	1/250	
Memoir, ...	2 "	General theory of the removal of earth. Application to a particular project,	.....	
Register, ...	3 "	Register of the removal of earth as represented in Plate 6.		
Estimate, ...	1 "	Estimate of the part of the project to which the abstraction of measurements has been applied.		
		3d Section: Projection of the improvement of an existing fortified place.		
Plate 7,.....	30 "	Complete projection of the project for improving an existing fortified place,	1/1000	
Plate 8,.....	6 "	Details of the most interesting parts of the project, in plans, sections, and elevations,	1/250	
Memoir, ...	2 "	Marginal notes on the defects presented by the existing system, and on the means employed for correcting them.		
Calculation,	5 "	Balance of the "deblais" and "remblais" of the project.		
		3d Part.—Attack and Defense of Places.		
Single Plate,	30 "	Project of attack of a front of fortification on level ground,	1/2000	Common.
		Details of the attack,	1/200	
Journal, ...	4 "	Journal of the siege. Details relating to the composition of the garrison and of the besieging army; also on the material for the Artillery and Engineers required for the attack and defense. Pen sketch of the most elementary works of attack.		

RECAPITULATION FOR THE ARTILLERY.

I. Lectures. Parts of the Course.	Number of Lectures.	Credits for the Lectures.			Number of Interrogations.	Observations.
		With application (*a.*)	Without application (*b.*)	Total.		
First Part. Study of existing Fortifications,.....	10	4.5	21	26	1	(*a.*) The Lectures with application count for 1 hour 5 minutes. (*b.*) Those without application for 3 hours.
Second Part. Principles of the Art of Fortification,..	....	....	....	....	....	
First Section. Fortification on level ground,....	19	24.0	9	33	2	
Second Section. Fortification on hilly ground,....	19	19.5	18	38	2	
Third Section. General questions of Fortification	4	....	12	12	....	
Third Part. Attack and Defense of Places, ...	24	24	24	48	2	
Totals,.....	76	72	84	157	7	

II. Execution of Work.		Number of				Credits.	Observations.
		Drawings.	Memoirs.	Various.	Sittings in the Halls of Study.		
First Part.	Front of Cormontaigne,.....	1	..	..	20	90	
Second Part.	Plate 1. Construction of Project on Level Ground,.....	1	..	..	8	35	
	Plate 2. Project on Level Ground,.....	1	..	..	28	125	
	Memoir on ditto,.....	..	1	..	6	55	
	Plate 3. Project on Hilly Ground,.....	1	..	..	20	90	
	Memoir on ditto,.....	..	1	..	3	30	
	Plate 4. Project of Details. Plan,.....	1	..	..	20	90	
	Plate 5. Project of Section. Plan,.....	1	..	..	10	45	
	Abstraction of Measurements,.....	..	..	1	3	25	
	Plate 6. Removal of Earth,.....	1	..	..	11	50	
	Memoir on ditto,.....	..	1	..	2	20	
	Register of ditto,.....	..	..	1	3	25	
	Estimate of the Project,.....	..	..	1	1	10	
	Plate 7. Project of Improvements,.....	1	..	..	30	135	
	Plate 8. Details of ditto,.....	1	..	..	6	25	
	Memoir on ditto,.....	..	1	..	2	20	
	Balance of Deblais and Remblais,.....	..	..	1	5	45	
Third Part.	Project of Attack,.....	1	..	..	30	135	
	Journal of the Siege,.....	..	1	..	4	35	
	Totals,.....	10	5	4	212	1,085	

RECAPITULATION OF THE CREDITS OF INFLUENCE.

Lectures,.....	165	1,250
Execution of Works,.....	1,085	

RECAPITULATION FOR ARTILLERY—*continued.*

II. Studies and Execution of Work.		Number of Drawings.	Number of Memoirs.	Number of Sittings in the Halls of Study.	Credits.	Observations.
First Part.	Front of Cormontaigne,.....	1	..	20	90	
Second Part.	Plate 1. Construction of the Project on Level Ground,.....	1	..	8	35	
	Plate 2. Project on Level Ground,.....	1	..	28	125	
	Memoir,.....	..	1	6	55	
	Plate 3. Project on Hilly Ground,.....	1	..	20	90	
	Plate 4. Details of the Project,.....	1	..	10	45	
	Memoir,.....	..	1	3	30	
Third Part.	Plate. Project of Attack,.....	1	..	30	135	
	Journal of Attack,.....	..	1	4	35	
	Totals,.....	6	3	129	640	

RECAPITULATION OF THE CREDITS OF INFLUENCE.

Lectures,.....	160	800.
Studies and Execution of Work,.....	640	

RECAPITULATION FOR THE ENGINEERS.

I. Lectures.		Number of Lectures.	Credits for Lectures: With Application.	Credits for Lectures: Without Application.	Credits for Lectures: Total.	Number of Interrogations.	Observations.
First Part.	Study of existing Fortification,.....	10	4.5	21	26	1	The number 162 is applicable to the Interrogations.
Second Part.	Principles of the Art of Fortification,...	..	..	..	..	..	
	First Section. Fortification on Level Ground,.....	19	24.0	9	33	2	
	Second Section. Fortification on Hilly Ground,.....	26	36.0	6	42	2	
	Third Section. General Questions on Fortification,.....	5	1.5	12	13	..	
Third Part.	Attack and Defense of Places,.....	24	24.0	24	48	2	
	Totals,.....	84	90.0	72	162	7	

VI. PROGRAMME OF THE COURSE OF TOPOGRAPHY.

The course of Topography comprehends two parts.

The first relates to the art of topographical drawing, and the second to the art of making topographical surveys. Both parts are carried on *pari passu;* but as the order in which the different branches of the instruction can be given depends very much on the other works carried on in the School, it will be more convenient to give the programme for each separately.

FIRST PART.—INSTRUCTION IN TOPOGRAPHICAL DRAWING.

The instruction in topographical drawing comprehends lectures and exercises in graphical representation. It is based on a complete exposition of the conventional principles of this species of drawing, and it is illustrated by engraved examples of the characteristics adopted for the representation of the various details.

First Section.—Lectures.

The lectures have for their object the explanation of the general principles of the instruction in topographical drawing, and the geometrical conditions which should regulate the shading of maps and their reduction. They immediately precede the exercise to which they relate.

Lecture 1 relates to small maps, copies, and reductions of these; and it explains the object of topographical maps, the various kinds and the different scales generally used. The manner in which the form of the ground is represented by equi-distant contour or level lines is also explained, and mention is made of the conventional tints used, and the species of writing and value of the scale employed.

Lectures 2 and 3 relate to the execution of shaded plans by the brush and the pen, under different circumstances of light and shade.

Lecture 4 explains the different methods for reducing topographical maps, also the description, mode of using, and verification of pentagraphs.

Second Section.—Exercises.

These exercises are intended to teach the students the conventional signs used in topographical drawing, and to give them facilities with the pencil and brush for producing shaded maps, and in reducing them from one scale to another.

SECOND PART.—INSTRUCTION IN TOPOGRAPHICAL SURVEYING.

This instruction comprises:

1st. Lectures given in amphitheatre.
2d. Practical lectures or exercises.
3d. The execution of topographical surveys.

First Section.—Oral Lectures.

These lectures are divided in two classes, which comprehend:—

1st. Those relating to the description of the instruments, and of the methods used in topography.

2d. Those which have reference to the manner in which the students should proceed in the execution of the work, and principally of surveys of limited extent.

Eight lectures are devoted to the description of the various instruments, the method of adjusting their errors, and the manner of using them, as well as to the different ways of proceeding in topography; touching also on the various modes of measuring distances, with descriptions of the compass, plane table, and instruments used for leveling, and on the taking observations for and preparation of sections, and the orientation of maps.

Four preparatory lectures are given, showing the manner in which the students should proceed when on the ground to make a survey of small extent.

Two lectures relate to the methods that should be employed in making a survey of considerable extent, and on the appropriate scales.

Two lectures on military reconnaissance plans; instruments and scales employed.

Two preparatory lectures relate to the execution of a reconnaissance plan, in which the operations of a sham siege are intended to be recorded.

Second Section.—Practical Lectures or Exercises.

The object of these lectures, which take place on the glacis of the fortification, is to show the students the practical modes of using the instruments, and the precautions which must be taken, together with the most elementary proceedings in topography. They are given to ten or twelve students at the same time, and the Professor is assisted by an officer of the staff. Each lecture lasts two and a half hours.

Third Section.—On the Execution of Topographical Surveys.

The object is to familiarize the students with the use of the principal instruments and the principal operations, and they comprehend out-of-door work, of which the results are sketches, registers, and minutes made in pencil, and in the construction of plans, and inking in of the minutes in the Halls of Study.

The out-of-door work is performed under the superintendence of officers of the staff, who assist the students in their work. The construction of the plans is not commenced until the pencil minutes have been examined by the Professor.

These exercises comprise:—

1st and 2d. Construction of plans by the aid of the compass.
3d. The plan of a fortification made with the plane table.
4th. The determination of the variation of the compass.
5th. The execution of a second survey by the aid of the compass.
6th. " " rapid survey by pacing the distances.
7th. " " reconnaissance survey.
8th. " " an itinerary and reconnaissance sketch.
9th. The preparation of a plan on which the whole of the operations of a sham siege may be laid down, as the works of attack and defense proceed.

RECAPITULATION FOR THE ARTILLERY AND ENGINEERS.

Lectures.	Number of Lectures.	Credits for Lectures. With Application.	Credits for Lectures. Without Application.	Credits for Lectures. Total.	Number of Interrogations.	Observations.
1st part:						
Topographical Drawing,	4	6	.....			* The credit is diminished here and carried forward to the exercises, which serve for the interrogations of many lectures. These lectures have therefore really three series of interrogations.
Art of Surveying—						
On the instruments and Topographical processes,	8	12	.....	36	2	
On Surveys of considerable magnitude,	2	.....	6			
On Reconnaissance Plans,	2	1.5	3			
Preparatory to out-of-door work,	5	7.5	.....			
Total,	21	27	9	30*	2	

RECAPITULATION—*continued.*

Execution of Work.	Number of Drawings.	Memoirs.	Various.	Attendances In the halls.	Attendances Out of the halls.	Attendances Out of doors.	Credits.	Observations.
1st Part:—								
Topographical Drawing:								
Conventional Tints,	1	....	....	3	....	....	10	* The description Itinerary is reckoned with the simulated siege operations.
Study of Maps,	4	....	....	26	....	....	120	
Reduction,	1	....	....	2	....	....	10	
Construction of a Triangulation with the Compass,	1	....	....	3	....	....	15	
1st Survey with the Compass:								
Out-of-door work,	....	....	1	....	....	6	50	
Laying down,	1	....	....	4	....	....	20	
Survey of Fortifications with the Plane-table:								
Out-of-door work,	1	....	1	....	....	10	80	† For a Memoir.
Laying down,		1	....	4	....	....	25	
Determination of the Variation of the Compass,	1	....	....	1	1h	....	5	
2d Survey with the Compass:								
Out-of-door work,	1	....	1	....	....	8	65	‡ This number is formed with 5 taken from it for the credit of the interrogations because the exercises serve for the interrogations of several lectures.
Laying down,	1	....	....	2	....	....	10	
Rapid Survey:								
Out-of-door work,	1	....	1	....	....	6	50	
Laying down,		1	....	4	....	....	25	
Reconnaissance Survey:								
Out-of-door work,	1	....	1	....	....	4	30	
Laying down,		1	....	3	....	....	20	
Itinerary and Reconnaissance,*	1	....	....	....	....	1	10	
Topographical operations relative to a sham siege†	....	....	....	....	....	....	....	
Topographical exercises, each of 2½ hours duration,	....	....	....	....	6	....	20‡	
Total,	15	3	5	52	7	35	565	

RECAPITULATION OF THE CREDITS OF INFLUENCE.

Lectures, ... 30
Execution of work, ... 565 } 595.

VII. PROGRAMME OF THE COURSE OF GEODESY AND DIALLING.

This course is divided into two parts—the one part special for the engineers, and the other common to the artillery and engineers.

The first comprises:—

1st. The study of the execution of a triangulation of some extent, and of its connection with the general triangulation of France, executed under the superintendence of the Dépôt de la Guerre, and

2d. Leveling with the barometer.

The second contains:—

1st. The study of reflecting instruments.

2d. The principles of dialling.

Each of these parts comprehend:—

1st. Lectures given in the amphitheatre.

2d. Practical lectures or exercises.

3d. An application.

FIRST PART.—SPECIAL FOR ENGINEERS.

1st Section—Lectures.

These Lectures include:—

1st. A description of the principal geodesical instruments.

2d. The establishment of the triangulation.

3d. The survey and the calculations connected with it.

4th. The orientation of the triangulation.

5th. The calculation of the co-ordinates of the points and their construction from the minutes of the survey.

6th. The geodesical and barometrical leveling.

The first lecture is devoted to the explanation of the different kind of signals used under various circumstances; on the method of measuring bases and angles, and the principles on which these operations are performed; and concluding with the description and mode of using certain instruments for measuring angles.

The second lecture continues and enlarges on the subject of the measurement of angles, horizontal and vertical, with different kinds of instruments.

The third lecture relates to the corrections and reductions which must be made to observed angles, such as the correction for the eccentricity of the instruments, to the reduction of the angles to the horizon, and to the center of the station, and also on the adjustments of the instruments, or the application of corrections for certain errors.

The fourth lecture discusses the calculation of the triangles and their errors, and points out the best organization that can be given to the triangulation, and the exactitude which can be expected from it.

The fifth lecture also relates to the calculation and the development of the triangulation, and explains the nature of the geodesical operations for the map of France.

The sixth lecture explains the manner of observing for, and determination of the azimuthal bearing, for the orientation of the triangulation.

The seventh lecture has reference to the convergence of meridians, calculation of rectangular co-ordinates, sundry problems, and geodesical leveling.

The eighth lecture shows in what manner the barometer is made use of for the determination of differences of altitude, the nature of the corrections to be applied to the instrument, and the degree of exactitude to be found in the results of this process.

The ninth lecture points out the order in which geodesical calculations should be performed and the verifications which should be exacted.

The Second Section contains five lectures or exercises, and they have for their object to familiarize the students with the use of the various kinds of instruments employed in carrying on the operations which have been shortly described in the first section.

The Third Section relates to the practical application of the preceding principles, and mostly consists of geodesical applications.

SECOND PART.—COMMON TO THE ARTILLERY AND ENGINEERS.

The First Section consists of lectures given in the amphitheatre, and relates to reflecting instruments, such as the sextant, reflecting circle, and the method of using them, and also on the principles of dialling, and its connection with various problems in astronomy; describes also the different kinds of dials.

SECOND SECTION.—PRACTICAL EXERCISES.

In which the students are called upon, in the presence of the Professor, to adjust the sextant, and to use it in connection with an artificial horizon for the measurement of the angle between any two objects of the altitude of these objects above the horizon, and also the same altitude.

Third Section contains the practical application of the principles enunciated in the preceding sections, in the preparation by the students of two drawings, in which they will exhibit the graphical representation of the hour in terms of the altitude of the sun previously observed, and show the various constructions of a sun-dial, according to the specified conditions based on the observation of the hour angle.

RECAPITULATION FOR THE ENGINEERS.

Lectures.	Number of Lectures.	Credits for Lectures.			Number of Interrogations.
		With application.	Without application.	Total.	
First Part:—Geodesy:					
Lectures with application,	4	6	...	21	1
" without application,	5	...	15		
Second Part:					
Reflecting Instruments,	1	1.5	...	4.5	1
Dialling,	2	3			
Total,	12	10.5	15	25.5	2

Execution of Work.	Number of					Credits.
	Drawings.	Memoirs.	Etats Divers.	Attendances		
				In the Halls.	Out of the Halls.	
First Part:						
Geodesical calculations,...	..	..	1	4	..	20
Exercises of 2½ hours,....	..	..	1	..	5	10
Second Part:						
Drawings of Dialling,....	2	..	..	4	..	20
Exercises of 2½ hours,....	..	..	..	..	1	5
Total,.....	2	..	2	8	6	55

RECAPITULATION OF THE CREDITS OF IMPORTANCE.

Lectures,..... 25
Execution of Work,..... 55 } 80.

RECAPITULATION FOR THE ARTILLERY.

Lectures.	Number of Lectures.	Credits for Lectures.			Number of Interrogations.
		With application	Without application	Total.	
Reflecting Instruments,.....	1	4.5	..	5	1
Dialling, ...	2				
Total,.....	3	4.5	..	5	1

Execution of Works.	Number of				Credits.
	Drawings.	Days.		Memoirs.	
		In the Halls.	Out of the Halls.		
Drawings of Dialling,.....	2	4	..	..	20
Exercises of 2½ hours,.....	..	..	1	..	5
Total,.....	2	4	1	..	25

RECAPITULATION OF THE CREDITS OF IMPORTANCE.

Lectures,..... 5
Execution of Works,..... 25 } 30.

VIII.—PROGRAMME OF THE COURSE OF SCIENCES APPLIED TO THE MILITARY ARTS.

		Lectures.
1st part—	Geology,	12
2d "	On the Metallurgy of Iron, on Working in Iron,	6
3d "	Applications of the Working in Iron,	3
4th "	On the Manufacture of Small-arms,	4
5th "	" " of Ordnance,	5
6th "	" " of Powder,	5
7th "	On Pyrotechny,	2
	Total,	37

FIRST PART.—GEOLOGY.

Lecture 1.—Preliminary notions. Definition of geology expressed from its applications. Division in four sections:—1st. Mineralogy. 2d. Paleontology. 3d. Geognosy. 4th. Geogeny. (Only the three first are here treated of.)

First Section.—Mineralogy. Generalities. Distinctive characters of minerals. Fundamental principle of a mineralogical classification. Minerals are distinguished as having characters either exterior, crystalline, chemical, or physical; classification of minerals.

Lecture 2.—First class: Simple bodies forming one of the essential principles of minerals. Genus silica, quartz, sulphur. Second class: Alkali and alkaline salts, potass, soda, &c. Third class: Alkaline earths, and earths. Genus lime. Fourth class: Metals. Iron of various kinds; copper, lead, tin, zinc.

Lecture 3.—Fifth class: Silicates of various kinds. Sixth class: Combustibles, minerals.

Lecture 4.—Description of various rocks. Classification of rocks.

Lecture 5.—Use of rock and stone in the arts, and particularly in the art of construction.

Lecture 6.—On the calcination of calcareous stones, lime-kilns.

Lecture 7.—Manufacture of artificial hydraulic lime, manufacture of bricks, stucco, or cements.

Lecture 8.—Second Section: Paleontology. General division established in zoölogy and botany. General notions relating to the different kinds of animals and vegetables, of which the remains are found in various geological formations. Third section: Geognosy. Lectures 9, 10, 11, 12, occupied with the explanation of the various formations.

SECOND PART.—ON WORKING IN IRON.

Lecture 13.—Preliminary notions. Definitions and general considerations. Characteristics of iron, steel, cast-iron, &c.

Lecture 14.—On iron ore and the various kinds of fluxes.

Lecture 15.—On combustibles. Vegetable combustibles, mineral combustibles.

Lecture 16.—Manufacture of cast-iron. High furnaces, different modes of proceeding with vegetable and mineral combustibles.

Lecture 17.—Manufacture of iron and steel and the different kinds of iron.

THIRD PART.—APPLICATION OF THE WORKING OF IRON.

Lecture 19.—Making of projectiles, carriages for guns and mortars, axle-trees and anchors. Use of cast-iron for artillery. General notions in moulding. Use of wrought-iron and steel. Materials first made use of for the making of projectiles, and in the casting of cannon-balls, &c.

Lecture 20.—On the manufacture of hollow projectiles and the carriages for guns and mortars.

Lecture 31.—On the manufacture of axles and anchors.

FOURTH PART.—ON THE MANUFACTURE OF SMALL-ARMS.

Lecture 22.—Preliminary considerations. Assay of metals. Fire-arms, manufacture of gun-barrels, describing the various details.

Lecture 23.—Bayonets, locks, &c.

Lecture 24.—On the making of stocks. Finishing. Rifling small-arms.

Lecture 25.—Manufacture of sabres, swords, lances, hatchets, cuirasses, and on the preservation, maintenance, and repair of arms.

FIFTH PART.—ON THE MANUFACTURE OF ORDNANCE.

Lecture 26.—Preliminary notions. Metals proper for the manufacture of ordnance. Composition and properties of gun-metal. Wrought and cast-iron ordnance. Moulding generally. Moulding of cannons.

Lecture 27.—Moulding of howitzers. Foundries. Fusion of the metals.

Lectures 28, 29.—Boring. Turning. Carving. Turning of the trunnions, &c. Manufacture and reception of bushes. Insertion and replacement of bushes.

Lecture 30.—Last operations. Proofs and reception of cannon. Chemical operations. Assay and analysis of the metals employed in the casting of gun-metal; proportion of the several ingredients.

SIXTH PART.—ON THE MANUFACTURE OF POWDER.

Lecture 31.—General notions. Various kinds of powder, &c. On saltpetre and sulphur.

Lecture 32.—Charcoal; wood employed; various kinds of charcoal; proceeding followed in making powder in various ways by the pestle.

Lecture 33.—Manufacture by mills, &c.

Lecture 34.—Influence of the proportion of the several ingredients, and of the manner of making it on its various properties. Preservation, inflammation, and combustion.

Lecture 35.—Proofs and reception of powder. Proof of its projectile force. Mortar proof, and various kinds of other proofs to which it is subject. Reception and analysis of powder.

SEVENTH PART.—PYROTECHNY.

Lecture 36.—Preliminary ideas. Objects of the course. Precautions that should be adopted to prevent accident. Mixture of the materials. Manufacture of leaden balls of various kinds. Caps. Fireworks for warlike purposes, used for setting buildings, &c., on fire. Firing cannon and exploding mines.

Lecture 37.—Fireworks employed under various circumstances in war. Signal rockets. For illuminating or setting on fire. For explosions. Petards. On ordinary fireworks.

Works of Application.—The works of application which are connected with the course of science applied to the military arts are as follows:—

1st. Study of samples of mineralogical specimens.
2d. Study of geological maps to be followed by a memoir.
3d. Memoirs on: 1st. Iron and its applications. 2d. Manufacture of cannon. 3d. Manufacture of small-arms and powder.
4th. Out-of-door geological excursions to be followed by memoirs.
5th. Manipulations relative to moulding in earth or sand.
6th. Chemical manipulations.
7th. Pyrotechnic manipulations.

First.—Study of Samples of Mineralogical Specimens.

This study has for its object the determination of the kind of minerals described in the course. It is made in sections of ten or twelve Sub-Lieutenants and by attendances of one hour, each Sub-Lieutenant being called upon to reply at least three times.

Second.—Study of Geological Maps, followed by a Memoir.

The study of geological maps will consist in indicating, by conventional colors, the different geological formations of a lithographical map, and to make a section in a particular direction. The map will be the same for all, and it will be conceived so as to correspond with the geological formation of France, but the sections will differ for each student.

An explanatory memoir will have for its object to call the attention of the Sub-Lieutenants to the most salient facts which will be placed in relief by this study.

One attendance in the halls of study will be devoted to this work.

Third.—Three Memoirs.

Three memoirs on different parts of the course, other than the geological, will be made immediately after the interrogations relative to each section. Particular data will be furnished to each Sub-Lieutenant. Three attendances in the halls of study will be allowed for these memoirs.

Fourth.—Geological Excursions.

Three geological excursions will be made in the environs of Metz by groups of ten or twelve Sub-Lieutenants under the direction of the Professor, and at the period of the out-of-door work, so as not to interfere with the current work in the halls. The first excursion will have for its object the study of the lias and lower oolite, met with in the vicinity of Metz. If the time will admit of it, a reconnaissance will be made to the great oolite at Taumont or at Amanvillers.

The second excursion will be made in the direction of Gorze for the study of the lower oolitic formation and to trace it up to Bradford clay, where an important fault occurs in this direction near to Metz. The study of this fault will be the great object of this excursion.

The third excursion will be made in the direction of Forbach, meeting with the lias, chalk-colored freestone, &c.

Three entire days will be devoted to these excursions, and each Sub-Lieutenant will enter his observations in a note-book, and make a certain number of

sections, and report the results of these excursions in three memoirs in a specified time.

Fifth.—Manipulations relative to Moulding in Earth or Sand.

These mouldings of projectiles will be made by sections of ten or twelve Sub-Lieutenants, two attendances of three hours each being devoted to them, one for ordinary and the other for hollow projectiles.

The manipulations for the moulding of cannon will be executed by the Professor.

All the Sub-Lieutenants will be successively called by sections a certain number of times, in order that they may be enabled to render an account of the different states of advancement of the work.

Programme of practical instruction for the casting of projectiles.

1st attendance. Making shot, &c.

2d attendance. Making hollow projectiles.

Programme of the moulds to be executed by the Professor.

Manufacture of cannon; moulding in earth and the various processes to be carried on.

Sixth.—Chemical Manipulations.

The chemical manipulations are made by sections of ten or twelve Sub-Lieutenants.

Nine attendances of three hours each are employed.

1st. To the determination of the specific gravity and real density of gunpowder and to its analysis.

2d. To two other analyses of gun-metal, iron-ore, &c.

Seventh.—Manipulations in Pyrotechny.

The manipulations in pyrotechny will be made by the whole division, divided into three brigades. Each brigade will be assembled in one of the halls at the School of Pyrotechny, and will execute the different manipulations indicated in the following programme, under the direction of the Professor, and with the assistance of the master artificers of the School of Pyrotechny. Five attendances of three hours will be employed at these manipulations.

PROGRAMME OF THE PRACTICAL INSTRUCTIONS ON MUNITIONS AND FIREWORKS.

1st Attendance. Munitions for small-arms.

Infantry cartridges, { Construction of bullets. " of pouches and caps. " of cartridges.

Cartridges with oblong bullets.

2d Attendance. Ammunition for field guns.

Construction and filling of pouches, packing in wood, &c.

3d Attendance. Ammunition for siege artillery, &c.

Construction and filling of cartridges, &c.

Charging hollow projectiles.

4th Attendance. Fireworks for war purposes.

Construction of matches, quick matches, tubes, fusees for shells and grenades.

Construction of signal rockets.

5th Attendance. Carriage of field ammunition.
Loading and unloading field ammunition chests for cannons, howitzers, and infantry wagons.
Construction of ornamental lances and Roman candles.

RECAPITULATION FOR THE ARTILLERY AND ENGINEERS.

Lectures.—Parts of the Course.	No. of Lectures.	Credits for Lectures. With application, 1h. 5m.	Credits for Lectures. Without application, 3h. 0m.	Total Credits.	No. of Interrogations.	Observations.
1st Part, Geology,.....	12	15	6	20	2	
2d " on Working in Iron,..	6	.....	18	20	1	The first series of interrogations relates to mineralogy.
3d " Applications of working in Iron,.....	3	15	6	10		
4th " Manufacture of Small Arms, ...	4	.....	12	10	1	The second to geognosy.
5th " Manufacture of Cannon,.....	5	.....	15	15	1	
6th " Manufacture of Powder,.....	5	.....	15	15	1	
7th " Pyrotechny,.....	2	3	.....	5		
	37	19.50	72	95	6	

Works of Application.	Number of Studies.	Sketches.	Memoirs.	Exercises.	Manipulations.	Attendances in halls, 4h. 5m.	Attendances out of doors. 6h.	Attendances at the Laboratory. 1h. to 2h.	Attendances at the Laboratory. of 3h.	Attendance at the School of Pyrotechny 3h.	Credits.	Observations.
Study of Mineralogical Specimens.....	3	....	....	....	....	....	....	3	.....	.....	5	
Study of Geological Map, followed by a Memoir Map,.....	....	1	....	....	...	1	....	.....	.....	.....	5	
Memoir,.....	....	....	1	....	....	....	....	.....	1	.....	10	
Memoirs on the Metallurgy of Iron, and its—												
1. Application,.....	....	....	1	....	....	1	....	.....	.....	.....	10	
2. Manufacture of cannon	....	....	1	....	....	1	....	.....	.....	.....	10	
3. " " small arms or powder,.....	....	....	1	....	....	1	....	.....	.....	.....	10	
Geological Excursions, followed by Memoirs :												
Excursions,.....	....	....	....	3	....	....	3	.....	.....	.....	20	
Memoirs,.....	....	....	3	....	....	....	....	.....	.....	.....	20	
Manipulations in Moulding	....	....	....	....	2	....	....	.....	2	.....	5	
" Chemistry	....	....	....	....	9	....	....	.....	9	.....	25	
" Pyrotechny	....	....	....	....	5	....	....	.....	.....	5	15	
Total,.....	3	1	7	3	16	4	3	3	12	5	135	

RECAPITULATION OF THE CREDITS OF INFLUENCE.

Lectures,..... 95
Works of Application,..... 135 } 230.

IX. PROGRAMME OF THE COURSE OF APPLIED MECHANICS.

FIRST SECTION.—GENERAL PRINCIPLES.

Lectures 1 and 2.—Short account of the general principles which serve as a base for the application of mechanics to machines, under the compound ratio of their establishment and of the calculation of their effects.

Lecture 3.—General composition of a factory; power, recipient, transmission of movement, tools. General method of calculating the effect of forces in a complete factory.

Lectures 4, 5, and 6.—Theoretical rules and the results of experiments concerning the flow of liquids. (Particular reference is made to the principles which relate to the large orifices of machines moved by water.)

Lecture 7.—Guaging of the volumes and valuation of the dynamical power of water-courses which feed machines.

SECOND SECTION.—MOTOR MACHINES.

Lecture 8.—Theory of the effect of water on hydraulic wheels. Determination of the elements of the calculation.

Lectures 9 to 13.—Application of the general theories to the principal hydraulic recipients. Conditions of the maximum, relative to the useful effect of each kind. Results of experiments, &c. (With reference to turbines, those which are most generally employed in the artillery workshops must be adverted to.)

Lecture 14.—Comparative abstract of the usual properties of various hydraulic "recepteurs". Operations that must be carried on in order to arrive at their results and to their reception in manufactories.

Lecture 15.—Physical ideas relative to the use of the vapor of water as a motive power. Theoretical bases of the calculation of the effects of steam-engines. Force exerted by the compression and expansion of elastic fluids.

Lectures 16 to 18.—Practical notions and results of experiments relating to the effects and to the usual properties of the principal systems of steam-engines in use, as to the employment, reception, and maintenance in workshops.

THIRD SECTION.—RESISTANCE OF MATERIALS.

Lecture 19.—Resistance to compression: 1st, by gradual pressure; 2d, by shock. Results of experience. Application to wooden and cast-iron supports, and to the foundations of machines. Stocks of hammers.

Lecture 20.—Resistance to traction. Application to the shank of a piston, to bolts, chains, cordage, and leather straps. Resistance to flexure. Practical formulæ for calculating the transverse dimensions of the wooden or cast-iron arms of hydraulic wheels, of the catches or sails.

Lecture 21.—Continuation of the resistance to flexure. Practical formula for calculating the dimensions of the several parts of such machines. Cranks, winches, and handles in wood or in metal.

Lecture 21.—Resistance to torsion. Practical formulas. Results of experiments relative to the resistance of wood and metals to boring and turning. Resistance of cast-iron plates to clipping.

FOURTH SECTION.—WORKING MACHINES.

Lectures 23 and 24.—Of blowing machines. General expression of their useful effect. Conditions of the maximum effect. Ventilators; their use in workshops and galleries of mines. Practical bases of their construction. Blowing machines with a piston. Description. Calculation of the effects and results of experiment.

Lectures 25 and 26.—Description and properties of alternative and circular sawing machines. Practical rules for their establishment. Results of experiments concerning the motive power they require, the useful effect obtained, and the resistance of various kinds of wood to the action of the tool. Results of observation relative to the work in shops by hand-saws.

Lectures 27 and 28.—Machines which act by shocks. Practical formula for the calculation of the loss of acting force in the shock. Description and usual properties of various kinds of hammers employed in workshops. Results of experiments proper for serving as the base for the establishment of lever hammers and pestles in powder manufactories. Results of calculation and observation relative to hammers and pestles moved directly or by the transmission of a movement by steam.

Lecture 29.—Grindstones for powder manufactories. Rapidity suitable to the different parts of the work. Means of obtaining it. Calculation of the necessary motive power. Sharpening grindstones for the manufacture of arms. Ventilation.

Lecture 30.—Lathes and drilling bits. Description. Rapidity of movement and form of the tools, according to the nature of the matter and kind of work. Results of experiments concerning the motive force required, and its relation to the useful effect obtained. Composition of a workshop of turning-lathes for an arsenal of artillery.

Lecture 31.—Boring. Machines for cutting and boring. The form of the tool and the rapidity of its action must depend on the nature of the material and the kind of work. Results of experience concerning the motive power required, and its relation to the useful effect obtained, principally for the boring machines of the manufactories of arms and of foundries. Boring machines, disposal of them in an arsenal.

Lecture 32.—Flatteners. Machines for centering, for making screw holes. Descriptions. Different rapidity of the work, dependent on its nature and that of the material. Results of experiments concerning the amount of the motive power and its relation to the useful effect obtained.

FIFTH SECTION.—LECTURES PREPARATORY TO THE WORKS OF APPLICATION.

Lecture 33.—Proceeding to be followed in the preparation of the sketches of a machine. Observations on the effects of machines, their duration, original cost, and cost of maintenance, mode of making, &c. Indications of the difficulties which are met with, and means which should be employed.

Lecture 34.—Project of a factory (specially for the sub-lieutenants of artillery.) Legal conditions respecting the erection of factories. General mode of proceeding with the project. Choice of motor machines dependent on local circumstances and the nature of the work to be performed.

Lecture 35.—(Special for the sub-lieutenants of artillery.) Determination of

the effects supported by the pieces, whose dimensions should be calculated in applying the practical formula of the resistance of materials. Selection of materials.

Lecture 36.—(Special for the sub-lieutenants of artillery.) Principal assemblages of various pieces of machines. Building, foundations, supports of trunnions and pivots.

SECTION SECOND.—WORKS OF APPLICATION.

Survey of Workshops.

This survey of workshops comprehends:—

1st. Figured sketches and observations made on the ground.

2d. Drawing of the whole and of details shaded.

3d. A memoir containing an accurate description of the machines and workshops, the calculation of the dynamical effect, the exposition of the mode of fabrication, and, in general, the results and consequences of the observations made on the spot. It must be executed by each, conformably with the particular programme, and to the instruction which will be given to him. He is allowed for this work thirty-four days.

Project of Machines.

This work, executed immediately following the preceding, by the sub-lieutenants of artillery only, has exclusively for its object the establishment of a workshop for the service of the artillery, comprehending the driving machines and the principal operators; or, if there be time, the improvement of the workshops of the same arm, described in the preceding work. This project must be executed conformably to the particular programme given to each sub-lieutenant. It comprehends; 1, sheet of drawings: 2, a memoir. Twenty-six days are allowed for this work.

RECAPITULATION.

Oral Instruction—Parts of the Course.	Artillery.					Engineers.				
	No. of Lectures.	Credits for Lectures.		Total Credits.	No. of Interrogations.	No. of Lectures.	Credits for Lectures.		Total Credits.	No. of Interrogations.
		With application.	Without application.				With application.	Without application.		
1st Section—General Principles,	7	6	9	15	1	7	6	9	15	1
2d Sec.—Driving Machines,	11	12	9	21	1	11	12	9	21	1
3d " Resistance of materials,	4	5	3	8	.....	4	5	3	8	...
4th Sec.—Working Machines,	10	15	....	15	1	10	15	....	15	1
5th " Lectures preparatory to the works of application,	4	6	....	6	.....	1	1.50	....	1.50	...
Total	36	44	21	65	3	33	39.50	21	60.50	3

RECAPITULATION.

Works of Application.	Number of					Number of				
	Sheets of drawings.	Memoirs.	Attendances: In the Halls.	Attendances: Out-of-doors.	Credits.	Sheets of drawings.	Memoirs.	Attendances: In the Halls.	Attendances: Out-of-doors.	Credits.
Survey of Workshops: Figured sketches and observations,	1 note book.	....	....	8	65	1 note book.	.....	....	8	65
Shaded drawings,	1	....	22	....	100	1	.....	22	....	100
Memoir,	.....	1	4	....	40	.....	1	4	....	40
Project of Machines: Calculations and drawings,	1	....	20	....	90	.....	.....	....	....	.....
Preparation of memoir,	.....	1	6	....	60	.....	.....	....	....	.....
Total,	1 note book 2 sheets	2	52	8	355	1 note book 2 sheets	1	26	8	205

RECAPITULATION.

	Artillery.	Engineers.
Credits for lectures assigned to the interrogations,	65	60
Credits for works of application,	355	205
	420	265

X.—PROGRAMME OF THE COURSE ON CONSTRUCTION.

The course on construction is divided into four parts.

The first part relates to the elements of masonry and the principles which should regulate the form, dimensions, and the construction of walls, and the different parts of buildings; it contains eighteen lectures.

The second part is devoted to the architecture of military buildings—twelve lectures.

The third part supplies the theory of the stability of construction, and is divided into—

1st section, relating to the resistance of materials—six lectures.

2d " to the stability of walls of revetments and arches—nine lectures.

The fourth part applies to constructions in water—twenty lectures.

The course is very nearly the same for the Artillery as for the Engineers.

ELEMENTS OF MASONRY, ETC.

Lectures 1, 2, and 3.—Relate to the elements of which masonry is composed, such as the different kinds of stones, usual dimensions, manner in which good stone may be known; bricks, lime, cement, sand, mortar, stucco, mastic plaster, asphalte, &c., and to the general considerations relating to foundations, and the different kinds of walls under various circumstances.

Lecture 4.—Treats of sustaining walls and the probable effects of the pressure of the earth. Of the conditions which must be fulfilled to insure stability. Various formulæ on the subject. Details of construction and on the proper material to be used.

Lecture 5.—Refers to the manner of facing masonry. Openings in walls, windows. Partition-walls.

Lecture 6.—On cylindrical arches, vaults, key-stones. Formulæ for the calculation of the thickness of piers of an arch or vault. Construction and use of tables for the calculation of the thickness. Construction of arches and vaults in different materials.

Lecture 7.—Arches continued, flat arches, plate bands, &c.

Lecture 8.—On the woods used in construction. On the influence of the soil on its quality. Characteristics of good wood. Preservation of wood. Proper wood for constructions.

Lecture 9.—Flooring. Beams. Girders. Joists. Ceilings.

Lecture 10.—Staircases, conditions respecting. Construction of different kinds of staircases, part of masonry, wood, &c.; steps. Construction of landing-places, &c.

Lectures 11 and 12.—Roofs in carpentry. Conditions which should be satisfied. Composition of the roof of a building. On the different kinds of roofs.

Lecture 13.—On the different ways of joining pieces of wood or timber together.

Lecture 14.—On permanent kinds of roofing. Conditions which should be fulfilled by good roofing. Composition of roofing. Tiles, lathing, cut slates, ridge tiles, hollow tiles, Dutch tiles. On slate roofing. Metallic roofing. Metal mostly used. Precautions to be taken with reference to all metal roofing.

Lecture 15.—Details relating to inhabited buildings. Cellars. Privies. Drainage. Chimneys; cause of their smoking. Most favorable forms of the flues, pipes. Bake-house, hearth.

Lecture 16.—On joinery and locksmiths' work. Flooring of different kinds. Doors. Camp-beds. Racks and mangers in stables. Shutters.

Lecture 17.—Apparatus for heating and for cooking food. Hearth, ash-pan. Grate-flues. Amount of surface to be given to heating apparatus. Furnace of kitchens in barracks. Summary notions on the heating and ventilating of buildings. Calorifiéres with hot air, steam, and hot water.

Lecture 18.—Plan of a building. Projections adopted for the representation of a building. Plans, sections, and elevations. Order in which the measurements should be made, and the sketch prepared. Height at which the horizontal plane of projections should pass, &c.

SECOND PART.—ARCHITECTURE OF MILITARY BUILDINGS.

Lecture 1.—Decoration, without making use of the orders of architecture. Principal conditions relating to decoration. Symmetry, regularity, simplicity, unity, and apparent solidity. Proper character. Proportions of the façades. Height of the stories. Basements. Horizontal chains or fillets. Vertical chains and pilasters. Proportions of the doors and windows. Arcades and arched windows. Cornices, pediments.

Lecture 2.—Distribution of buildings. Considerations that should have weight in the distribution. Number composing the edifice. Circumstances that guide in the disposal of masses. Conditions that should be satisfied in placing a building. Locality and suitable dimensions. Relations that should exist between them. Interior and exterior communications. Stories on the same floor.

Position of the large rooms. Separation of the rooms. Position and arrangement of staircases. Verification of stability.

Lecture 3.—Conditions to be fulfilled in the distribution of the principal military establishments. Arsenals. Polygons for drill. Military establishments to the School of Bridges.

Lecture 4.—Foundries. Manufacture of arms.

Lecture 5.—Refining saltpetre. Powder. Powder magazines. Details relative to the construction of lightning conductors.

Lecture 6.—Infantry and cavalry barracks.

Lecture 7.—Hospitals. Military prisons and penitentiaries.

Lecture 8.—Storehouse for corn. Store-pits. Storehouse for fodder. Preserving houses.

Lecture 9.—Cisterns. Filtration.

Lecture 10.—Military tribunals. Guard-house. Gates of cities. Hotels and dwelling-houses. Officers' quarters.

Lecture 11.—Preparatory to the execution of a project for a building. Method of proceeding. Composition of the sketch; approximate surface of all the locality; separation into symmetrical groups in the case of several buildings; number of stories; surface of the ground floor; length and breadth of the building between its walls; distribution of each story; verification of the relation between the stories. Elevation of the building. Sketches. Memoir. General details, and details of execution.

Lecture 12.—Discussion before the abstraction of the measurements and the preparation of the estimate of the building.

THIRD PART.—FIRST SECTION: ON THE RESISTANCE OF MATERIALS.

1. Resistance of prismatic bodies to extension and compression. Elasticity of bodies. Modulus of elasticity. Limits of permanent efforts. Resistance to extension and compression of stone, bricks, and analogous materials; also of wood and metals. Applications.

2. Transverse resistance. Some cases in which it is brought into play. Results of experience. Resistance of bodies submitted to the effects of transversal flexure. Results of experience and conventions. Conditions of equilibrium of bodies submitted to efforts directly transversal to their length. Direction and value of molecular efforts. Equation of the axis of the body. Equation of the squaring. Discussion of these equations.

3. Geometrical method for determining the inertia. Application to the research for the inertia of various sections. Applications of general equations of equilibrium and of squaring to straight pieces.

1st. A horizontal piece set in a frame at one extremity, and subjected to a weight acting at the other extremity, with a uniform vertical effect.

2d. Horizontal beam placed upon two supports, and subjected to a weight acting at its center, and with a uniform vertical effect.

3d. Beam placed horizontally on two supports, and having two equal weights symmetrically placed with respect to its center.

4th. Beam placed horizontally on two supports, and subjected to a weight acting at any point whatever throughout its length.

5th. Horizontal beam fixed at both its extremities, and subjected to a weight acting at its center with an equal vertical effect.

6th. Horizontal beam placed on three points of support, at unequal distances, and weighted with two weights acting at the middle of the intervals between the supports.

7th. Vertical beam fixed at the foot, and charged with a weight acting at a certain distance from the axis of the beam.

5. Solids of equal resistances. Most suitable form for cast girders. Applications of the formula of equilibrium and squaring to various kinds of carpentry.

6. On polygonal roofs. Conditions respecting them. Arched roofs, pressure, &c. On the stability of walls required to resist the pressure of roofs.

SECOND SECTION: ON THE STABILITY OF REVETMENT WALLS AND ARCHES.

7. On the pressure of earth. Explanation of the theory on Coulomb's system. Investigation of the pressure of earth by analysis. Hypothesis necessary in order to simplify the calculations. General formula of the value of the pressure, &c. Equations of stability and equilibrium under the hypothesis of slipping and rolling.

8. Simplification of the general equations of equilibrium in three particular cases. Determination of the co-efficient of stability in Vauban's profile. M. Poncelet's formula for calculating the thickness of revetment walls with perpendicular face. Transformation of the profile of a revetment to another of equal stability. Vauban's counterforts, &c.

9. Geometrical method for determining the pressure of earth, whatever may be the profile of the wall and of the earth, taking into account the friction of the earth on masonry. Geometrical determination of the amount of the pressure. Proceeding for the determination, by geometry, of the thickness of a revetment wall at the level of the exterior ground.

10. On buttresses. Geometrical determination of the buttressing of earth, and of its momentum. Simplification of the geometrical constructions of the pressure, of the buttressing, and of their momenta under certain hypotheses.

11. Points of application of the pressure and of the buttress. 1st. In the case of a terrace sloping less than the natural slope of the ground. 2d. In the case of the ordinary revetments of fortification.

On the stability of the foundations of revetment walls.

Compressible soil. The resultant of all the forces should pass through the center of the base. Size of the footing of the wall or depth of the foundations to arrive at the result. Possibility of the wall slipping over the base of the foundations. Use of the buttress to prevent this movement. Graphical method to determine the depth of the foundations. Depth of the foundations in unstable soil.

12. Pressure of arches. Case of cylindrical arches. Explanation of the theory of the pressure of arches. Point of application of the pressure in the five modes of possible rupture. Expression for the pressures and resistances by rolling or slipping. Proceeding to be followed to find by calculation the pressures and resistances.

13. Geometrical determination of the pressures and resistances by rolling. Explanation of the solution of this question. Construction of lines proportional to the surfaces of the voussoirs. 1st. In the case of an arch. Extrados without coping or additional weight. 2d. In that of an arch with extrados in the form of coping, and with or without additional weight. Construction of the

verticals passing through the center of gravity of the voussoirs. Abstract of the operations to be performed. Determination by geometrical means of the pressure and resistance against slipping.

14. Co-efficient of stability of arches from the springing. Manner of finding the outline of an arch for a certain given co-efficient. Stability of a cylindrical arch on its piers. Thickness of the piers. Considerations relative to the value of the co-efficient of stability. Stability of an arch on the base of its foundations. Filling in and depth of the foundations of piers.

Extension of the geometrical methods serving for the determinations of the pressures and thicknesses of piers in case of cross vaulting, arcades, and spherical vaulting.

15. Investigation by analysis of the pressures and resistances of an arch.

1st. Hypothesis of a plat-band; stability at the springing charge necessary on the coussinet; stability of the plat-band on its piers; thickness of the piers. Squaring of a tie-beam of iron which annihilates the pressure.

2d. Hypothesis of a semicircular vaulting with arched extrados. Pressures and resistances. In similar arches the pressure is proportional to the square of the radius.

FOURTH PART.—HYDRAULIC CONSTRUCTION.

1st. Classification of ground on which it may be necessary to place a foundation. Soundings. Their object. Various kinds of sounding line. Dams in earth, and in wood and earth combined. Case of an unstable foundation. Construction on rock. Thickness of dams and of the clay work. General disposition of a dam. Bottom-springs. Means of choking or smothering them or of diverting them. Use of sunk dams. Service bridges. Their height and disposition. Railways in great constructions. Their disposition.

2d. Summary review of draining or pumping machines. Choice between the different methods of draining. Table of the useful effect of such machines.

Pile driving. Pile driving machine with hand ropes. Preparation of the pile and operation of driving. Pile driving machine with catch. Choice between the two kinds of pile driving machines. Precautions to be taken in the driving of piles. Distribution of piles, the space to be left between them, and the squaring of them. Disposition and driving of planks. Method of drawing up piles and planking. Execution of a foundation on piles. Driving stakes out of water. Machine for squaring piles.

3d. Parafouilles. Their object and construction.

Foundations in mortar under water. Preparation and immersion of the mortar. Examples.

Thickness of sunk dams with the enceint in mortar.

4th. Foundation frames and platforms. Their object and their construction. Preparation of the foundation frames in masonry.

Foundation by packing.

Foundation by coffer-dams. Details of a coffer-dam.

5th. Foundations on solid gravel. Properties of gravel. Case where it is advantageous to make use of gravel. Examples.

Foundations on sunk wooden piles, in gravel, and in gravel and mortar.

Foundation on pillars built in masonry.

Foundations on quicksand.

Species of foundation to adopt according to the nature of the ground.

6th. Banks of reservoirs. Conditions which should be fulfilled in their establishment. Banks in earth; their profile; revetments to protect them; the wet slope; sort of remblai; precautions which exact a large remblai. Banks in remblai and sustaining walls combined. Banks entirely in masonry; movements observed in walls; most suitable profile. Comparison between banks in earth and masonry. Works which are employed in connection with banks of reservoirs. Dikes of inundations. Their profile; defense of their slope against the action of water; their establishment and works in connection with them.

7th. Batardeaux in the ditches of strong places. Situation; profile; details of construction. Weirs. Their object; effect of a weir in a current. Advantages of the wedge or circular form. Height to give to a weir; and longitudinal form of the swelling occasioned by a horizontal dam. Construction of weirs with vertical walls, with a long slope down the stream. Injuries to which weirs are liable. Profile to adopt according to the nature of the ground.

8th. Sluice-dams, their object; form of the piles; distance apart, and dimensions. Details of construction. Various kinds of apparatus for opening and shutting sluice-dams. Play of a revolving gate. Calculation of the dimensions of the two half sluice gates and of the wicket. Carpentry of a revolving gate. Movable dams with iron wickets. Modifications to render them applicable to the retention of water at a greater height than 2.80 meters.

9th. Navigable locks. Canal lock; its management; form of the chamber; profile of the cheeks. Trace of the pier on which the gates work. Means of filling and emptying the chambers. Means of raising the paddle-valves. Wood-work of the gates sheathed in timber. Planes. Details of the pivots, collars and rollers. Arrangements for the management of the sheathed gates.

10th. Gates sheathed in wood; curves. Ties of cast-iron, and lining in wood or sheet-iron. Cast-iron gates.

River Navigation.—Advantages and disadvantages of water transit. Conditions of a navigable river. Works for the improvement of the navigation on a river.

Artificial Navigation.—Classification of canals. Conditions which determine the best position for a summit level. Search after a minimum of elevation. Expenditure of water at the summit level.

11th. Principal processes employed to economise the water in passing through a lock. Profile of a navigable canal.

Deep cuttings; their profile. Great landslips and means of remedying them.

Tunnels; their profile. Piercing of a tunnel.

12th. Bridges in masonry. Position; breadth of the roadway; outlet to be left for the water; size and form of the arches; trace of the surbased arches on more than five centers. Expansion of the bridge-heads. Profile of the arch. Thickness of the piles and abutments. Apparatus for the arches and bridge-heads. Parts above the arches. Leveling with the banks. Fixed and movable centerings. Removal of the centerings of arches.

13th. *Wooden Bridges* composed of straight pieces. Arrangement of the stakes and starlings. Different construction of the openings according to their span. Arrangement of the platform.

American Bridges.—Arrangement of the earliest form of bridge on Town's system. Height of the trusses constructed in the form of trellis-work. Modi-

fications introduced to increase the resistance of the bridge. Calculation of the resistance of the trusses.

Arched frame-work of bridges. Composition of the arches. Junction of the straight beams with the arches.

Cast-iron Bridges.—Different systems. General principles of their construction.

Aqueducts in masonry; in cast-iron.

14th. *Suspension Bridges.*—Equation of the curve of the chains and construction of this curve. Tension supported by the suspension cables, their thickness. Influence of the length of the flèche upon the tension of the cables. Inconveniences resulting from a long flèche. Vibrations and means of diminishing them. Limits of length of the flèche. Length of the curve of suspension. Causes operating to vary this length; means of obviating the effects produced by them. Length of the suspension rods. Number of supports to be adopted. Thickness of the piles. Points at which the fixing cables are to be attached. Advantages and disadvantages of chains composed of bars and of cables of iron wire. Some details of construction.

15th. *Drawbridges.*—Conditions which they must satisfy. General principle of their balance.

Drawbridges with Flyers.—Special theory of this bridge. Reduction of it to practice. Alteration of equilibrium and means of remedying it.

Disadvantages of the drawbridge with flyers.

16th. Spiral drawbridge of Captain Berché. Trace of the spiral. Determination of the radius of the chain-roller, and of the greatest radius of the spiral.

17th. Drawbridges with variable counterbalances, invented by M. Poncelet. Construction of the chains of the counterbalance. Establishment of the leverage. Calculation of the counterbalances for the special case of the pulleys in front corresponding to the axis of the platform. Influence of the nature of the chains. Method of allowing for the weight of the small chains. Definitive construction of the chains of the counterbalance. Provision of loose cords.

18th. Succinct ideas upon the motion of the sea, and its action on the shore.

Undulating movement. Height of the waves, and depth at which the agitation is perceptible. Effects of the waves on the coasts. Tides; spring-tides; neap-tides. Height of tides and hour of flood. General currents. Action of the sea on its shores. Protection of level and steep shores.

19th. Sea-ports. Requisites of a good port. Ports in the Mediterranean. Conditions of a good roadstead. Moles and breakwaters. Ocean ports, channel tide-dock, floating dock, and sluice of floating dock, laying-up dock, and sluice for the ditch of fortifications. General arrangement of a harbor.

20th. Construction of moles. Stones dropped for foundations. Profile of a loose heap. Volume of the materials which insure their stability. Settling of masonry resting on a heap. Instances of masonry constructed at sea. 1. Wall of Cherbourg. 2. Fort Boyard.

Piers.—Direction, length, form of interval between, and profile of piers. Their construction. Passages reserved through piers.

RECAPITULATION.

First Part.—Parts of Buildings,		18
Second Part.—Architecture of Military Buildings,		12
Third Part.—	First Section. Resistance of Materials, 6	15
	Second Section. Stability of Constructions, 9	
Fourth Part.—Hydraulic Constructions,		20
Total,		65

WORKS OF APPLICATION.

Name of work.	No. Days allowed for execution of work to Students of		Subject employed on.	Observations.
	Artillery.	Engineers.		
Survey of a Building:			Representation of an existing building or a part of a building by means of plans, sections, and elevations. The memoir contains an accurate and critical description of the distribution, construction, and decoration of the building.	Each day is equivalent to 4½ hours' work. The sketches are executed to scales approximating to one-fiftieth for the whole drawing, of one-twentieth for the large details, and of ½ to ¼ for the minute details. The drawing prepared from the sketches is made on the scale of 1-100th.
Sketch (out-of-door work,).	8	8		
Drawing,	21 } 31	21 } 31		
Memoir,	2	2		
Project for a Building:			Study and preparation of a project of a building, in accordance with certain given data. The sketches, the result of the first study, are made in pencil; the drawing is the fair copy of the sketch, modified as may be necessary. The memoir contains an explanation of the rules and principles which must be observed in the construction of buildings, and the grounds on which the dispositions contained in the building have been adopted. The abstraction of the measurements and their reduction to the proper elements, and the estimates, are prepared in conformity to the instructions laid down for the Engineer Service in towns: these supply the estimated cost of the construction of the building according to the project.	This work, common to the students of the two arms, is an application of the first part of the course. The scale for the drawing is in general 1-200th for the plans and elevations, and 1-100th for the sections. It is restricted by the condition that the whole of the drawings should be given on a single sheet of paper. The details need only occupy half a sheet of paper, and its scales must depend on the size of the objects to be represented. The project for a building is an application of the two first parts of the course, as well as of the 1st section of the 3d part.
Sketch, (first study in pencil,)	12	12		
Drawing, (fair copy,)	18	18		
Details,	4	4		
Memoir,	4 } 42	4 } 42		
Abstraction of Measurements and Estimates	4	4		
Diagram of the Stability:			Determination of the profile for a revetment wall, according to certain conditions. Verification of the stability of an arch, and calculation of the pier supporting this arch. In the memoir a short explanation is given of the theory relating to the strength of revetment walls and arches, as well as the results of the application of these principles to the particular case.	The drawing is executed to the scale of 1-100th. This work is an application of the 2d section of the 3d part.
Drawing,	6 } 9	6 } 9		
Memoir,	3	3		
Project for an Hydraulic construction:			Study and composition of a project for a great work of art on certain given data. In the memoir an explanation is given of the principles and the results of the theories which are to be applied in making this project. The arrangements adopted in the project are discussed for the foundation and all other parts of the construction.	The scale of the drawing is chosen in such a manner that the project may be placed on a single sheet; generally it is 1-200th, or smaller. The project of a hydraulic construction is an application of the 1st section of the 3d part as well as of the 4th part of the course.
Sketches,	10	12		
Drawing,	15 } 28	18 } 34		
Memoir,	3	4		
Total,	110	116		

1st. Lectures.—Parts of the Course.	Artillery.					Engineers.					Observations.
	No. Lectures.	Credits for Lectures.			No. Interrogations.	No. Lectures.	Credits for Lectures.			No. Interrogations.	
		With application.	Without application	Total.			With application.	Without application	Total.		
1st Part: Elements of Masonry, form and dimensions of the different parts of buildings,.....	18	24*	6	30	2	18	24*	6	30	2	* A lecture with application is equivalent to 1½ hours of work, and a lecture without application is equal to 3 hours.
2d Part: Architecture of military buildings,....	12	18	.....	18	1	12	18	.....	18	1	
3d Part: Theory respecting stability: 1st section—Resistance of materials,	6	6	6	12	1	6	6	6	12	1	
2d section—Stability of revetment walls and arches,.	9	10.5	6	16.5	1	9	10.5	6	16.5	1	
4th Part: Hydraulic Constructions,.....	20	24	12	36	1	20	24	12	36	1	
Total,.....	65	82	30	112	6	65	82	30	112	6	

2d. Execution of the Work.	Artillery. Number of						Engineers. Number of						Observations.
	Drawings and Sketches.	Memoirs.	Various.	Attendances in halls 4½ hours.	Attend'nces out of doors, 6 h.	Credits.	Drawings and Sketches.	Memoirs.	Various.	Attendances in halls 4½ hours.	Attend'nces out of doors 6 h.	Credits.	† Of which 30 is for the out-of-door work, and 30 for the sketch. ‡ The time allowed for the preparation of the memoirs in the halls should be doubled, in order to take an account of the correction out of the halls of study.
Plan of a Building: Sketches (pen,)....	1	....	....	....	8	50	1	....	....	....	8	50†	
Drawing,.....	1	....	....	21	....	95	1	....	....	21	....	95	
Memoirs,.....	....	1	....	2	....	20	....	1	....	2	....	20‡	
Project of a Building: Sketch, ...	1	....	....	12	....	55	1	....	....	12	....	55	
Drawing,.....	1	....	....	18	....	80	1	....	....	18	....	80	
Detail,.....	1	....	....	4	....	20	1	....	....	4	....	20	
Memoir,.....	....	1	....	4	....	35	....	1	....	4	....	35	
Abstraction of quantities and estimates,	....	....	1	4	....	20	....	....	1	4	....	20	
Diagram of Stability. Drawing,.....	1	....	....	6	....	25	1	....	....	6	....	25	
Memoir,.....	....	1	....	3	....	25	....	1	....	3	...	25	
Project of an Hydraulic construction. Sketch, ...	1	....	....	10	....	45	1	....	....	12	....	55	
Drawing, ...	1	....	....	15	....	70	1	....	....	18	....	80	
Memoir,.....	....	1	....	3	....	25	....	1	....	4	....	35	
Total,.....	8	4	1	102	8	565	8	4	1	108	8	595	

RECAPITULATION OF THE CREDITS OF INFLUENCE FOR THE COURSE.

Artillery, { Lectures,.....112 / Execution of Work,.....565 } 677, or about 680.

Engineers, { Lectures,.....112 / Execution of Work,.....595 } 707, or about 710.

XI.—PROGRAMME OF THE COURSE IN THE GERMAN LANGUAGE.

SECOND DIVISION.—FIRST YEAR'S STUDY.

Number of Lectures, 50.

Grammar and composition during the 25 Lectures forming the odd numbers.

Oral translations of German authors. Phraseology. Lecture on idioms, founded on the passages which have been translated and given in the form of conversation during the first half of the 25 Lectures forming the even numbers.

Dialogues and conversations, on various subjects of every-day life, such as are particularly useful to an officer traveling in Germany, carried on during the second half of the Lectures of the even numbers.

FIRST DIVISION.—SECOND YEAR'S STUDY.

Number of Lectures, 100.

Translations of German authors, and conversations in German on the passages translated, during fifty Lectures, reckoning the odd numbers.

Military reconnaissances, in the form of a dialogue in German and in French, during the first half of the fifty Lectures, even numbers.

Translation of French into German: 1st, Narratives; 2d, Historical and descriptive fragments; 3d, Dramatic scenes; 4th, Epistolary style, during the second half of the fifty Lectures, even numbers.

At the close of the second year, the Sub-Lieutenants give in a composition on a certain subject.

The Sub-Lieutenants most advanced are not obliged to follow the course in German, but they should make translations of articles taken from German military works. These translations, after having been corrected, are deposited in the Library of the School.

Abstract of the course in German:—

1st year's study, ...	50	Lectures.
2d " "	100	"
Total, ...	150	at ½ hour each—112. 3 0.
Credits of influence, ...	110.	

XII.—PROGRAMME OF A SHAM SIEGE.—(Common to the Artillery and Engineers.)

FIRST SECTION.—PRELIMINARY MEASURES.

ART. I.—*Commission charged to study the Project for a Sham Siege.*

A Commission is charged with drawing up and presenting to the General commanding the School a project for a sham siege. This is composed of:—

The Colonel second in command of the School, ... President.

The Major of Artillery, ...
The Major of Engineers, ...
The Professor of Artillery, ...
The Professor of Fortification, ... } Members.
Clerk.

The Professors of Artillery and Fortification may be replaced by the Assistant Professors.

The General Commandant of the School decides in a Council of Instruction on the dispositions to be adopted for the project of a sham siege.

ART. II.—*Preparatory Lectures.*

By the Professor of Military Art, ... 2

1st. Considerations relating to the fortress of Metz. Circumstances which might bring on a siege of it. Force of the garrison and of the besieging army. Investment.

2d. Trace of the lines of circumvallation and of countervallation.

By the Professor of Topography, ... 1

Execution of the second reconnaissance plan (*mémoire*,) (1 lecture.)

1st. Measure of the base. Plan of the ground of the attack. Construction of the plans. Plans of the work executed.

By the Professor of Permanent Fortification, ... 2

1st. Discussion on the points of attack Organization of the *personnel* and *matériel* of the Engineers of the besieging army and of the garrison.

2d. General progress of attack, and general dispositions of defense.

By the Professor of Artillery, ... 2

1st. Composition of the personnel and matéreil of the Artillery of the besieging army. Transport of the siege equipage.

2d. General dispositions of the artillery in the attack and defense.

SECOND SECTION.—COMPOSITION OF THE PERSONNEL.

Director of the Siege.—The General Commandant of the School.

Chief of the Staff.—The Colonel second in command of the School.

Chief of the Artillery Service.—The Major of Artillery attached to the Staff.

Director of the Park of Artillery.—This may be given to the preceding.

Chief of the Engineer Service.—The Major of the Engineers attached to the Staff of the School.

Director of the Engineer Park.—This may be given to the preceding.

Major of the Trenches.—A Captain. Chiefs of Attacks. Captains.

Chiefs of Brigades.—Named by the General Commandant of the Siege.

THIRD SECTION.—CONFERENCES.

Before proceeding to the ground, the sub-lieutenants assist at conferences which are held for the purpose of explaining to them the successions of the several operations of the siege, as well as upon the traces which they have to execute. These conferences, eight in number, are divided as follows:—

The Chief of the Artillery Service will hold 4 conferences, and
The Chief of the Engineer Service " 4 "

FOURTH SECTION.—TRACING OF LINES AND TOPOGRAPHICAL WORK.

1st. The second reconnaissance survey (comprised in the course of topography.) Tracing of lines; one day is allowed for this work.

2d. "Director" plan. The execution of this plan comprises out-of-door work and drawing. The out-of-door work includes the measurement of one or many bases, the observation of the angles which are formed by this base, and the direction of certain remarkable points in the city and fortification, and the formation of a net-work of triangulation, intended to co-ordinate the surveys of the details.

The work of constructing the plan consists in laying down, day by day, the surveys of the details of the ground, as well as of the traces executed. Five

days are allowed for the execution of the topographical work, which precedes the opening of the trenches. The Director Plan is kept close up during the whole duration of the siege.

3d. Itineraries and sketches (comprised in the course of topography.)

The Professor of Topography directs the whole of the surveys and the execution of the Director Plan.

FIFTH SECTION.—TRACING OF THE WORKS OF ATTACK, AND ACTUAL EXECUTION IN FULL RELIEF OF CERTAIN WORKS.

The sub-lieutenants, divided into brigades, trace the works of the siege, under the direction of the officers of the staff, and take part in the superintendence of the works executed in full relief when the exigencies of the service will permit the chief of the Artillery Service and the Colonel of the Regiment of Engineers to place workmen at the disposal of the General Commandant of the School. Six days are appropriated to this work.

SIXTH SECTION.—WORK IN THE HALLS OF STUDY.

The work in the Halls of Study consists of:—

1st. A memoir on the sham siege, which memoir must be approved by the General Commandant of the School.

2d. Of a sketch representing one of the works traced or executed in full relief. These works in the Halls are performed during the interval of the attendances devoted to out-of-door work. Two days are appropriated to the preparation of the memoir, and two to the execution of the sketch. This time is included in the eleven days allowed to the sham siege.

RECAPITULATION FOR THE ARTILLERY AND ENGINEERS.

Lectures and Confereoces.	No. of Lectures or Conferences.	Credits for Lectures or Conferences.			No. of Questions.	Observations.
		Lectures.	Conferences.	Total.		
By the Professor of Military Art,	2	3	..	3	2	One series of questions by the Chief of the Artillery Service, as to what relates to that arm.
" of Topography,	1	1½	..	1½		
" of Permanent Fortification,	2	3	..	3		
" of Artillery,....	2	3	..	3		One series of questions by the Chief of the Engineer Service, as to what relates to that arm.
Conferences by the Chief of the Service, of Artillery,...	4	..	6	6		
Conferences by the Chief of the Service, of Engineers,..	4	..	6	6		A Credit of 11 is assigned to each series of questions.
Total,.....	15	10½	12	22½	2	

Works of Application.	Number of Drawings.	Number of Memoirs.	Attendances out of doors. of 4½h.	Attendances out of doors. of 8 h.	Attendances in the Halls.	Credits.	
2d Reconnaissance Plan (Memoir.)							
Topographical Work, ...	..	..	4	..	..	20	Credits given by the Professor of Topography.
Itinerary and Sketch (Memoir,)	..	..	..	..	..	..	
Plan "Director,"	..	..	..	..	1	5	Credits given by the Captains of the Staff, Chiefs of Brigades.
Tracing of Lines,.....	..	..	..	1	..	10	
Tracing of Works of Attack and of Defense,.....	..	..	6	..	..	25	
Sketch, ...	1	..	..	..	2	1	Credits given by the Chiefs of the Service of the Artillery and Engineers.
Memoir,.....	..	1	..	..	2	2	
Total, ...	1	1	10	1	5	90	

XIII.—PROGRAMME OF THE COURSE ON THE VETERINARY ART.

FIRST PART.—INTERIOR OF THE HORSE.

Lecture 1.—Classification and nomenclature of the various matters which constitute the horse. Skeleton (head and body.)

Lecture 2.—Skeleton (limbs.) Mechanical importance of the skeleton. Nomenclature and use of the muscles. Cellular and fatty tissues, grease, skin. Insensible perspiration.

Lecture 3.—Functions for maintenance. Arteries of the nerves. Animal heat.

Lecture 4.—On various functions.

SECOND PART.—EXTERIOR OF THE HORSE.

Lecture 5.—Proportions. Equilibrium. Description and importance of the natural beauties and defects of the head and region of the throat.

Lecture 6.—Description and importance of the other parts of the horse. Blemishes. Soft tumors.

Lecture 7.—Osseous tumors. Various accidents. Temperaments. Description of clothing, &c.

Lecture 8.—Data respecting horses.

Lecture 9.—To know the age. On various bad habits. Examination of the eyes; their diseases.

Lecture 10.—Defective paces, &c. Draught and pack horses. Mules.

Lecture 11.—Stud and remounts. Races.

Lecture 12.—Vicious horses, and different bits. Manner of bitting a horse. On grooms and punishment.

THIRD PART.—ON THE HEALTH OF THE HORSE.

Lecture 13.—Examination of the foot, and shoeing with the hot shoe.

Lecture 14.—Shoeing with the cold shoe. Different kinds of horse-shoe, &c.

Lecture 15.—On stables. Food. Rations.

Lecture 16.—Description and nomenclature of the saddle. Harness and pack. Various saddles.

Lecture 17.—On work and rest. Horse and mule on the road and in bivouac. On diseases and accidents.

Abstract of the course:—

Interior of the horse, 4 Exterior, ... 6 Health, ... 7	17 lectures at 1½ hours.	Total time, 25½ hours. Credits, 25.

The instruction on horseback can, under certain circumstances, be considered as connected with this course; and questions are asked during the time when the sub-lieutenants are not engaged in actual riding exercise. This instruction is described under the head of Practical Military Instruction; it comprises at the maximum 272 attendances, and its credit of influence is valued at 240.

ARTILLERY AND ENGINEERS' REGIMENTAL SCHOOLS.

I. ARTILLERY REGIMENTAL SCHOOLS.

These are intended for the theoretical and practical instruction of officers, *sous-officiers*, and gunners.

Each School is under the orders of the General of Brigade commanding the Artillery in the military division in which it is situated.

Independent of the general officer, the school has the following staff:—

A Lieutenant (associated assistant to the General.)
A Professor of Sciences, applying more particularly to the Artillery.
A Professor of Fortification, of drawing, and construction of buildings.
Two *Gardes* of Artillery (one of the first, and the other of the second class.)

There are, in addition, attached to each school the number of inferior officers (captains, lieutenants, or *sous-lieutenants*) required for carrying on the theoretical courses, which are not placed under the direction of the professors.

A captain of the first class, assisted by two first lieutenants, is the director of the park of the school. Another captain, also of the first class, but taken from the regiment of Pontooneers, has the direction of that portion of the bridge equipage necessary for the special instruction of this corps, as well as of the material of the artillery properly belonging to this instruction.

The lieutenant-colonel, assistant to the general, fulfills, independent of every other detail of supervision with which he may be charged, the functions of *ordonnateur secondaire*, in what concerns the expenses of the school and their propriety (*justification.*) He corresponds with the minister of war for this part of the service.

The instruction is divided into *theoretical* and *practical*, and the annual course is divided into half-yearly periods, or into summer and winter instructions.

The summer instruction commences, according to different localities, from the 1st of April to the 1st of May, and that of the winter from the 1st of October to the 1st of November.

The winter and summer instruction is subdivided into school and regimental instruction.

The school instruction comprehends all the *theoretical* and *practical* instruction common to the different corps which require the

assistance of the particular means of the school, the employment of its professors, locality, and material, as that of the practical instruction in which the troops belonging to the different corps of the army are united to take part.

The regimental instruction is that which exists in the interior of the regiments and the various bodies of the artillery. It is directed by the chiefs of these corps, who are responsible for it, with the means placed at their disposal, under the general surveillance of the commandant of the school.

The special instruction of the Pontooneers not admitting of their following the same instruction as the other regiments of artillery, the chief of this corps directs the special instruction according to certain bases prescribed by the regulations.

There are for the captains of artillery, each year during the winter half-year, six conferences for the purposes of considering and discussing projects for the organization of different equipages and armaments for the field service, and for attack and defense of places.

In a building belonging to each school of artillery, under the name of the hotel of the school, are united the halls and establishments necessary for the theoretical instruction of the officers and sous-officers, such as halls for *théorique* drill and drawing, library, depots of maps and plans, halls for machines, instruments and models, &c.

Each school is provided with a physical cabinet and a chemical laboratory. There is also a piece of ground, called a polygon, for exercising artillerymen to the manœuvers of cannon and other fire-arms of great range. Its extent is sufficient in length to furnish a range of 1,200 meters, and in breadth of 600 meters.

Permanent and temporary batteries are established on this ground, and they seem not only for practice, but also to accustom the men to the construction of fascines, field batteries, &c.

The administration of each school, and the accounts relating to it, are directed by an administrative council, consisting of—

The General Officer commanding the Artillery (President.)

The Colonels of the regiments of Artillery in the towns where two regiments of the Artillery are quartered, and in other towns, the Colonel and Lieutenant-Colonel of the regiment.

The Colonel of the regiment of Pontooneers in the town where the principal part of the corps may be stationed, and in any other town the Lieutenant-Colonel or the Major.

The Lieutenant-Colonel associated assistant with the General Commandant.

The functions of secretary of the council are intrusted to a *grade* of the first class.

The functionaries of the corps of intendants fulfill, in connection

with the administrative councils of the artillery schools, the same duties as are assigned by the regulations relating to the interior administration of bodies of troops. They will exercise over the accounts, both of money and material of the said schools, the same control as over the administration connected with the military interests of the state.

II. ENGINEER REGIMENTAL SCHOOLS.

The colonel of each regiment has the superior direction of the instruction.

The lieutenant-colonel directs and superintends, under his orders, the whole of the details of the regimental instruction.

A major, selected from among the officers of this rank belonging to the *état-major* of this arm, directs and superintends, under the orders of the colonel, the whole of the details of the special instruction.

The complete instruction consists of—

General instruction, or that of the regiment, by which a man is made a soldier.

Special or school instruction, having for its object the training of the miner or sapper.

The instructions are each separated into *theoretical* and *practical* instruction.

The theoretical instruction of the regiment comprehends the theories:—

On the exercises and manœuvers of infantry. On the interior service. On the service of the place. On field service. On the maintenance of arms. On military administration. On military penal legislation.

The practical instruction of the regiment comprises:—

The exercises and manœuvers of infantry. Practice with the musket. Military Marches. Fencing.

The teaching of these various duties is confided to officers, *sous-officiers*, and corporals of the regiments, as pointed out by the regulation, and the orders of the colonel.

The fencing school is organized in a similar manner to those of the infantry, and the military marches are also made in the same way as in those corps.

The *special* and *theoretical* instruction consists of:—

Primary instruction. Mathematics. Drawing. Geography. Military history of France. Fortification and the various branches of the engineering work.

Three civil professors (appointed by competition) are attached to each regimental school, for the special theoretical instruction, as regards the primary instruction, drawing, and mathematics.

The courses are distributed and taught in the following manner;

Primary instruction for the Soldiers.		By the Professor of Primary Instruction.
French grammar for the Corporals.		
Book-keeping for the *Sous-Officiers.*		
Elementary arithmetic for the Corporals.		
Complete arithmetic	for the Serjeants.	
Elementary geometry		
Complete geometry	for the Serjeant-Major.	By the Prof. of Mathematics.
Trigonometry		
Surveys for the *Sous-Officiers.*		
Special mathematics for the Officers.		
Drawing for the Corporals and *Sous-Officiers.*		By the Professor of Drawing, who is also charged with completing the collection of models which relate to it.
The elements of fortification for the Serjeant-Majors.		By the Officers of the regiment, named by the Colonel, independently of those appointed by the regulations
Construction, and theories on practical schools	for the *Sous-Officiers.*	
Permanent fortification	for the Officers.	
The attack and defense of places		
Mines		
Bridges		
Ovens		
Topography		
Geography	for the *Sous-Officiers.*	
Military history of France		

At the end of each course the colonel of the regiment causes a general examination to be made in his presence of the whole of the men who have followed this course, and has a list made out in the order of merit, with notes of the capacity and aptitude of each.

These lists are consulted in the formation of tables of promotion, and placed with the said tables before the inspector-general.

Each captain and lieutenant are obliged to give in at least a single treatise on five different projects, consisting of a memoir discussing or the journal of a siege, with drawing of the whole, and of details in sufficient number to render them perfectly intelligible.

The *special practical* instruction is composed of seven distinct schools, relating to:—

Field Fortification. Saps. Mines and Fireworks. Bridges. Ovens. Topography. Gymnastics.

And they comprehend, in addition, sham sieges, and underground war. Each of these seven schools is taught in accordance with the special instructions annexed to the regulation, which, however, are not published.

Winter is more especially devoted to the course of special theoretical instruction, which commences on the 1st November, and usually finishes on the 15th March, and the course of *special practical* instruction is carried on during the summer from the 15th March to the 15th September. The second fortnight of September and the month of October are devoted to sham sieges and underground war, to the leveling of the works executed, and to the arrangement of magazines.

SCHOOL FOR INFANTRY AND CAVALRY

AT ST. CYR.

GENERAL DESCRIPTION. CONDITIONS OF ADMISSION. STAFF.

It will have been seen in the accounts of the Polytechnic School and the School of Application at Metz, in what manner young men destined for commissions in the artillery and engineers receive their previous education, and under what conditions appointments as officers in these two services are made in France. The regulations for the infantry, the cavalry, and the marines are of the same description. There are in these also the same two ways of obtaining a commission. One, and in these services the more usual one, is to rise from the ranks. The other is to pass successfully through the school at St. Cyr. Young men who do not enter as privates prove their fitness for the rank of officers by going through the course of instruction given, and by passing the examinations conducted in this, the principal, and putting aside the School of Application at Metz, the one Special Military School of the country.

The earliest foundation of the kind in France was the Ecole Royale Militaire of 1751. Like most other similar institutions of the time, it was intended for the young nobility. No one was to be admitted who could not prove four generations of *Noblesse*. The pupils were taught free of charge, and might enter at eight years old. Already, however, some marks of competition are to be discerned, as the best mathematicians were to be taken for the Artillery and Engineers. Buildings on the Plain of Grenelle (the same which still stand, occupying one end of the present Champs de Mars, and retaining, though only used as barracks, their ancient name,) were erected for the purpose. The school continued in this form till 1776, when it was dissolved (apparently owing to faults of discipline,) and replaced by ten Colleges, at Sorrèze, Brienne, Vendôme, and other places, all superintended by ecclesiastics. A new Ecole Royale Militaire, occupying the same buildings as the former, was added in 1777.

This came to an end in 1787; and the ten colleges were suppressed under the Republic. A sort of Camp School on the plain

of Sablons took their place, when the war had broken out, and lasted about a year under the name of the Ecole de Mars.

Under the Consulate in 1800, the Prytanée Français was founded, consisting of four separate Colleges. The name was not long after changed to the Prytanée Militaire; and after some time the number was diminished, and La Flèche, which had in 1764 received the youngest pupils of the old Royal Military School, became the seat of the sole remaining establishment; which subsequently sunk to the proportions of a mere junior preparatory school, and became, in fine, the present establishment for military orphans, which still retains the title, and is called the Prytanée Militaire de la Flèche.

A *special* Military School, in the meantime, had been set up at Fontainebleau in 1803, transferred in 1808 to St. Cyr, and thus taking the place of the Prytanée Militaire and of its predecessor, the original Ecole Royale Militaire, gradually assumed its present form.*

The course of study lasts two years; the usual number of cadets in time of peace is five, or at the utmost six hundred; the admission is by competitive examination, open to all youths, French by birth or by naturalization, who on the first of January preceding their candidature were not less than sixteen and not more than twenty years old. To this examination are also admitted soldiers in the ranks between twenty and twenty-five years of age, who, at the date of its commencement, have been actually in service in their regiments for two years.

The general conditions and formalities are the same as those already stated for the Polytechnic. It may be repeated that all the candidates, in accordance with a recent enactment, must have taken the usual degree which terminates the task at the *lycées*—the baccalaureate in sciences.

Those who succeed in the examination and are admitted, take an engagement to serve seven years either in the cavalry or infantry, and are thus under the obligation, if they are judged incompetent at the close of their two years' stay at the school to receive

* Founded the Ecole Royale Militaire, 1751. Junior pupils transferred to La Flèche, 1764.
Suppression of the Ecole Royale Militaire and establishment of ten Colleges, 1776.
New Ecole Royale Militaire, for the best pupils of the Colleges, 1777.
Suppression of the Colleges and of the Ecole Royale Militaire, 1787.
Foundation of the Ecole de Mars, May 1794.
Foundation of the Prytanée Français at Paris, Versailles, St. Germain, Fontainebleau, 1800.
Foundation of the Ecole Spéciale Militaire at Fountainebleau, 1803.
The four Schools of the Prytanée Français are converted into the Prytanée Militaire, 1806; and are transferred to La Flèche, 1808.
The Ecole Spéciale Militaire is transferred to St. Cyr, also in 1808.

a commission, to enter and serve as common soldiers. The two years of their stay at the school counts as a part of their service. It is only in the special case of loss of time caused by illness, that permission is given to remain a third year.

The ordinary payment is 60*l.* (1,500 francs) per annum. All whose inability to pay this amount is satisfactorily established, may claim, as at the Polytechnic, an allowance of the whole or of half of the expenses from the State, to which may be added an allowance for the whole or for a portion of the outfit (from 24*l.* to 28*l.*) These *bourses* or *demi-bourses*, with the *trousseau*, or *demi-trousseau*, have during the last few years been granted unsparingly. One-third of the 800 young men at the school in February 1856 were *boursiers* or *demi-boursiers*. Candidates admitted from the Orphan School of La Flèche, where the sons of officers wounded or killed in service receive a gratuitous education, are maintained in the same manner here.*

It was the rule till lately that cadets appointed, on leaving St. Cyr, to the cavalry should be placed for two years at the Cavalry School at Saumur. This, however, has recently been changed; on entering St. Cyr those who desire appointments in the cavalry declare their wishes, and are put at once through a course of training in horsemanship. Those who are found unfit are quickly withdrawn; the remainder, if their place on the final examination allows of their appointment to the cavalry, are by that time sufficiently well practiced to be able to join their regiments at once.

Twenty-seven, or sometimes a greater number, are annually at the close of their second year of study placed in competition with twenty-five candidates from the second lieutenants belonging to the army,† if so many are forthcoming, for admission to the Staff School at Paris. This advantage is one object which serves as a stimulus to exertion, the permission being given according to rank in the classification by order of merit.

The school consists of two divisions, the upper and the lower, corresponding to the two years of the course. Each division is divided again into four companies. In each of these eight companies there are sub-officers chosen from the *élèves* themselves, with

* About twenty-five are sent every year from La Flèche. The admissions from the army (*i. e.*, of soldiers between twenty and twenty-five years old) do not amount to more than four or at the utmost five per cent. They are very frequently young men who have previously failed for St. Cyr. and who then enter the army as privates, and come in as such. They have to pass the same examination.

† Few usually present themselves; and these also, it is said, are very generally old *élèves* of St. Cyr. who had not succeeded in obtaining admission to the Staff School before. They are not examined *with* the pupils of St. Cyr, but are intercalated in the list according to their merit.

the titles of *Sergent*, *Sergent Fourrier*, and *Caporal;* those appointed to the companies of the junior division are selected from the second year cadets, and their superiority in standing appears to give these latter some considerable authority, exercised occasionally well, occasionally ill. The whole school, thus divided into eight companies, constitutes one battalion.

The establishment for conducting the school consists of—

A General as Commandant.
A Second in Command (a Colonel of Infantry.)
A Major, 4 Captains, 12 Lieutenants, and 5 Second Lieutenants of Infantry; the Major holding the office of Commandant of the Battalion.
A Major, 1 Captain, 34 Lieutenants, and 3 Second Lieutenants of Cavalry to superintend the exercises, the riding, &c.
A Director of Studies (at present a Lieutenant-Colonel of Engineers.)
Two Assistant Directors.
Six Examiners for Admission.
One Professor of Artillery.
One Assistant ditto.
One Professor of Topography and Mathematics.
One Professor of Military Administration, Military Art, and Military History.
One Professor of Fortification.
One Professor of Military Literature.
Two Professors of History and Geography.
One Professor of Descriptive Geometry.
One Professor of Physics and Chemistry.
Three Professors of Drawing,
One Professor of German.
Eleven Military and six Civilian Assistant Teachers (*Répétiteurs.*)

There is also a Quartermaster, a Treasurer, a Steward, a Secretary of the Archives, who is also Librarian, an Almoner (a clergyman,) four or five Surgeons, a Veterinary Surgeon, who gives lessons on the subject, and twelve Fencing Masters.

The professors and teachers are almost entirely military men. Some difficulty appears to be found by civilians in keeping sufficient order in the large classes; and it has been found useful to have as *répétiteurs* persons who could also be employed in maintaining discipline in the house. Among the professors at present there are several officers of the engineers and of the artillery, and of the staff corps.

There is a board or council of instruction, composed of the commandant, the second in command, one of the field officers of the school staff, the director of studies, one of the assistant directors, and four professors.

So, again, the commandant, the second in command, one of the field officers, two captains, and two lieutenants, the last four changing every year, compose the board or council of discipline.

St. Cyr is a little village about three miles beyond the town of Versailles, and but a short distance from the boundary of the park. The buildings occupied by the school are those formerly used by Madame de Maintenon, and the school which she superintended.

Her garden has given place for the parade and exercise grounds; the chapel still remains in use; and her portrait is preserved in the apartments of the commandant. The buildings form several courts or quadrangles; the Court of Rivoli, occupied chiefly by the apartments and bureaux of the officers of the establishment, and terminated by the chapel; the Courts of Austerlitz, and Marengo, more particularly devoted to the young soldiers themselves; and that of Wagram, which is incomplete, and opens into the parade grounds. These, with the large stables, the new riding school, the exercising ground for the cavalry, and the polygon for artillery practice, extend to some little distance beyond the limit of the old gardens into the open arable land which descends northwards from the school, the small village of St. Cyr lying adjacent to it on the south.

The ground floor of the buildings forming the Courts of Marengo, Austerlitz, and Wagram appeared to be occupied by the two refectories, by the lecture-rooms or amphitheaters, each holding two hundred pupils, and by the chambers in which the ordinary questionings, similar to those already described in the account of the Polytechnic School, under the name of *interrogations particulières*, are conducted.

On the first floor are the *salles d'étude* and the *salle des collections* the museum or repertory of plans, instruments, models and machines, and the library; on the second floor the ordinary dormitories; and on the third (the attics,) supplementary dormitories to accommodate the extra number of pupils who have been admitted since the commencement of the war.

The commission, when visiting the school, was conducted on leaving the apartments of the commandant to the nearest of the two refectories. It was after one o'clock, and the long room was in the full possession of the whole first or junior division. A crowd of active and spirited-looking young soldiers, four hundred at least in number, were ranged at two long rows of small tables, each large enough, perhaps, for twelve; while in the narrow passage extending up and down the room, between the two rows, stood the officers on duty for the maintenance of order. On passing back to the corridor, the stream of the second year cadets was issuing from their opposite refectory. In the adjoining buttery, the loaf was produced, one kilogramme in weight, which constitutes the daily allowance. It is divided into four parts, eaten at breakfast, dinner, the afternoon lunch or *gouter*, and the supper. The daily cost of each pupil's food is estimated at 1 f. 80 c.

The lecture rooms and museums offer nothing for special remark. In the library containing 12,000 books and a fine collection of maps, there were a few of the young men, who are admitted during one hour every day.

The *salles d'étude* on the first floor are, in contrast to those at the Polytechnic, large rooms, containing, under the present circumstances of the school, no less than two hundred young men. There are, in all, four such rooms, furnished with rows of desks on each side and overlooked in time of study by an officer posted in each to preserve order, and, so far as possible, prevent any idleness.

From these another staircase conducts to the dormitories, containing one hundred each, and named after the battles of the present war—Alma, Inkerman, Balaclava, Bomarsund. They were much in the style of those in ordinary barracks, occupied by rows of small iron beds, each with a shelf over it, and a box at the side. The young men make their own beds, clean their own boots, and sweep out the dormitories themselves. Their clothing, some portions of which we here had the opportunity of noticing, is that of the common soldier, the cloth being merely a little finer.

Above these ordinary dormitories are the attics, now applied to the use of the additional three hundred whom the school has latterly received.

The young men, who had been seen hurrying with their muskets to the parade ground, were now visible from the upper windows, assembled, and commencing their exercises. And when, after passing downwards and visiting the stables, which contain three hundred and sixty horses, attended to by two hundred cavalry soldiers, we found ourselves on the exercising ground, the cavalry cadets were at drill, part mounted, the others going through the lance exercise on foot. In the riding-school a squad of infantry cadets were receiving their weekly riding lesson. The cavalry cadets ride three hours a-day; those of the infantry about one hour a week. The exercising ground communicates with the parade ground; here the greater number of the young men were at infantry drill, under arms. A small squad was at field-gun drill in an adjoining square. Beyond this and the exercising ground is the practice ground, where musket and artillery practice is carried on during the summer. Returning to the parade ground we found the cadets united into a battalion; they formed line and went through the manual exercise, and afterwards marched past; they did their exercise remarkably well. Some had been only three months at the school. The

marching past was satisfactory; it was in three ranks, in the usual French manner.

Young men intended for the cavalry are instructed in infantry and artillery movements and drill; just as those intended for the infantry are taught riding, and receive instruction in cavalry, as well as artillery drill and movements.

It is during the second year of their stay they receive most instruction in the arms of the service to which they are not destined, and this, it is said, is a most important part of their instruction. "It is this," said the General Commandant, "that made it practicable, for example, in the Crimea, to find among the old *élèves* of St. Cyr, officers fit for the artillery, the engineers, the staff; and for general officers, of course, it is of the greatest advantage to have known from actual study something of every branch."

The ordinary school vacation last six or seven weeks in the year. The young men are not allowed to quit the grounds except on Sundays. On that day there is mass for the young men.

The routine of the day varies considerably with the season. In winter it is much as follows:—At 5 A. M. the drum beats, the young men quit theis beds; in twelve minutes they are all dressed and out, and the dormitories are cleared. The *rappel* sounds on the *grand carré;* they form in their companies, enter their *salles*, and prepare for the lecture of the day until a quarter to 7. At 7 o'clock the officers on duty for the week enter the dormitories, to which the pupils now return, at a quarter to 8 the whole body passes muster in the dormitories, in which they have apparently by this time made their beds and restored cleanliness and order. Breakfast is taken at one time or other during the interval between a quarter to 7 and 8 o'clock.

They march to their lecture rooms at 8, the lecture lasts till a quarter past 9, when they are in like manner marched out, and are allowed a quarter of an hour of amusement. They then enter the halls of study, make up their notes on the lecture they have come from, and after an hour and a half employed in this way, for another hour and a half are set to drawing.

Dinner at 1 is followed by recreation till 2. Two hours from 2 to a quarter past 4 are devoted to military services.

From 4 to 6 P. M. part are occupied in study of the drill-book (*théorie,*) part in riding or fencing: a quarter of an hour's recreation follows, and from 6¼ to 8½ there are two hours of study in the *salles.* At half-past 8 the day concludes with the supper.

The following table gives a view of the routine in summer :—

4½	A. M.	to	4¾	A. M.	Dressing.
4¾	"	to	7¼	"	Military exercises.
7¼	"	to	8¼	"	Breakfast, cleaning, inspection.
8¼	"	to	9½	"	Lecture.
9½	"	to	9¾	"	Recreation.
9¾	"	to	11½	"	Study.
11½	"	to	1	P. M.	Drawing.
1	P. M.	to	2	"	Dinner and recreation.
2	"	to	4	"	Study of drill-book (*théorie*) or fencing.
4	"	to	6	"	Study for some, riding for others.
6	"	to	6¼	"	Recreation.
6¼	"	to	8	"	Riding for some, study for others,
8	"	to	8½	"	Supper.

The entrance examination is much less severe than that for the Polytechnic; but a moderate amount of mathematical knowledge is demanded, and is obtained. The candidates are numerous; and if it be true that some young men of fortune shrink from a test, which, even in the easiest times, exacts a knowledge of the elements of trigonometry, and not unfrequently seek their commissions by entering the ranks, their place is supplied by youths who have their fortunes to make, and who have intelligence, industry, and opportunity enough to acquire in the ordinary *lycées*, the needful amount of knowledge.

Under present circumstances it is, perhaps, more especially in the preparatory studies that the intellectual training is given, and for the examination of admission that theoretical attainments are demanded. The state of the school in a time of war can not exactly be regarded as a normal or usual one. The time of stay has been sometimes shortened from two years to fifteen months; the excessive numbers render it difficult to adjust the lectures and general instruction so as to meet the needs of all; the lecture rooms and the studying rooms are all insufficient for the emergency; and what is yet more than all, the stimulus for exertion, which is given by the fear of being excluded upon the final examination, and sent to serve in the ranks, is removed at a time when almost every one may feel sure that a commission which must be filled up will be vacant for him. Yet even in time of peace, if general report may be trusted, it is more the drill, exercises, and discipline, than the theory of military operations, that excite the interest and command the attention of the young men. When they leave, they will take their places as second lieutenants with the troops, and they naturally do not wish to be put to shame by showing ignorance of the common things with which common soldiers are familiar. Their chief incentive is the fear of being found deficient when they join their reg-

iments, and, with the exception of those who desire to enter the staff corps, their great object is the practical knowledge of the ordinary matters of military duty. "Physical exercises," said the Director of Studies, "predominate here as much as intellectual studies do at the Polytechnic."

But the competition for entrance sustains the general standard of knowledge. Even when there is the greatest demand for admissible candidates, the standard of admission has not, we are told, been much reduced. No one comes in who does not know the first elements of trigonometry. And the time allotted by the rules of the school to lectures and indoor study is far from inconsiderable.

EXAMINATIONS FOR ADMISSION—STUDIES AT THE SCHOOL.

The examinations for admission are conducted almost precisely upon the same system which is now used in those for the Polytechnic School.* There is a preliminary or pass examination (*du premier degré*,) and for those who pass this a second or class examination (*du second degré*.) For the former there are three examiners, two for mathematics, physics, and chemistry, and a third for history, geography, and German. The second examination, which follows a few days after, is conducted in like manner by three examiners. A jury of admission decides. The examination is for the most part oral; and the principal difference between it and the examination for the Polytechnic is merely that the written papers are worked some considerable time before the first oral examination (*du premier degré*,) and are looked over with a view to assist the decision as to admissibility to the second (*du second degré*.) Thus the *compositions écrites* are completed on the 14th and 15th of June; the preliminary examination commences at Paris on the 10th of July; the second examination on the 13th.

The subjects of examination are the following:—

Arithmetic, including vulgar and decimal fractions, weights and measures, square and cube root, ratios and proportions, interest and discount, use of logarithmic tables and the sliding rule.

Algebra, to quadratic equations with one unknown quantity, maxima and minima, arithmetical and geometrical progressions, logarithms and their application to questions of compound interest and annuities.

Geometry, plane and solid, including the measurement of areas, surfaces, and volumes; sections of the cone, cylinder, and sphere.

Plane Trigonometry: construction of trigonometrical tables and the solution of triangles; application to problems required in surveying.

Geometrical representations of bodies by projections.

* The system was, in fact, first tried at St. Cyr, and adopted, on the representation of the Mixed Commission, at the Polytechnic. The previous method, by which different sets of examiners took different districts, had created distrust and dissatisfaction.

French compositions.
German exercises.
Drawing, including elementary geometrical drawing and projections; plan, section, and elevation of a building; geographical maps.
Physical Science (purely descriptive:) cosmography; physics, including elementary knowledge of the equilibrium of fluids; weight, gravity, atmospheric pressure, heat, electricity, magnetism, acoustics, optics, refraction, microscope, telescope.
Chemistry, elementary principles of; on matter, cohesion, affinity; simple and compound bodies, acids, bases, salts, oxygen, combustion, azote, atmospheric air, hydrogen, water; respecting equivalents and their use, carbon, carbonic acid, production and decomposition of ammonia, sulphur, sulphuric acid, phosphorus, chlorine; classification of non-metallic bodies into four families.
History: History of France from the time of Charles VII. to that of the Emperor Napoleon I. and the treaties of 1815.
Geography, relating entirely to France and its colonies, both physical and statistical.
German: the candidates must be able to read fluently both the written and printed German character, and to reply in German to simple questions addressed to them in the same language.

The general system of instruction at St. Cyr is similar to that of the Polytechnic; the lectures are given by the professors, notes are taken and completed afterwards, and progress is tested in occasional *interrogations* by the *répétiteurs*. One distinction is the different size of the *salles d'étude* (containing two hundred instead of eight or ten;) but, above all, is the great and predominant attention paid to the practical part of military teaching and training. It is evident at the first sight that this is essentially a military school, and that especial importance is attached both by teachers and pupils to the drill, exercise, and manœuvers of the various arms of the service.

The course of study is completed in two years; that of the first year consists of:—

	27	lectures in descriptive geometry.
	35	" physical science.
	20	" military literature.
	35	" history.
	27	" geography and military statistics.
	30	" German.
Total,	174	

In addition to the above, there is a course of drawing between the time when the students join the school early in November and the 15th of August.

The course of *drawing* consists in progressive studies of landscape drawing with the pencil and brush, having special application to military subjects, to the shading of some simple body or dress, and to enable the students to apply the knowledge which has been communicated to them on the subject of shadows and perspective. This course is followed by the second or junior division during the first year's residence.

The course of lectures in *descriptive geometry* commences with certain pre-

liminary notions on the subject; refers to the representation of lines on curved surfaces, cylindrical and conical, surfaces of revolutions, regular surfaces, intersection of surfaces, shadows, perspective, vanishing points, &c., construction of geographical maps, and *plan côté*.

The lectures in *physical science* embrace nine lectures on the general properties of bodies; heat, climate, electricity, magnetism, galvanism, electro-magnetism, acoustics.

There are twelve lectures in *chemistry;* on water, atmospheric air, combustibles, gas, principal salts, saltpetre, metallurgy, organic chemistry.

There are fourteen lectures in *mechanics applied to machines;* motion, rest, gravity, composition and resolution of forces, mechanical labor, uniform motion, rectilinear and rotatory, projectiles in space, mechanical powers, drawbridges, Archimedean principle, military bridges, pumps, reservoirs, over and under-shot wheels, turbines, corn mills, steam-engines, locomotives, transport of troops, materials, and munitions on railways.

The twenty lectures in *military literature* refer to military history and biography, memoirs of military historians, battles and sieges, the art of war, military correspondence, proclamations, bulletins, orders of the day, instructions, circulars, reports and military considerations, special memoirs, reconnaissance and reports, military and periodical collections, military justice.

The thirty-five lectures in *history* principally relate to France and its wars, commencing with the Treaty of Westphalia and ending with the Treaty of Vienna.

The twenty-seven lectures in *geography* and *military statistics* are subdivided into different parts; the first eight lectures are devoted to Europe and France, including the physical geography and statistics of the same; the second six lectures are devoted to the frontiers of France; and the third part of thirteen lectures to foreign states and Algeria, including Germany, Italy, Spain, Portugal, Poland, and Russia.

The studies for the first division during the second year of their residence consist of—

10	lectures in	topography.
27	"	fortification.
15	"	artillery.
10	"	military legislation.
12	"	military administration.
27	"	military art and history.
20	"	German.
Total, 121		

One lesson weekly is given in drawing, in order to render the students expert in landscape and military drawing with the pencil, pen, and brush.

We must not omit to call attention to the fact that mathematics are not taught in either yearly course at St. Cyr.

The course in *topography*, of ten lectures, has reference to the construction of maps, copies of drawings, theory, description, and use of instruments for measuring angles and leveling, the execution for a regular survey on the different systems of military drawing, drawing from models of ground, on the construction of topographical drawing and reconnaissance surveys, with accompanying memoirs.

Twenty-seven lectures are devoted to *fortification;* the first thirteen relate principally to field fortification, statement of the general principles, definitions, intrenchments, lines, redoubts, armament, defilement, execution of works on the ground, means necessary for the defense, application of field fortification to the defenses of *têtes de pont* and inhabited places, attack and defense of in-

trenchments, &c., castramentation; six lectures have reference to permanent fortification, on ancient fortifications, Cormontaigne's system, exterior and detached works, considerations respecting the accessories of defense to fortified places; eight lectures relate to the attack and defense of places, preparations for attack and defense, details of the construction of siege works from the opening of the trenches to the taking of the place, exterior works, as auxiliaries, sketches, and details of the different works in fortifications, plans, and profile, &c.

The students also execute certain works, such as the making of fascines, gabions, saucissons, repair of revetments of batteries, platform, setting the profiles, defilement, and construction of a fieldwork, different kinds of sap, plan and establishment of a camp for a battalion of infantry, &c.

Under the head of *artillery*, fifteen lectures are given, commencing with the resistance of fluids, movement of projectiles, solution of problems with the balistic pendulum, deviation of projectiles, pointing and firing guns; small arms, cannon, materials of artillery, powder, munition, fireworks for military purposes; range of cannon, artillery for the attack or defense of places or coasts, field artillery, military bridges.

The students are practically taught artillery drill with field and siege guns, practice with artillery, repair of siege batteries, bridges of boats or rafts.

The ten lectures allowed for the course of *military legislation* have for their object the explanation of the principles, practice, and regulations relating to military law, and the connection with the civil laws that affect military men.

The twelve lectures on what is called *military administration* relate to the interior economy of a company, and to the various matters appertaining to the soldier's messing, mode of payment, necessaries, equipment, lodging, &c.

Military art and history is divided into three parts. The first, of five lectures, relates to the history of military institutions and organization. The second, of fifteen lectures, refers to the composition of armies and to considerations respecting the various arms, infantry, cavalry, état-major, artillery and engineers, and the minor operations of war. The third part, of seven lectures, gives the history of some of the most celebrated campaigns in modern times. In the practical exercises, the students make an attack or defense of a work or of a system of fieldworks during their course of fortification, or of a house, farm, village, in the immediate vicinity of the school, or make the passage of a river.

The students receive twenty lectures in *German*, and are required to keep up a knowledge of German writing.

EXAMINATIONS AT THE SCHOOL.

The examinations at the end of the first year take place under the superintendence of the director and assistant director of studies. They are conducted by the professor of each branch of study, assisted by a *répétiteur*, each of whom assigns a credit to the student under examination, and the mean, expressed as a whole number, represents the result of the student's examination in that particular branch of study. The examination in military instruction for training (in drill and exercises) is carried on by the officers attached to companies, under the superintendence of the commandant of the battalion, and that relating to practical artillery by the officer in charge of that duty.

The pupils' position is determined, as at the Polytechnic, partly by the marks gained at the examination, partly by those he has obtained during his previous studies. In other words, the half of the credit obtained by a student at this examination in each subject is added to the half of the mean of all the credits assigned to him,

in the same subject, for the manner in which he has replied to the questions of the professor and *répétiteur* during the year; and the sum of these two items represents his total credit at the end of the year. The scale of credit is from 0 to 20, as at the Polytechnic.

Every year, before the examinations commence, the commandant and second in command, in concert with the director and assistant director, and in concurrence with the superior officer commanding the battalion for military instruction, are formed into a board to determine the amount of the minimum credit which should be exacted from the students in every branch of study. This minimum is not usually allowed to fall below eight for the scientific, and ten for the military instruction.

Any student whose general mean credit is less than *eight* for the scientific, or *ten* for the military instruction, or who has a less credit than *four* for any particular study in the general instruction, or of *six* for the military instruction, is retained at the school to work during the vacation, and re-examined about eight days before the re-commencement of the course, by a commission composed of the director and assistant director of studies for the general instruction, and of the second in command and the commandant of the battalion, and of one captain for the military instruction. A statement of this second examination is submitted to the minister of war, and those students who pass it in a satisfactory manner are permitted by him to proceed into the first division. Those who do not pass it are reported to the minister of war as deserving of being excluded from the school, unless there be any special grounds for excusing them, such as sickness, in which case, when the fact is properly established before the council of instruction, they are permitted to repeat the year's studies.

Irregularity of conduct is also made a ground for exclusion from the school. In order to estimate the credit to be attached to the conduct of a student, all the punishments to which he can be subjected are converted into a specific number of days of punishment drill. Thus,

For each day confined in the police chamber, 4 days' punishment drill.

For each day confined in the prison, 8 days' punishment drill.

The statement is made out under the presidency of the commandant of the school, by the second in command, and the officer in command of the battalion. The credits for conduct are expressed in whole numbers in terms of the scale of 0 to 20, in which the 20 signifies that the student has not been subjected to any punishment

whatever, and the 0, that the student's punishments have amounted to 200 or more days of punishment drill. The number 20 is diminished by deducting 1 for every 10 days of punishment drill.

The classification in the order of merit depends upon the total amount of the sum of the numerical marks or credits obtained by each student in every branch of study or instruction. The numerical credit in each subject is found by multiplying the credit awarded in each subject by the co-efficient of influence belonging to it.

The co-efficients, representing the influence allowed to each particular kind of examination, in the various branches of study are as follows:—

Second Division, or First Year's Course of Study.

General Instruction.	Descriptive Geometry,	Course,	6	40
		Drawing and Sketches,	2	
	Physical Science applied to the Military Arts,	Course,	6	
		Sketch and Memoir,	2	
	History,		6	
	Geography and Statistical Memoirs,	Course,	5	
		Sketch and Memoir,	2	
	Literature, Memoir on		4	
	German,		4	
	Drawing,		3	
Special Instruction:—Drill, Practice, Manœuvers (Infantry and Cavalry,)				7
Conduct,				3
				50

First Division, or Second Year's Course of Study

			Infantry.	Cavalry.	
General Instruction.	Topography,	Course,	3	3	32
		Maps, Memoirs, and Practical Exercises,	3	2	
	Fortification,	Course,	4	4	
		Drawings, Memoirs, and Practical Exercises,	3	2	
	Artillery and Balistic Pendulum,	Course,	4	4	
		Practical Exercises, School of Musketry,	2	1	
	Military Legislation,		2	2	
	Military Administration,	Course,	3	3	
		Sheets of Accounts,	1	1	
	Military History and Art,	Course,	4	4	
		Memoirs and applications,	1	1	
	German,		4	4	
	Drawing,		1	1	
Special instruction for	Infantry,	Theory of Drill, Manœuvers—3 Schools,	4		9
		Practical Instruction,	3		
		Regulations,	2		
	Cavalry,	Riding,		3	12
		Theoretical and Practical Instruction,		7	
		Veterinary Art,		2	
	Conduct		6	6	
	Total,		50	50	

To facilitate this classification in order of merit, three distinct tables are prepared,—

The first relating to the general instruction;

The second relating to the military instruction; and

The third relating to the conduct;

and they respectively contain, one column in which the names of the students are arranged by companies in the order in which they have been examined; followed by as many columns as there are subjects of examination, for the insertion of their individual credit and the co-efficient of influence, by which each credit is multiplied; and lastly by a column containing the sum of the various products belonging to, and placed opposite each student's name.

These tables are respectively completed by the aid of the existing documents, the first for the general instruction, by the director of studies; the second for the military instruction, by the officer commanding the battalion; the third for conduct, under the direction of the commandant of the school, assisted by the second in command.

A jury formed within the school, composed of the general commandant, president, the second in command, the director of studies, and the officer commanding the battalion, is charged with the classification of the students in the order of merit.

To effect it, after having verified and established the accuracy of the above tables, the numbers appertaining to each student in the three tables are extracted and inserted in another table, containing the name of each student, and, in three separate columns, the numbers obtained by each in general instruction, military instruction, and conduct, and the sum of these credits in another column.

By the aid of this last table, the jury cause another to be compiled, in which the students are arranged in the order of merit as established by the numerical amount of their credits, the highest in the list having the greatest number.

If there should be any two or more having the same number of total credits, the priority is determined by giving it to the student who has obtained a superiority of credits in military instruction, conduct, general instruction, notes for the year; and if these prove insufficient, they are finally classed in the same order as they were admitted into the school.

A list for passing from the second to the first division is forwarded to the minister at war, with a report in which the results for the year are compared with the results of the preceding year; and the minister at war, with these reports before him, decides who

are ineligible from incompetency, or by reason of their conduct, to pass to the other division.

The period when the final examinations before leaving the school are to commence, is fixed by the president of the jury, specially appointed to carry on this final examination, in concert with the general commandant of the school.

The president of the jury directs and superintends the whole of the arrangements for conducting the examination; and during each kind of examination, a member of the corps, upon the science of which the student is being questioned, assists the examiner, and, as regards the military instruction, each examiner is aided by a captain belonging to the battalion.

The examination is carried on in precisely the same manner as that already described for the end of the first year's course of study. And the final classification is ascertained by adding to the *numerical* credits obtained by each student during his second year's course of study, in the manner already fully explained, *one-tenth* of the numerical credits obtained at the examinations at the end of the first year.

The same regulations as to the minimum credit which a student must obtain in order to pass from one division to the other, at the end of the first year, which are stated in page 160, are equally applicable to his passing from the school to become a second lieutenant in the army.

A list of the names of those students who are found qualified for the rank of second lieutenant is sent to the minister at war, and a second list is also sent, containing the names of those students that have, when subjected to a second or revised examination, been pronounced by the jury before whom they were re-examined as qualified.

Those whose names appear in the first list are permitted to choose according to their position in the order of merit, the staff corps or infantry, according to the number required for the first named service, and to name the regiments of infantry in which they desire to serve.

Those intended for the cavalry are placed at the disposal of the officer commanding the regiment which they wish to enter.

Those whose names appear in the second list are not permitted to choose their corps, but are placed by the minister at war in such corps as may have vacancies in it, or where he may think proper.

The students who are selected to enter the staff corps, after competing successfully with the second lieutenants of the army, proceed as second lieutenants to the staff school at Paris. Those who fail pass into the army as privates, according to the terms of the engagement made on entering the school.

THE CAVALRY SCHOOL AT SAUMUR.

This school was established in 1826, and is considered* the most perfect and extensive institution of the kind in Europe,—perhaps the only one really deserving the title, the others being more properly mere schools of equitation.

It is under the control of the Minister of War, and was established for the purpose of perfecting the officers of the cavalry corps in all the branches of knowledge necessary to their efficiency, and especially in the principles of equitation,—and to diffuse through the corps a uniform system of instruction, by training up a body of instructors and classes of recruits intended for the cavalry service.

The instruction is entirely military, and is based upon the laws and regulations in force with regard to the mounted troops. It includes; 1st. The regulations for interior service; 2nd. The cavalry tactics; 3rd. The regulations for garrison service; 4th. The regulations for field service applied, as far as possible, on the ground, especially with regard to reconnaissances; 5th. A military and didactic course of equitation, comprising all the theoretical and practical knowledge required for the proper and useful employment of the horse, his breaking, application to the purposes of war, and various civil exercises; 6th. A course of hippology, having for its object practical instruction, by means of the model breeding-stud attached to the school, in the principles which should serve as rules in crossing breeds and in raising colts, to explain the phases of dentition, to point out the conformation of the colt which indicates that he will become a good and solid horse, the method to be pursued to bring the colt under subjection without resistance, and, finally, to familiarize the officers and pupils with all the knowledge indispensable to an officer charged with the purchase and care of remount horses. This course includes also a knowledge of horse-equipment, illustrated in the saddle factory connected with the school; 7th. Vaulting, fencing, and swimming. The non-commissioned officers are also instructed in the theory of administration and accountability. The course

* "Report of Observations in Europe during the Crimean War," by Major Gen. McClellan.

of instruction continues one year, commencing in the month of October. The pupils at the school are:—

1st. A division of lieutenants, (*lieutenants instructeurs.*)
2nd. " of sub-lieutenants, (*sous-lieutenants d'instruction.*)
3rd. " of sub-officers, (*sous-officiers élèves instructeurs.*)
4th. " of non-commissioned officers, (*brigadiers élèves.*)
5th. " of cavalry recruits, (*cavaliers élèves.*)

The lieutenants are chosen out of the regiments of cavalry and artillery, as well as from the squadrons of the park-trains and military equipages, from the lieutenants who voluntarily present themselves for the appointment to the General Board of Inspectors. Their age must not exceed thirty-six years.

The sub-lieutenants are appointed from the cavalry regiments, must be graduates of the Special Military School, not above thirty-four years of age, and have served at least one year with the regiment.

The sub-officers are selected from the cavalry corps—one from every two regiments of cavalry and artillery, and every two squadrons of the park-trains and military equipages.

The non-commissioned officers are chosen annually by the inspectors-general—one from each regiment of cavalry—from among those that show a peculiar aptness for equitation and are distinguished by good conduct, information, zeal, and intelligence; those who are recommended for promotion in their corps are selected in preference. Their age must not exceed twenty-five years, and they must have served at least one year in the ranks.

These pupils, numbering about four hundred, are sent to the school by order of the Minister of War. They continue connected with their corps, from which they are regarded as detached while they remain at the school. They receive additional pay. Those who after due trial are found deficient in the necessary qualifications, are sent back to their regiments.

Upon the recommendation of the inspector-general of the school, the officers who are serving as pupils, compete for promotion by choice with the officers of the corps from which they are detached.

The cavalry lieutenant, who graduates first in his class, is presented for the first vacancy as captain-instructor that occurs in the cavalry, provided he has the seniority of rank required by law. The lieutenant who graduates second obtains, under the same condition, the second vacancy of captain-instructor, provided his division consisted of more than thirty members. The sub-lieutenant graduating first, provided he is not lower than the tenth in the general classifi-

cation of the officers of both grades, is presented for promotion to the first vacant lieutenancy that occurs in his regiment.

The non-commissioned officers who pass a satisfactory final examination, are immediately promoted to vacancies that have been preserved for them in their regiments—those who have graduated among the first ten of the class, being presented for promotion as sub-lieutenants, as soon as they have completed their required term of service as non-commissioned officers. Those who attend the school as non-commissioned officers, frequently return as officers for instruction, and again in a higher grade on the staff of the school.

Officers transferred from the infantry to the cavalry are generally sent to this school for a short time at least. The captains-instructor of the cavalry regiments, and the instructors of equitation in the artillery regiments, are mostly selected from the graduates.

The school also receives by voluntary enlistment, such young men, not above the age of twenty-one years, as desire to enter the cavalry service. They are not admitted until they have been subjected to an examination before a committee, by whom they are classified according to their fitness. These volunteer enlistments for the cavalry school are made at Saumur, at least a month before the commencement of the course, on presentation of the certificate of classification and of approval by the commandant of the school. The number is limited to fifty each year.

Such of these cavalry pupils as are distinguished for diligence and good conduct and pass a satisfactory final examination are transferred to the regiments of cavalry, for promotion to the rank of non-commissioned officers by their respective colonels. Those who have not been found fit for admission are sent back simply as privates.

A council of instruction is charged with the direction of the studies. They propose useful changes, and direct the progress of the studies. They are also charged with the examinations.

The recitations are by sections of about thirty each. In reciting upon the general principles of tactics, equitation, hippology, &c., the manner is as in our Military Academy; when reciting upon the movements in tactics, all the commands and explanations of the instructor to the troops are repeated "verbatim et literatim," and in the tone and pitch of voice used in the field. Perfect uniformity of tone and manner is required. The object of thus reciting is to teach the pupils the proper tone and pitch of voice, to accustom them to hear their own voices, and to enable them to repeat the text literally at this pitch of voice, without hesitation or mistake.

The course of hippology includes the structure of the horse, the circulation of the blood, organs of respiration, &c., food, working

powers, actions, breeds, manner of taking care of him, ordinary ailments and remedies, shoeing, lameness, saddling, sore backs, sanitary police, &c., but does not comprise a complete veterinary course.

The practical exercises consist of:—the ordinary riding-hall drill, including vaulting, the "kickers," &c.; the carrière, or out-door riding at speed, over hurdles, ditches, &c.; cutting at head; target-practice; fencing; swimming; the usual military drills; skeleton squadron and regimental drills; rides in the country; finally, in the summer, frequent "carousels" or tilts are held.

The veterinary surgeons of the lowest grade are sent here upon their first appointment to receive instruction in equitation, to profit by the study of the model stud, and to learn the routine of their duties with the regiments. They form a distinct class.

In the *Model Stud*, the number of animals varies. There are usually two stallions and about twenty mares, (Arabs, English, Norman, &c.,) in addition to those selected from time to time from among the riding-animals. Attached to it is a botanical garden, more especially for useful and noxious grasses and plants.

School for Breaking Young Horses.—The best horses purchased at the remount dépôts are selected for the officers, and sent to this place to be trained. The number is fixed at 100 as a minimum. These, as soon as their education is complete, are sold or given, according to the orders of the Minister of War, to those officers who need a remount—in preference, to officers of the general staff and staff corps, those of the artillery, and mounted officers of infantry. These officers may also select from among the other horses of the school, with the approval of the commandant.

School of Farriers.—This is attached to the cavalry school, and is under the direction of the commandant. It is composed of private soldiers who have served at least six months with their regiments, and are blacksmiths or horse-shoers by trade. There are usually two men from each mounted regiment. The course lasts two years; it comprises reading, writing, arithmetic, equitation, the anatomy of the horse, thorough instruction as to all diseases, injuries, and deformities of the foot, something of the veterinary art in general, the selection of metals, making shoes, nails, tools, &c., shoeing horses. The establishment has a large shoeing shop and yard, a recitation-room, museum, and store-rooms. In the recitation-room there are skeletons of horses, men, &c., as well as some admirable specimens of natural preparations in comparative anatomy, a complete collection of shoeing-tools, specimens of many kinds of shoes, &c.—*Annuaire de l'Instruction* 1861, *and* "*Observations.*"

THE SCHOOL OF APPLICATION FOR THE STAFF.

AT PARIS.

DUTIES OF THE FRENCH STAFF.

The staff is the center from which issue and to which are addressed all orders and military correspondence.

The officers of the staff are divided into chiefs of the staff, sub-chiefs, staff-officers, and aides-de-camp.

The colonels and lieutenant-colonels are employed as chiefs of the staff in the different military districts of France, and in the divisions of the army on active service. The ordinary posts of the majors and captains is that of aides-de-camp to general officers.

When several armies are united together under a commander-in-chief, the chief of the general staff takes temporarily the title of *Major-Général*, the general officers employed under him that of *Aide-Major-Général.*

The duties of the chief of the staff are to transmit the orders of the general; to execute those which he receives from him personally, for field-works, pitching camps, reconnaissances, visits of posts, &c.; to correspond with the commanding officers of the artillery and the engineers, and with the commissariat, in order to keep the general exactly informed of the state of the different branches of the service; to be constantly in communication with the different corps, so as to be perfectly master of everything relating to them; to prepare for the commander-in-chief and for the minister of war, returns of the strength and position of the different corps and detachments, reports on marches and operations, and, in short, every necessary information.

The distribution of the other officers of different ranks, when it has not been made by the minister of war, is regulated by the chief of the general staff.

In every division of the army an officer of the staff is specially charged with the office work; the others assist him when necessary, but they are more usually employed in general staff duties, in reconnaissances, drawing plans of ground, missions, the arrangement of

camps and cantonments, superintending the distribution of the rations, &c.

The officers of the staff may further be charged with the direction of field-works thrown up to cover camps and cantonments.

Staff officers of all ranks may be employed on posts and detachments. On special missions they command all other officers of the same rank employed with them. When a staff officer is charged with the direction of an expedition or a reconnaissance, without having the command of the troops, the officer in command concerts with him in all the dispositions it may be necessary to make to ensure the success of the operation.

The staff of generals of artillery and of engineers is composed of officers of their respective arms.

The war depot (*Dépôt de la Guerre*) was founded for the purpose of collecting and preserving military historical papers, reconnaissances, memoirs, and plans of battles; to preserve plans and MSS. maps useful for military purposes, and to have them copied and published.

It is divided into two sections—one charged with trigonometrical surveying, topography, plan drawing, and engraving; the other with historical composition, military statistics, the care of the library, the archives, plans, and maps. Each of these sections is under the direction of a colonel of the staff corps, who has under his orders several officers of his corps.

The war depot has taken a large share in the preparation of the map of France. The first idea of undertaking this important work dates from 1808. After various delays and difficulties, the trigonometrical survey, which had been for a time suspended, was recommenced in 1818. The work was placed under the war depot, intrusted to the corps of geographical engineers. Since this period the geographical engineers have been incorporated in the staff corps, by the officers of which the work has been continued. The primary triangulation was finished in 1845; the secondary is now finished; the filling in the details will occupy several years to come. The number of officers of the staff corps employed on the survey has varied from twenty-six to ninety.

THE STAFF CORPS.

The officers of the French staff constitute a distinct and separate corps, numbering thirty-five colonels, thirty-five lieutenant-colonels, one hundred and ten majors, three hundred and thirty captains, and one hundred lieutenants. None but officers of this corps can be

employed on the staff. When, by accident, there is not a sufficient number present, regimental officers may be temporarily employed, but they return to their regiments as soon as officers of the staff corps arrive to replace them. The division of the staff into adjutant-general's and quartermaster-general's department does not exist in the French service.

The only means of entering the staff corps is through the Staff School of Application. Of the fifty student-officers which the School of Application usually contains, twenty-five leave annually to enter the staff corps, and are replaced by an equal number. Three of these come from the Polytechnic, the remaining twenty-two are selected from thirty pupils of the Military School of St. Cyr, who compete with thirty second lieutenants of the army, if so many present themselves; but, in general, the number of the latter does not exceed four or five.

The course of study in the Staff School of Application lasts two years. The students have the rank of second lieutenant. On passing the final examination they are promoted to the rank of lieutenant; they are then sent to the infantry to do duty for *two years*, at the expiration of which time they are attached for an equal period to the cavalry. They may finally be sent for a year to the artillery or engineers.

This routine can not be interrupted except in time of war, and even then the lieutenant can not be employed on staff duty until he has completed his *two years* with the infantry. However, officers who have a special aptitude for the science of geodesy or topography, may even earlier be employed on the map of France or other similar duty; and, further, two of the lieutenants, immediately on quitting the Staff School of Application, are sent to the war depot (*Dépôt de la Guerre*) to gain a familiarity with trigonometrical operations.

The General Officers at their Inspections are required to report specially to the Minister of War on the captains and lieutenants of the staff corps doing duty with the regiments in their districts, both as to their knowledge of drill and manœuvres, and their acquaintance with the duties of the staff. They are to require these officers to execute a military reconnaissance, never allowing more than forty-eight hours for the field sketch and its accompanying report.

Officers of all arms of the rank of captain or under, are permitted to exchange with officers of equal rank in the staff corps; but they must previously satisfy the conditions of the final examinations of the Staff College.

THE BUILDINGS AND ESTABLISHMENT.

The Staff School of Application is situated in Paris, in the Rue de Grenelle, close to the Invalides. Of the ninety officers attending it, sixty lodge in the building and thirty out of it, but all take their meals in the town. Each has, in general, a room to himself. Servants are provided in the proportion of one to about eight rooms. The officers are forbidden to have private servants.

The staff of the school is composed as follows:—

The Commandant, a General of Brigade.

The Second in Command, Director of the Studies, a Colonel or Lieutenant-Colonel of the Staff Corps.

A Major of the Staff Corps, charged with the superintendence of the interior economy and the drills and exercises.

Three Captains of the same Corps, charged with the details of the interior economy of the School, and to assist the Major in the instruction of the Officers in their military duties. The Captains are required to take the direction of a portion of the topographical works on the ground.

A Medical Officer.

Thirteen Military Professors, or Assistant Professors, viz.:—

A Major or Captain, Professor of Applied Descriptive Geometry.

A Major or Captain, Professor of Astronomy, Physical Geography, and Statistics.

A Major or Captain, Professor of Geodesy and Topography.

A Major or Captain of Engineers, Professor of Fortification.

A Major or Captain of Artillery, Professor of the instruction relative to this arm.

A Military Sub-Intendant, Professor of Military Legislation and Administration.

A Major or Captain, Professor of Military Art.

A Captain, Assistant Professor of Descriptive Geography; charged also to assist the Professor of Fortification.

A Captain, Assistant Professor of Topography; charged also to assist the Professor of Geography.

A Major or Captain of Cavalry, Professor of Equitation; he acts under the immediate orders of the Major of the College.

Two Lieutenants or Second Lieutenants of Cavalry, Assistant Professors of Equitation.

An Officer of Cavalry of the same rank, acting as Paymaster to the Riding Detachment.

The Non-Military Professors are:—

Two Professors of Drawing.
Two Professors of German.
A Professor of Fencing.

One hundred and forty-five horses are kept for the use of the student-officers, and eighty-two men belonging to the cavalry to look after them.

Both the studies and examinations at the Staff School hold an intermediate place between those of the Polytechnic and St. Cyr, being less abstract than the former, and higher and more difficult than the latter.

CONDITIONS OF ADMISSION.—ENTRANCE EXAMINATIONS.

The entrance to the Staff School of Application in France is, as is the case in all the French military schools, by means of a competitive examination, or, rather, by the results of three distinct examinations, and by the selection of different sets of successful candidates. *Three* are taken from the students leaving the Polytechnic, who have an absolute right to the three first places in the Staff School, and *twenty-two* are selected from the thirty best students leaving St. Cyr, and an equal number of sub-lieutenants of the line under twenty-five years of age, if so many present themselves. The sub-lieutenants must have one year of service in that rank, and they must make known their request to be allowed to compete for admission to the Staff School to the Inspector General, and, through him, to the Minister of War. It should be added, that their number is generally extremely small.

The usual number of young officers admitted yearly to the school in time of peace is twenty-five, but this number is sometimes considerably exceeded, and we found no less than ninety present. The *three* Polytechnic students select the Staff School after their final examination, and the St. Cyr students make known their desire when the whole are examined by a Board of Examiners, and the thirty best are then selected as competitors for admission into the Staff School of Application.

The sub-lieutenants also repair to St. Cyr, where they are examined separately by the same examiners who have just conducted the examination of the St. Cyr students, and in the same subjects.

Their marks or credits are then compared with those of the St. Cyr pupils; and the relative position of the two sets of candidates is ascertained, and the list of those to be admitted to the School of Application determined accordingly.

These examinations take place before a Commission of Officers, composed of,—

A Lieutenant-General President, appointed by the Minister of War.
The Director or Chief of the Dépôt de la Guerre.
The Commandant of the School of Application.
Four Colonels or Lieutenant-Colonels of the Staff, appointed by the Minister of War.
A Field Officer chosen from among the Officers employed at the Dépôt de la Guerre, as permanent Secretary.

This Commission is also charged with drawing up and proposing regulations for the approval of the Minister of War concerning the interior organization and the course of study to be followed in the

school, and to make changes in the programmes for admission and for leaving the school.

A very detailed account of the subjects of the entrance examination is drawn out, and inserted in the *Journal Militaire*, and the *Moniteur* every year. The following are the subjects:—

(1.) Trigonometry and Topography.
(2.) Regular Topography—the measuring of plane surfaces and leveling.
(3.) Irregular Topography, Plane Trigonometry.
(4.) Military Art and History, including—
  (*a.*) History of Military Institutions at the chief periods.
  (*b.*) Present composition of the French army.
  (*c.*) Organization of an army in the field.
  (*d.*) History of some of the most memorable campaigns, as those of 1796—97 in Italy, and of 1805 and 1809, in Germany.
(5.) Artillery and Science of Projectiles.
(6.) Field Fortification and Castremetation.
(7.) Permanent Fortification.
(8.) Military Legislation.
(9.) Military Administration.
(10.) Manœuvres.
(11.) German Language.
(12.) Drawing.

The marks assigned and the influence allowed to each of these subjects are the same as those given in the final examination at St. Cyr. The entrance examination places the students in order of merit.

THE STUDIES.

All the details of the teaching are in the hands of a Council of Instruction, similar to that of the Polytechnic, and consisting of the General Commandant (President,) the Director of Studies, and three Military Professors, appointed yearly by rotation. Other professors and assistant professors, or officers of the staff of the school, may be called in to assist the Council, but (except in deciding the list at an examination) they have no votes.

This council does not interfere directly with the administration, the common work of the school. It draws up, indeed, the list of lectures, making any alterations in them, or in the books to be used which may seem from time to time desirable. But the officer accountable for the daily working of the school is the Director of Studies. His functions appeared to us to bring him into more constant connection with the pupils than was the case with the director of the Polytechnique. In all the schools the General Commandant and the Director of Studies live in the establishment; but at the *Ecole d' Application* and at St. Cyr the director "examines the methods of teaching, and proposes to the Council of Instruction any modifications or improvements which may raise or quicken the instruction. He inspects the work of the student-officers, both in

and out of the school. He keeps a register of the marks given by the professors, and at the end of every three months brings the sum of them before the General Commandant in a detailed report." In fact, his school functions are not modified, as at the Polytechnic, by a body of able professors.

As already stated, there are fifteen professors, without reckoning those of equitation, and thirteen of them are officers; but the system of *Répétiteurs*, which we have seen so influential at the Polytechnic, does not exist here.

The hours of work are, in summer, *i. e.* from May to November, from six to five, and in winter from eight to five, with the exception of one hour for breakfast and one hour for *étude libre*, which appears to mean very little indeed. From seven to nine hours daily may be taken as the amount, but (as is the case with most French schools) there is a constant change, not only in the subjects taught but in part of the work being *out* and part *in* doors, some really head work, much purely manual. There does not appear to be the same intense application as at the Polytechnic; indeed, the work for three months in the year is almost entirely in the open air, consisting in making plans and military sketches, either in the neighborhood of Paris or in the more distant parts of the country; eight months are devoted to the in-door studies, one month to the examinations.

The in-door studies are entirely conducted in the halls of study (*Salles d'étude*,) in each of which we found parties of twelve or fifteen students seated. They are inspected constantly by the director or some of the professors. None of the regular work may be done in private. It seems everywhere a fixed belief in the French Military Schools that very much would be done idly and ill if done in private. This presents a striking contrast to the feeling on the subject in England.

The severer and preparatory studies of mathematics are supposed to have been completed prior to entrance into the Polytechnic or St. Cyr. Some, however, of the studies of applied science occupy considerable time at the School of Application.

The following analysis will show the time assigned to each branch:—

1. *Astronomy* occupies 1½ hours weekly for the pupils of the first year; afterwards it ceases entirely.

2. To *Applied Descriptive Geometry* a good deal of time is given, but still only by the pupils of the first year. 12 hours a week are spent upon it in the first half year, 10 in the second.

3. *Military Topography* occupies about 10½ hours in the first year, 6 in the second.

4. A good deal of time is devoted to *Field Fortifications.* The junior division, it is true, only begin it in their second half year of study, and then only work at it for 1½ hours weekly. But the senior division are occupied 4½ hours weekly in their first half year, and 7½ hours in their second.

5. *The Study of Military Administration and Legislation* is begun immediately upon entrance. It occupies during both years 1½ hours weekly.

6. *Lectures on Military Art and Tactics* are also given for 1½ hours weekly during both years, and after hearing these lectures the students are occasionally required to write a military memoir on a campaign, descriptions of reconnaissances, or of fields of battle, and to make sketches of ground with accompanying reports. This course was noted by General Foltz, the director of the school, as defective, on the ground that it was too difficult to find a teacher for, or indeed to teach military art; and he thought that lectures on military history, or such works as Napoleon's Memoirs, would be more useful to the pupils.

7. *Drawing* occupies throughout 4½ hours weekly, and great attention is bestowed upon it. We were shown a large number of works done by the young officers of the school. To enumerate some of the most important—there were specimens of objects, with shadows; perspective of the exterior and interior of buildings, with shadows; perspective views of country; machinery drawings, plan, section, and elevation; in fortification, a plan of comparison of a portion of ground with proposed field-works for defense; military bridges; reconnaissance, and memoir of a route, with accompanying notes and sketches, done both on foot and on horseback; plan of a portion of country made with a compass by parties of ten, under the direction of a Captain (for this the trigonometrical points and distances were furnished, and it was filled up by a minor triangulation;) plan of a field of battle, made without points; and a description of the battle.

These drawings were mostly executed with great care, and we were told that the course was fully as much as the student could accomplish in two years. Some parts of it are done entirely in the *Salle d'étude;* sketches are made on horseback in the neighborhood of Paris, always under the direction of the professors, others again at great distances, such as one at Biarritz last year, and the one on which the pupils are to be engaged this year, is the line of operations of Wellington from the Spanish frontier to Toulouse. The two last kinds of work are roughly sketched, and finished at Paris. These summer occupations seem to stand in place of vacations, of which there are none.

(1.) To *Fencing*, three hours a week are given throughout.

(2.) To the *Cavalry Drill* two hours weekly in the first division. It is replaced by *Infantry Drill* in the second.

The studies which none but the senior division pursue are,—

(1.) *Artillery* studies, which occupy 4½ hours weekly.

(2.) *Geography*, meaning chiefly the military geography of a country, with a few lectures on statistics and political economy; these take 1½ hours weekly.

(3.) *Geodesy*, or trigonometrical surveying, also for 1½ hours.

The only strictly literary occupation is the study of German for about three hours per week during the whole time. We were told that a large proportion of the pupils unite among themselves to learn English privately, but no public course is given.

THE EXAMINATIONS.

The students have two examinations to go through in each year; the first commencing about the first of June, the last in November, and each of the first year's examinations is held before a jury consisting of—

(1.) The General Commandant, or the Director of Studies; President.
(2.) The Professor of the Course examined in.
(3.) Two Officers appointed by the Council of Instruction.

The last examination in each year is, of course, the most important, inasmuch as the passage from the Second or Junior to the First or Senior Division, and in part from the Senior into the Staff Corps, is regulated by the results of these examinations; and the value allowed to the last examination in each year is just double of that assigned for the examinations in June.

The examinations of the first year are confined to the subjects of study followed during that year, viz.:—

Descriptive Geometry, Astronomy, Topography, Artillery, Fortification, Military Art and Administration, German, Drawing, Register of Notes and Memoranda.

The professors and members of the jury are directed rigorously to conform themselves to the following scale as regards the marks or credits they award for the oral answers, graphical representations, &c.

0 to 4	bad.
5 to 10	passable.
10 to 13	fair.
14 to 18	good.
19 to 20	very good.

The Co-efficients of influence of the various studies of the first year are as follows:—

Descriptive Geometry,	Theory,	4	9	
	Geographical Representation,	3		
	Drawing of Machines, Memoir,	1		
	Drawing,	1		
Astronomy,	Theory,	4	5	
	Graphical Representation,	1		
Topography	Theory,	4	10	
	Graphical Representation,	6		
Artillery,		4		
Fortification,	Theory,	4	8	
	Graphical Representation,	2		
	Memoirs,	2		
Military Art	Theory,	4	7	
	Memoirs, On various questions,	1		
	Memoirs, On surveys,	2		
Total,			43	
Amount carried forward,				

Subdivision of the Co-efficients of the Graphical Representations.

Survey with compass,	1	6
Rapid sketch,	1½	
Itinerary of the first survey,	1½	
Itinerary of the second survey,	1½	
First Topographical Drawing,	½	
Second, with relief,	¾	
Third, on the scale of $\frac{1}{20000}$,	¾	

			Subdivision of the Co-efficients of the Graphical Representations.
Amount brought forward,		43	
Military Administration,	Theory, 4	5	
	Memoirs, 1		
Manœuvres,		2	
German,		4	
Drawing,		2	
Keeping of Memorandum Books,		1	
Conduct and Discipline,		1	
Riding and Knowledge of the Horse,		2	Riding, Hippology, 2
Total,		60	

As soon as the examinations are concluded, the Council of Instruction prepares a provisory classified list of the students, made out in order of merit from the credits or marks awarded by the Examining Jury in connection with the above-mentioned co-efficients of influence, in a similar manner to that already explained in the account of the Polytechnic School, the student with the largest numerical credit being placed at the head of the list.

This provisory list is submitted to the Consulting Committee of the Staff Corps for transmission to the Minister of War.

In order to pass from the Second or Junior into the First or Senior Division, every Student Officer must have obtained the following marks or credits from the Jury, viz.:—

In Astronomy and Geometry, six out of twenty in each.

In all other branches of theoretical instruction, four out of twenty.

In the classification of the graphical representations in topography, a mean of eight out of twenty, and in each of the other courses a mean of six out of twenty; and as the general result of his various works and of his examinations (the mean of the year being combined with the number obtained before the jury in the proportion adopted by the Council of Instruction,) he must have obtained a number of credits equal to one-half of the maximum (1,200.)*

Every Student Officer who in his oral examination before the Jury has failed in obtaining the minimum stated above is subjected to a fresh proof before the Consulting Committee of the Staff Corps, and if this is not favorable to him he ceases to belong to the school, and must return to his regiment, unless such failure can be attributed to an illness of forty-five days, in which case he may be permitted to double his first year's course of study.

If the second proof be favorable he is retained at the school, but

* There must be some error in the printed regulations on the subject.

placed at the bottom of the classified lists prepared by the Council of Instruction.

The co-efficients of influence for the second year are—

				Subdivision of the Co-efficients of the Graphical Representations, &c.	
Geography and Statistics,	Theory,	4	5		
	Memoir,	1			
Geodesy and Topography,	Theory,	4	10	Survey with the Compass,	1
	Geographical Representation,	6		Reconnaissance,	1½
				Itinerary of the first survey,	1½
				Itinerary of the reconnaissance	
				Drawing of a Fortress and its Environs,	1½
				Reduction of the Drawings,	½
					6
Artillery,	Theory,	4	8	First Drawing of a Military Bridge,	1
	Graphical Representation,	3		Second ditto,	½
	Memoirs,	1		Breaching Battery	½
				Drawing of Artillery Carriage,	1
					3
Fortification,	Theory,	4	11	Defilement,	1
	Graphical Representation,	3		Project of Fortification,	2
	Memoir on a Fortified Place,	2½			3
	Memoir on a Project of Field Fortification,	1½			
Military Administration,	Theory,	4	4		
Military Art	Theory,	4	8		
	Memoir on various questions comprised in drawing up a memoir,	2			
	Memoir on the survey with a Compass, or sketch reconnaissance,	2			
Manœuvres,			3		
German,			4		
Drawing,			2		
Keeping of Note Books,			1		
Conduct and Discipline,			1		
Riding and Knowledge of the Horse,			3	Riding, 2 / Veterinary Art, 1	3
Total,			60		

The examinations of the students of the Senior or First Division is made in a similar manner to that already described for the Junior Division, but after they are concluded, and prior to these students being admitted into the Staff Corps, they are subjected to another examination before the Consulting Committee of the Staff Corps, consisting of—

3 Generals of Division on the Staff.
3 Generals of Brigade.

3 Colonels of the Staff.
5 Lieutenant-Colonels, including the Secretary.

The professors belonging to the school may be called in to assist at this examination, and when it is concluded the Consulting Committee proceeds to the definitive classification of the Student Officers of the First Division by causing the following documents to be placed before them, viz.:—

The register of the notes of each Student Officer.

Tables of the value of their work; the classified list of passage to the First Division, and the provisionary list for leaving, recently prepared by the Council of Instruction. The numerical credits obtained in these two classifications are added (each sum being halved) to the definitive classification prepared by the committee. The total is divided by two, in order not to exceed the regulated limit of 1,200 credits for the maximum.

Every Student Officer who, in this examination for leaving, has not obtained the half of the maximum number of numerical credits is considered to be inadmissible to the Staff Corps.

This classified list, prepared by the Consulting Committee of the Staff Corps, fixes the position of the Student Officers in order of merit, and according to this order of merit they enter the Staff Corps. The committee reports to the Minister of War the names of the Student Officers that are not eligible for the Staff Corps.

The first two or three places, we were told, are always remembered as marks of distinction, but the honor does not descend lower, as in the intense competition of the Polytechnic.

Students belonging to the First Division may also be permitted to double the second year's course of study on account of illness; but in no case can an officer be permitted to remain more than three years at the school.

MILITARY ORPHAN SCHOOL

AT LA FLECHE.

THE *Collége* or *Prytanée Militaire* appears, in point of studies, to differ from the schools that have just been described, chiefly in its having only one department for the elder pupils, the scientific, with merely occasional subsidiary lessons in grammar and literature.

The institution is a school for boys between the ages of ten and eighteen; no one under ten or above twelve years old can be admitted: and no one can commence a new course at the school after completing his eighteenth year.

The prescribed instruction comprise the following courses:—

Humanities (Latin, &c.)
History and Geography.
German.
Mathematics.
Physical Sciences.
Natural History.
Figure Drawing.
Linear Drawing.

And the general object of the courses is to qualify the pupils to pass the examination for the degree of Bachelor of Science.

The pupils also go through military and gymnastic exercises, and learn to swim.

The school is under military discipline, is governed by a general officer of the staff corps or a colonel in active service, as commandant and director of studies, and by a lieutenant-colonel or major, with the title and functions of second in command and sub-director. In addition there are four officers, twenty-three professors and teachers, and eighteen *répétiteurs*.

The yearly charge for paying pupils is 850 francs, and the cost of outfit about 500 francs; but there are 400 free and 100 half-free places (400 *bourses* and 100 *demi-bourses*) granted by the state in favor of the sons of officers, the order of preference being regulated as follows, those who are orphans on both sides having the first claim, and those who have lost their father, the next:—

1. Those whose fathers have been killed, or have died of wounds received in action.
2. Those whose fathers have died in the service, or after retiring on a pension.
3. Sons of fathers who have been disabled in consequence of wounds received in action.

Sons of non-commissioned officers or of private soldiers who have been killed or have been disabled in action, who have been placed on the retired list, or have been discharged after twenty years' service, may also be admitted, as a special mark of favor.

The candidates undergo an examination, not, however, for the purpose of competition, but merely to show that they are qualified to enter the classes.

The school is inspected annually by a general officer sent by the war department, as also by an officer of the commissariat. There is no sort of engagement or expectation that the pupils should enter the military service. The nature of the studies holds out some inducement to them to compete for admission at St. Cyr or the Polytechnic; and in the examination for entrance at St. Cyr, it is stated that the sons of military men have the privilege of being raised fifteen places in the list of the order of merit. An officer's or soldier's son from La Flèche would, in case of 300 candidates being admitted to St. Cyr, be able to claim admission, if he came 315th on the list, to the exclusion of the candidate who stood 300th.

SCHOOL OF MUSKETRY.

The School of Musketry, formed by the Ministerial Order of 29th March, 1842, was only intended at first to supply instructors to the ten battalions of Chasseurs who were armed with rifles. The results of its establishment were, however, found so valuable, that the benefits of the instruction it afforded were by degrees extended to the whole army.

In 1845, the Duc d'Aumale, who had taken a special interest in the improvement of fire-arms and the better instruction of the soldier in their use, was nominated Inspector-General of Schools of Musketry. Besides the chief school at Vincennes, others were formed in the principal garrisons; and eventually a regimental School of Musketry was established in every regiment of infantry.

Some changes have been made in the system established under the Duke. The School of Musketry at Vincennes has only been regularly organized on its present footing since 1852. A portion of the fortress affords the accommodation required for the theoretical instruction, while the Polygon offers admirable facilities for practical instruction and target practice.

The Staff of the School consists of,—

A Commandant, a Lieut.-Colonel of Infantry.
An Instructor in Musketry, a Major of Infantry.
A Professor, a Captain of Artillery.
An Assistant Professor, a Captain of Artillery.
A Sub-Instructor in Musketry, a Captain of Infantry.

Each regiment sends an Officer (a Sub-Lieutenant or a Lieutenant) to Vincennes, to go through the course of instruction. The course commences on the 1st of March, and lasts four months. Two hours a day three times a week are devoted to lectures on the construction and use of fire-arms, and the theory of projectiles. Each officer is required to complete a certain number of drawings of the separate parts of arms. At the termination of the course, certificates are given, and, if favorable, go towards the officer's claim to be promoted "*au choix.*"

We were conducted over the rooms of the fortress set apart for the school by the officer charged with the Theoretical Instruction (Captain Févre, of the Artillery.) They consist of a large paved

room, where the officers perform their small-arm exercise in bad weather; of the study-room, in which the drawings are executed; of a lecture-room or amphitheater; of the library, chiefly supplied with technical works on arms; and of a model-room, containing a very good collection of French and foreign arms, and of portions of arms, to illustrate the lectures. There are, besides, private rooms for the instructors, and a room for the orderlies. On the ground floor a small forge has been fitted up for the purpose of giving practical instruction in some of the details of the manufacture of arms.

To produce accurate marksmen is not the only object of the School of Musketry. Its staff may be considered a description of standing committee, to whom inventions in arms and ammunition are submitted, to have their qualities practically tested. On the day of our visits experiments on the relative merits of three forms of balls were being carried on, which we witnessed.

Quitting the fortress by a bridge over the ditch, in an angle of which the Duc d'Enghien was shot, we entered on the Polygon or practice ground. In a few minutes two detachments of troops, one from the Chasseurs de Vincennes, the other from the 20th regiment of the line, arrived and took up their ground in front of the practice butts. Of the balls between which comparisons were to be made, one was proposed by M. Minié, who was himself present, another by M. Nessler, the third was named the ball "*de la garde.*" There were six targets in line in front of the butt; the Chasseurs fired at three of them, and the 20th regiment at the other three. A trench runs along parallel to the butts, and at a few yards in front of them. The line of targets is in the space between the trench and the butts. The trench gives cover to the range party, one of whom is stationed opposite to each target, in a rude recess cut into the side of the trench, to afford shelter in wet weather. Each time a target is struck, the man opposite to it raises his banderol, which is then seen by the firing party, and acknowledged.

The trench is continued to some distance beyond the butts, and is there met by another trench at right angles to it; so that one may go up from the firing party to the range party without any risk.

On the cessation of the firing, the officer in command of the range party numbered the hits in each target. He marked separately the hits where the balls had arrived sideways (shown by the form of the perforation,) a very important consideration in comparative experiments with oblong balls.

Prizes and honorable mentions are bestowed annually on the best shots. The number of the regiment and the names of the men thus distinguished are inserted in the official military journal.

MILITARY NAVAL SCHOOLS OF MEDICINE AND PHARMACY.

I. IMPERIAL MILITARY SCHOOL OF APPLICATION OF MEDICINE AND PHARMACY AT PARIS.

This school, which is located at Paris, at the military hospital of Val-de-Grâce, is under the control of the Minister of War. Its design is to introduce the pupils in the medical service of the army to an actual exercise of their skill, to complete their practical education, and make them acquainted with the regulations which govern the army in its relation to the sanitary service.

Admission to the School of Application as resident physicians and pharmaceutists, is gained by passing successfully a competitive examination. These examinations are held at Paris, Strasburg, and Montpelier, at uncertain periods, as the wants of the service may require.

For admission to the examination, the candidate for employment as resident physician must have his name enrolled in a bureau of military superintendence, and satisfy the following conditions:—1st. Be a native of France; 2nd. Be not above thirty years of age at the time of the examination; 3rd. Have received the degree of doctor of medicine from one of the medical faculties of the Empire; 4th. Be free from any infirmity that disables from military service; and 6th. Subscribe a pledge of honor that he will devote at least five years to the military sanitary service. The candidates are subjected to an examination in pathology, medical therapeutics, anatomy, and practical surgery. Candidates for the office of resident pharmaceutist must also be natives of France, be not above thirty years of age, have a diploma of pharmacy of the first class, be free from every disabling infirmity, pledge themselves to at least five years service, and pass an examination upon the materia medica, chemistry, and pharmacy.

During their continuance at the School, they receive a fixed annual salary of 2,160 francs, and an allowance of 500 francs for the first expense of uniform. After spending one year at the school and passing a satisfactory final examination, they receive the brevet rank of medical or pharmaceutical aid-major of the second class.

There is at Strasburg, in connection with the Medical School, a Preparatory School, designed to prepare for the degree of doctor of medicine the pupils belonging to the sanitary service of the army. It is annually supplied with pupils, who, without having passed the usual course of matriculation, are enabled to satisfy the conditions requisite for admission to the first grade of a doctorate. Every pupil of the preparatory school, has the right of admission to the Imperial Military School of Application.—*Decrees of* 13*th of Nov.*, 1852, *and* 28*th of July*, 1860; *Acts of* 18*th of June, and* 15*th of October*, 1859, *and* 4*th of August*, 1860.

II. IMPERIAL NAVAL SCHOOLS OF MEDICINE AND PHARMACY.

These schools, located at Brest, Toulon, and Rochefort, are under the control of the Minister of the Marine; their design is to prepare sanitary officers for service in the vessels of the imperial marine.

The posts of surgeon, or pharmaceutist, of the third, second and first classes are assigned on examination, according to order of priority determined by a medical jury. For admission as student in these schools, after attaining to the first grade of the third class, it is necessary to be at least sixteen years of age, and not above twenty three, to produce a diploma as bachelor of sciences, to prove French nationality, and to be exempt from every infirmity that can cause unfitness for the marine service. Examinations for filling the vacancies in each school commence on the 1st of April, and 1st of October, annually.

The instruction is continuous. The libraries, cabinets of natural history, the botanical gardens, anatomical theaters, chemical laboratories, cabinets of natural philosophy, are at the disposition of the students. The candidates admitted, receive cards of membership. They are required to pay the treasurer of the library a sum of 50 francs, which is devoted to its maintenance.—*Ordinance of* 17*th July*, 1835, *and* 15*th May*, 1842.

THE IMPERIAL NAVAL SCHOOL AT BREST.

This school, located at the Road of Brest, on board the ship "*La Borda*," and under the control of the Minister of the Marine, is designed for the instruction of youth destined for the corps of state naval officers. Candidates are admitted to this school after a public examination, which occurs annually. For admission to the examination, they must prove; 1st. By the production of the records, that they are French by birth or naturalization, and that on the 1st of January of the year of the examination, they were at least fourteen years of age, and had not passed the maximum of seventeen years; 2d. By the certificate of a physician, that they have been vaccinated, or have had the small-pox, and that they have no infirmity that disables them from the performance of marine duty.

The matriculation of the candidate is effected between the 1st and 24th of April, at the prefecture of the department in which the domicil of the family is located. The examination is made at the principal office for examination nearest to that domicil, or to the college where he has been educated; the choice as regards the place of examination must be made known at the time of matriculation.

There is required for admission into the school, a knowledge of arithmetic, algebra, geometry, plane trigonometry, applied mathematics, natural philosophy, chemistry, geography, the English language, and drawing, in conformity with the course of study pursued at the lyceums. The candidates must prepare a French composition, a translation from the Latin, an exercise in English, a numerical calculation in plane trigonometry, a geometrical drawing, and the off-hand sketch of a head. These compositions are done at Paris, and the principal towns of the departments simultaneously, on the 2nd and 3rd of July. The oral examinations are commenced at Paris on the 2nd of July, and repeated at the other towns in succession as previously announced. The oral examinations are of two grades; the lowest serving to determine whether the candidates are sufficiently well prepared for admission, the higher—to which only those are subjected, who have successfully passed the first—being

the decisive one, and together with the compositions, determining the final classification in accordance with the order of merit.

The course of study continues two years, which are passed at the Board of Brest on the ship "*La Borda.*" The expense of board is 700 francs, and of the outfit, about 500 francs. A grant of the whole or half of the amount of the expense, may be made to young men without fortune. The insufficiency of the resources of a family for the maintenance of a pupil in the school, must be authenticated by a resolution of the municipal council, approved by the prefect. There may also be allowed to each beneficiary, at his entrance into the school, the whole or the half of his outfit. Application for this assistance must be made to the Minister of the Marine at the matriculation of the candidate.

The pupils that have passed the examinations of the second year in a satisfactory manner, are known as naval candidates of the second class.—*Law of 5th June*, 1850—*Decree of 19th January*, 1856—*Acts of Sept.*, 1852, *and 1st January*, 1861.

SCHOOL OF MILITARY GYMNASTICS NEAR VINCENNES.

The practice of gymnastics is an essential part of the training both of officers and men in the French army, and constitutes a portion of the regular exercise in every military school. There are also several schools specially devoted to this department of physical education, and one styled the Imperial School of Military Gymnastics at the Redoute de la Faisanderie, part of the fortifications near Vincennes, may be regarded as the Normal School for training both officers and privates in order to act as monitors or instructors in their respective regiments and battalions. The following account of the instruction given, is abridged from an article in the *New York Tribune*, under the heading, "How the French and the English make their Soldiers." The writer says that Military Gymnastics, in the form and to the extent taught in this school, is exclusively French, and is thought to have an important bearing on the more frequent and deadly use of the bayonet in future warfare.

About three hundred privates and officers compose the School of Military Gymnastics near Vincennes, where three professors of the science and art of gymnastics give a course of practical instruction for about six months each year. The school is under the same regulations as the School of Musketry—each colonel being responsible for the instruction of his regiment, and the lieutenant-colonel directs the application of the rules and regulations.

I. ELEMENTARY GYMNASTICS.

The gymnastic exercises are divided into "elementary gymnastics," and "gymnastics applied," that is, applied to special military purposes. A general progression regulates all the exercises.

The men are divided into three classes. The third class comprises all the recruits. These are exclusively practiced in the first lessons of elementary gymnastics during the first fortnight of their enlistment, and before they proceed to regimental drill. The first class consists of those who are proficient in the first four lessons of the general progression; and the second class, of those who are preparing for the first. The first class practices twice a week; the second, three times a week; the third class twice a day, until the men have commenced their regimental drill, and then once a week. Each practice lasts one hour and a half. "Returns" are drawn up recording the zeal and progress of the men, as in musketry instruction; and the captain instructor of gymnastics has to send in, every month, to the lieutenant-colonel, similar returns as to

the general progress of the instruction, so that the number of effectives of each company may be accurately known.

None but the prescribed exercises are permitted by the instructor. He must never allow the men to attempt any extraordinary or exaggerated feats, that might cause accidents. His aim must be to develop the strength, agility and dexterity of the soldier by a wisely regulated exertion, and inspire him with that self-reliance which the various occasions of his military life may demand. He must strive to rouse his pluck and emulation by rendering the exercises as agreeable and as easy as possible, taking all necessary precautions to prevent him from injuring himself or becoming discouraged. He must never forget that the perfect safety of the soldier under training, the pleasure of the various exercises, and, above all, the soldier's own desire to excel, are the first and secret elements of success in gymnastics. Harsh treatment must be carefully avoided, much more anything like turning his efforts into ridicule when he fails, or punishing him for involuntary awkwardness. In conclusion, he must not expect more than regularity, precision, and relative perfection in these exercises, to which a military form has been given merely to facilitate their study and their application to the whole army.

The men practice in their fatigue dress, in squads of ten or fifteen, and are provided with belts.

The first exercises are intended to make the body supple from head to foot, turning the head from right to left, forward and backward, or merely toward right and left, bending the body, raising the arms vertically, with and without bending them; flinging out the right or left arm, fists clenched, and describing a circle of which the arm is the radius.

No soldier marches so easily as the French. It is the result of his method of learning to march. In the moderate and quick cadence the foot comes flat to the ground, the point of the foot touching it first; in the running cadence the movement is an alternate hopping on the points of the feet. It is obvious that this mode of teaching to march must enable the soldier to avoid the great cause of universal bad marching and walking, namely, bringing the heel to the ground, thus shaking the whole body, especially the spine, and consequently distressing the brain and lungs. By the great elevation of the legs the soldier must habituate himself to bringing the toes first to the ground, instinctively, to avoid the shock, especially in the running cadence. During the practice the soldier repeats the words "*one—two,*" as each foot comes to the ground, in order to practice the lungs at the same time, and also to give a rhythm to the performance.

In order still more to direct locomotion to the fore-part of the foot, so essential to good and easy marching, there is the following practice:—1. Attention. 2. Flexion of the lower limbs. 3. Commence. 4. Cease. At the second command the soldier brings both feet together, throwing the weight of the body forward. At the word *commence*, he slowly lowers his body by bending his hams, so that the thighs touch the calves of the leg, the arms falling beside the body, the weight of the body being entirely thrown on the points of the feet. He then gradually rises to the erect position.

There is also what is called the "gymnastic chain." Circles are traced on the ground contiguously; the men are posted in these circles, in a single rank, three paces apart. The instructor commands:—1. Squad will advance. 2. Double. 3. March. 4. Halt. At the first word the soldier throws the whole weight of

his body on the right leg. At the word *march*, he throws the left foot smartly forward, the leg slightly bent, bringing the point of the foot to the ground, thirty-nine inches from the right, and so in like manner with the right, always keeping the weight of the body on the leg which feels the ground, allowing the arms to take their natural motion for equilibrium. The first man (a monitor, one of the best trained) runs successively through all the windings of the chain of contiguous circles without stopping; the others follow, preserving the distance. When the men meet each other at the intersections of the circles, they shorten or lengthen the pace, so as not to jostle each other, and so that two men shall not pass by the same interval.

To deliver a thrust or a blow with the bayonet, sword, or fist to the best advantage, requires training of the subsidiary muscles, and such scientific practice as places the body in the best position to aid and intensify the effect. This is done by the "Pyrrhic Exercise." The command is:—1. Pyrrhic Exercise (right or left limb forward.) 2. Ready. 3. March. 4. Halt. At the word *ready*, the soldier faces to the left, carries the right foot forward, the heel sixteen inches from the hollow of the left foot, the right knee bent, the left leg stretched, the right arm extended forward, the fist clenched, on a line with the shoulder, the nails slightly upward, the left arm in a line with the left side and but little bent, fist clenched, and about six inches from the thigh, the nails toward the thigh, the upper part of the body inclined forward, the head erect, the eyes looking to the front, the left shoulder lowered. At the word march, the soldier straitens his body, bringing the right heel near the hollow of the left foot without touching the ground, turns at the same time his right forearm, so that describing a circle from below upward, the fist lightly touches the right breast, then flinging the fist smartly forward, the nails a little upward, and advancing the right leg to about twenty-five inches, the foot striking the ground with force, or an "attack," as we call it in sword exercise, the upper part of the body inclining forward, the left leg stretched, the foot flat, the left arm turned outward and along the thigh as before. These movements are continued until the words "company—halt" are given, when the soldier faces to the right and comes to attention. The left arms are practiced in like manner, and a rhythm is given to the performance by the repetition of the numbers 1, 2, 3, by the soldier.

A soldier must not be easily knocked off his legs; so there are six positions for the practice devised to teach the soldier how to maintain his equilibrium. He stands alternately on the right or left leg, bending the other against the body with his locked fingers, or he stands on one leg, the other bent behind, or he comes slowly to the kneeling position and springs up smartly, flinging his arms suddenly above his head, the nails turned inward, and then comes to attention, or he bends forward on one foot, or backward in like manner, and to the right or left, all on one foot.

The elementary development of the muscles forms a most important part of the training. By word of command the soldiers strike their breasts with the right or left fist—strike out with the right and left as in boxing—support cannon balls in the hand, one or both arms extended, and hurl the balls to a distance. They fling an iron bar, held by the middle; they support a heavy club in every possible position, at the shoulder, behind the back, one with the left hand, another with the right, at right-angles, or two together, one in each hand. They swing the club horizontally and overhead, or vertically and behind, or round and round the body.

Preparatory to leaping. the proper muscles must be taught their necessary contractions, and this is done to the words of command—"Simultaneous flexion of the legs," "Simultaneous flexion of the thighs and legs," whereat they hop on the right or the left leg singly, and then on both together. They are practiced in advancing on the position of kneeling on one leg alternately, obviously a very useful mode of progression for a skirmisher in stealthily changing position behind a low wall or a hedge.

They are taught to walk systematically on the heels alone and on tiptoe, and to fling a cannon ball with the foot by means of a strap attached to it. As practice alone can habituate us to the proper inclination of the body in ascending and descending, both these modes of marching are carefully taught, attention being fixed to throwing the weight of the body on the point of the feet in the former, and on the heels in the latter.

Their wrestling takes every shape and mode of contest. With extended arms, the fingers interlocked, the left leg advanced, they push against each other; or, holding each other by the hands or by the wrists, they pull against each other; or, each man holding his left wrist with his right hand, the thumb underneath, seizes with his left hand the wrist of his antagonist, and then at the word "wrestle," he pulls or pushes uniformly or by jerks, to the right, to the left, forward, to the rear, upward and downward, striving to displace his antagonist.

Furnished with appropriate handles, with a short cord attached, they pull against each other, each striving to drag his antagonist with one hand, then with both hands; and then three wrestle together in like manner, the central man pulling or resisting the outer two, or both of these pulling against him in opposite directions.

Then two wrestle in a sitting posture. They sit, closing the legs, feet to feet, and sole to sole, with the aforesaid handle and cord between their feet, and at the word of command pull away, striving to raise each other. As soon as one is raised the contest ends, and the victor holds the handle in his left hand. The instructor then makes all those wrestle together successively who have won the handle, until only two remain, and then ascertains the strength of these two by a dynamometer, and makes a note of it.

The last of the elementary exercises are those of traction, or drawing against each other, holding on by a rope, either in pairs, or several together pulling against a fixed point, which may be a dynamometer, indicating the force of the combined pull resulting, or the men are divided into two squads and pull against each other.

As most of these exercises admit of a rhythm or cadenced sound emitted by the men themselves, this vocal accompaniment is strongly recommended. It certainly gives additional animation to the scene. Indeed the cultivation of the voice is considered eminently essential in the course of gymnastics. Singing exerts a salutary influence on the chest, and, moreover, it is incontestable that it will be the means of powerfully acting on the *morale* of the French soldier, by teaching him songs of patriotic and martial import. The singing-lesson at which I was present was particularly interesting. The system is one recently invented, wherein the ordinary notes are represented by arithmetical numbers—thus occupying about one-third of the usual space. Pointing by means of two canes to each representative number is all that is required by the instructor. The pupils, about 300 men and officers, intoned the notes with admi-

rable precision. When the instructor opened out the canes they made a crescendo—swelling to the loudest—and when he closed them gradually it was a beautiful diminuendo, "in linked sweetness long drawn out." There was then sung a concerted piece in two parts, extemporized by the highly-gifted Commandant, who figured it on the blackboard. It was at once most accurately sung—first and second so admirably concerted that the whole seemed as it were an organ of human stops—alto, tenor, and bass most harmoniously blending.

Such are the elementary gymnastics of the course.

II. APPLIED GYMNASTICS.

The exercises of applied gymnastics must be directed with extreme prudence. Care must be taken by the instructor that the emulation of the pupils should not degenerate into a spirit of rivalry, instigating them to dangerous efforts.

During cold weather they must abstain from executing leaps that require violent efforts; at all times those who are not perfectly disposed should not be required to leap at all. Carelessness and inattention to the rules can alone cause those accidents apprehended in these exercises.

The dimensions of the obstacles to be leaped over must be gradually increased; but no downward leap must ever exceed sixteen feet—five meters. Such is the regulation; but really to leap down sixteen feet seems no small matter, considering that the height of an ordinary room—some ten or twelve feet—would make the nerves tingle if we had to leap down that height; however, the French soldiers perform such leaps with ease, and therefore we must conclude that all Anglo-Saxons here or elsewhere can "go and do likewise."

The words of command are: 1. Attention. 2. Forward—leap—one, two, three. At the second word, the man closes the points of the feet; at the word one, he stoops on his lower extremities, slightly raising the heels and stretching his arms to the rear, the fists clenched; he then rises again, the arms hanging naturally down. At the word two, he repeats the movement; at three, he recommences the same movement, stretches the hams vigorously, throwing his arms forward, leaps the distance, or over the obstacle, falls on the point of his feet, stooping down, and then comes to attention.

The same principle is observed in all leaping, whether to a height, downward, or forward and downward—the only difference being in the position of the arms. In leaping upward, the arms are flung overhead to aid the ascent—the same in a downward leap; but if the leap be forward and downward, the soldier begins with his arms in advance, and then places them perpendicularly for the fall. The reverse takes place when in leaping forward and upward.

Thus they practice leaping in every possible direction—upward and downward combined—upward, forward, and downward—to the right or to the left—to the right and to the left and downward combined—the arms being directed accordingly. They leap backward precisely in the some directions, and according to the same rules. In leaping backward from the top of a wall, the man first takes a glance at the descent, turns, closes his feet—the heels projecting over the wall, stoops—the upper part of the body being forward, places his hands outside his feet and seizes the edge of the wall, the four fingers above, the thumb underneath, and thus flings himself backward, his arms overhead. When there is width as well as depth in the backward leap, the body and the legs are flung off almost horizontally.

The running leap is performed in a similar manner—the run being quickened

more and more up to the moment of springing forward. Some of the leaps I saw performed were from fifteen to twenty feet. As a complement to these leaping exercises, the ground may be prepared with various objects to leap over, such as benches, tables, heaps of stones, &c.

The men are also progressively practiced in all these leaps, carrying their arms and baggage. In such cases the downward leap must be restricted to thirteen feet. The soldier holds his rifle balanced at the trail with the right hand, the muzzle slightly raised, so as to prevent it from touching the ground; he holds his sword (as the French soldier has a sword) with his left hand. When the soldiers have become familiar with leaping, the difficulty is increased by rendering movable first the point of departure, and then the point of the fall, and, finally, both these points are made movable. To leap from a body in oscillation, the soldier leaps at the moment when the body is sinking. There is great danger in leaping from an object in rapid motion. In case of necessity, the soldier must face in the direction of the motion, and at the moment of quitting it he must lay hold of it, shortening his arms, and so push himself backward, lengthening his arms.

It is a general principle that in leaping from a height of any extent, the soldier should avail himself of anything at hand to diminish the shock of the fall.

The circumstances in which leaping must be resorted to are often unforeseen, and require prompt decision; it is therefore important that the men should be taught the following principles—useful to everybody—to apply them spontaneously on all occasions:—

First. To form a rapid judgment of the obstable, and also of the ground on either side. We scan the ground in advance of the obstacle, in order to make a good choice of a footing for the leap; if the ground is too smooth the foot may slip; on soft ground there can not be a good footing for the leap. By scanning the ground beyond the obstacle, we select our landing-place, and we foresee what difficulties we shall meet with. A difference of level between the point of departure and the fall modifies considerably the extent of the leap.

Second. During the leap the breathing must be restrained, and the air with which the lungs have been previously filled must be expired the moment the man reaches the ground.

Third. In leaps in width and height, fling out the clenched fists in the direction the body is to take, so as to augment the impulse given by the legs.

To prove the utility of this principle, the men, in leaping, sometimes hold in each hand a grenade of two-pounds weight, or a four-pound shot; with this auxiliary the width of the leap is augmented.

Fourth. In downward leaps, raise the arms vertically as soon as the body begins to descend, in order that the body, reaching the ground on the point of the feet, may sink vertically without losing its equilibrium. If a man leaps into water, he places his arms at his side, his hands on his hips, the feet close together, the points of the feet lowered, the body stiff and rigid.

Fifth. During the whole time of the leap keep the arms in the parallel position they have at its commencement, in order to preserve the equilibrium of the body.

Sixth. In forward or wide leaps incline the body forward, in order that the oblique action of the legs on the body may be more efficient.

The recommendation to precipitate the last movements of the run preceding the leap, has the important advantage of enabling the soldier to incline his body as much as possible.

Seventh. Fall on the point of the feet, the legs being close together, bending all the articulations of the body from above downward, in order that the shock be not transmitted to the head without being lessened and attenuated by numerous decompositions of the force. The articulations of the feet concur efficaciously with this result, and it would be dangerous not to avail ourselves of them by falling on the soles of the feet, especially the heels, as previously explained.

Eighth. Avoid too rough a fall by giving to all the articulations a general and supple "setting up," so as to make a light bound on landing.

Ninth. On landing avoid all useless motion, allow the muscles to relax; their continued contraction and rigidity would interfere with the body's equilibrium.

They also practice leaping with poles. These are of different dimensions, beginning with the smallest—not longer than the rifle—and finished with long ones from nine to twelve feet in length. He then seizes the pole higher or lower, according to the distance of the leap. Of course perfect success in this exercise depends greatly upon the energy of the effort, and the long and rapid run by which it is preceded. They also leap with two poles together from a height, the poles being planted parallel and about two feet apart.

Suspension-bars are made subservient to the training of the French soldier. This exercise enables him to use his body as he pleases, in any possible position, provided he can get hold of anything. Its beautiful and splendid result is extraordinary strength of arms, legs, hands, and fingers. Indeed, these suspensions of the body by the hands, the elbow, the legs, by one hand, one leg, one finger, in every possible position, show how the men are prepared for the thousand casualties of the assault.

They climb ropes after the manner of sailors, and horizontal beams are raised at various heights from the ground, in which they learn to preserve a perfect equilibrium—sitting, moving along them by the hands, supporting the body, which is free to fall, and, finally, walking erect upon them like a rope-dancer without his balance-pole! In these ticklish positions they meet and pass each other—simulate a fall and recover; the beams may be inclined or even set in motion, it matters not—they hold on and do their work equally well—and drop to the ground without injury.

They are taught to pick their way over scattered stones or stakes driven into the ground; and it has even been thought expedient to teach them how to walk systematically on stilts.

They are taught swimming—all its necessary movements before they go into the water; and many, I was told, strike out at once, at the first trial, thus proving the physiological or anatomical efficacy of the well-considered mode of tuition. In the water they are practiced in performing the feats required in actual warfare, carrying their arms and accoutrements in a variety of ways, according to the supposed circumstances of the campaign.

Of course, if the men are taught to swim they must be sent regularly into the water. This regulation, therefore, insures personal cleanliness—the first rule of health, which is much needed in all armies. The morality of most armies is generally above the average; it should naturally be less—as nothing conduces more to long life than exercise, regular hours, and a rational discipline, But cleanliness, personal cleanliness is wanting, and we have to deplore the consequences.

With a view to escalading, the French soldier is assiduously trained in all the

shifts of ladder-mounting—with ladders of wood and ladders of rope—and he becomes as good as a sailor in pulling himself up a rope, either looped, knotted, or smooth, from the ground to any reasonable or unreasonable height. If a scaling-ladder be not at hand, a tent-pole or any pole will do to enable him to get to the top of a wall or the crest of a parapet. He is actually taught nine different modes of performing this achievement so flattering to the ambition of the French soldier.

The scaling of a represented turret was something beautiful to see. "In the twinkling of an eye" or "done in no time," can alone describe the rapidity of the exploit.

Every appliance may, however, be wanting on certain occasions in war—it matters not—the French soldiers are taught how to mount a wall without any instrument whatever—with their feet and the hands and the fingers alone. Bullets and cannon balls leave holes and indentations in the hardest walls—these are represented on the walls of the Gymnasium—and thus they practice this last resort of the resolute and determined besiegers. If there be no holes —no *points d'appui* for the ascent—what then? Why, then they build a *pyramid of men*—four men stand as a base, two or four more perch themselves on the shoulders of these, and then one mounts to the top on the shoulders of the latter by way of apex!

They have adopted all the fetes of the *trapèze*, as performed by acrobats. These tend to strengthen the arms and promote that self-reliance and confidence which are the prime elements of a good soldier. Some of their swinging leaps with the *trapèze* were prodigious, from one end of the long gymnasium to the other, where they alighted, and caught on the top of the wall, and descended to the ground, with hands and fingers, by mimic bullet holes, as before described.

Flying leaps on and over a wooden horse are practiced in every possible direction, and the French cavalry are required to be able to leap on their horses from the rear while galloping, and to leap over a hedge or barrier together with the horses, but on foot, holding the reins! It is impossible to believe that very many can do this; but that is the aim, and the higher the aim the greater the effort, and something worth having is sure to be done, even if we fail of the highest attainment.

The most laborious of the practices is probably that of carrying, at the top of their speed, all the implements of war, fascines, sand-bags, gabions, projectiles, &c., whose weight is progressively increased from twenty to fifty pounds. They must also practice carrying ladders, beams, caissons, dragging gun-carriages, &c., and they are equally habituated to carry rapidly and skillfully the wounded from the field of battle, by placing men on litters, or any substitute at hand, in the gymnasium.

Sword exercise, bayonet exercise, boxing and fencing are also taught, but only the rudiments. In the regiments and battalions they have more opportunities of perfecting themselves in these accomplishments.

Such is a succinct account of the military gymnastics of the French. The 300 various fetes and practices have only one object in view, preparation for the possible and probable casualties of war, but they have, meanwhile, the positive and immediate effect of giving the men the utmost freedom of motion, *aplomb*, self-reliance, and that very useful self-estimate in the soldier, namely, that he is superior to every other in the world. It will take a vast deal to knock that conceit out of him.

REMARKS ON FRENCH MILITARY EDUCATION.

The English Commissioners in their Report on "The best Mode of Reorganizing the [English] System of Training Officers for the Scientific Corps, together with an Account of Foreign and other Military Education," close with the following general remarks on French Military Education:—

The following summary may close our account of French Military Education.

1. The French army combines a considerable proportion of officers professionally educated, with others, who form the majority, whose claims to promotion consist in their service, proved ability, and conduct. One-third of the officers in the line, two-thirds of those in the scientific corps, and the whole of the staff, receive a careful professional education; the remainder are taken upon the recommendation of their superior officers, from the ranks. But it was stated to us expressly that such officers do not often rise above the rank of captain.

2. There are no junior military schools in France, and no military education commences earlier than sixteen. This is the very earliest age at which pupils can be received at the Polytechnic or at St. Cyr, and the *usual* age is later; whilst in the case of the Special Corps, strictly professional education does not begin till twenty or twenty-one. The best preparation for the military schools is found to be that *general* (in France chiefly *mathematical*) education which is supplied by the ordinary schools of the country, directed as these are and stimulated by the open examinations for admission to St. Cyr and the Polytechnic.

3. The professional education for commissions in the line is that given at the school of St. Cyr. A fair amount of mathematics is required at entrance, but the chief instruction given at the school is of a professional character. Active competition, however, which is the principle of all French military education, is kept up amongst young men educating for the line by the competitive entrance to the school, by the system of examinations pursued in it, and in particular, by the twenty-five or thirty places in the Staff School which are practically reserved for the best pupils on leaving.

4. In the Staff School itself the competitive system is acted upon; there are strict examinations, and the pupils are ranged in the order of merit on leaving the College.

5. The officers of artillery and engineers may be said to be in quite a peculiar position in France, owing to the high education given at the Polytechnic School. The consequence is, that the preparatory education of French artillery and engineer officers is of the highest scientific character. We have already spoken largely on this point, and need do no more than allude to it.

6. We may remark, that preparatory military education in France is mainly mathematical—at the Polytechnic almost wholly so. The literary and classical elements, which enter so largely into all education in England and Prussia, are in French military education very much thrown aside. Lectures in military history and literature are said, however, to succeed at St. Cyr.

7. The system of State foundations (*Bourses*) existing in the Polytechnic and St. Cyr, and affording a curious parallel to the military foundations in the Austrian schools, requires some notice. Every pupil, in both the Polytechnic and St. Cyr, who can prove poverty, is entitled to State support, either entire or partial. At the present time, not less than one-third of the students in each of these schools receive such maintenance. The system of civil *Bourses* is of old standing in France; most of these were destroyed at the Revolution. They were renewed and greatly devoted to military purposes by Napoleon. The extent to which they are given may seem excessive, but it must prove a powerful incentive and assistance to talent.

8. It has been remarked that there is comparatively little practical teaching in the School of Application for Artillery and Engineers at Metz. But a very extensive practical training is in fact supplied to these officers after they enter the service, remaining as they must do with the troops until promoted to the rank of second captain, and subsequently being employed in the arsenals, workshops, fortified places, &c.

9. The French have no "senior departments" for military education. In this respect their practice differs from that of England and Germany.

FRENCH MILITARY EDUCATION IN 1869.

The following remarks on French Military Education are from the Report of the English Military Education Commission submitted to Parliament, and printed in 1870:

1. The proportion of professionally educated officers in the line is greater now than in 1856, when it was stated by the Commissioners in their report to be one-third.

2. The professional education for commissions in the line is given by a two years' course at St. Cyr, admission to the school being dependent on competitive examination. Admission to the Artillery and Engineers is obtained through the Polytechnic, where young men intended for commissions in those arms receive a preparatory education of a highly scientific character, in common with candidates for many other branches of the public service. Admission to the school is obtained by competition, and the choice of services is

dependent on the results of another competitive examination at the end of the two years' course. Commissions are then obtained in the respective corps, and the young officers go for a further period of two years to the School of Application at Metz, there to receive their strictly professional instruction. The course of teaching at Metz is still mainly of a theoretical character, and the main portion of the practical training of the officers is deferred until they join their regiments. The Staff Corps is recruited entirely from the Staff School; a very small number of pupils from the Polytechnic have a claim to admission to the school, but the great majority of the students are admitted by competitive examination, open nominally to the sub-lieutenants of the army and to the best students of St. Cyr, but in practice almost entirely confined to the latter. The students join the school with commissions as officers; at the end of the two years' course they are definitely appointed to the Staff Corps in the order in which they stand in a competitive examination, but before being employed upon the staff they are sent to do duty for five years with the various arms.

3. The military schools in France are not, as in England and in Prussia, placed under the control of a special department. They are all under the immediate management of the Minister of War. There is, however, for each branch of the service in the French army a consulting committee (*comité consultatif*), or board of general officers, attached to the War Department, for the purpose of giving advice to the Minister, and in matters affecting the individual schools the Minister generally consults the *comité consultatif* of that branch of the service for which the school is specially preparatory.

4. Each school has its own *conseil d'instruction*, composed of officers and professors of the establishment, which exercises a general supervision over the course of instruction, and has the power of suggesting alterations or improvements in it. The financial business of the school is managed by another board *conseil d'administration*); and there is generally also a similar board (*conseil de discipline*), which exercises more or less authority in questions of discipline. The effect of this arrangement is to give the various officers and professors of each school to some extent a voice in the general management of the institution.

5. The staff of officers and instructors employed appears, in most cases, very large in proportion to the number of the students; 48 for 270 in the Polytechnic; 33 for 170 in the school at Metz; 62 for 600 in St. Cyr, &c.

Though there is in all the schools a military staff separate from the staff of professors and instructors, and more especially charged with the maintenance of discipline, the line of separation between the two bodies is not, except at the Polytechnic, so distinctly drawn as in the English military schools. The military professors exercise disciplinary powers; while, on the other hand, the members of the strictly military staff in almost all cases take some part in instruction. The latter appear to be more utilized for this purpose than is the case either at Sandhurst or Woolwich.

6. Considerable care is exercised in the appointment of professors; at the Polytechnic the candidates are selected by the *Conseil de Perfectionnement;* at La Flèche they are recommended to the Minister of War by the Minister of Public Instruction; at the Staff School and St. Cyr the appointments are thrown open to competition.

7. The discipline maintained at all the schools is of a very strict nature;

except for the youngest pupils at La Flèche it is entirely military; the punishments are similar to those inflicted in the army, and even include imprisonment. The maintenance of discipline is considerably facilitated by the fact that the pupils at most of the schools are actually subject to military law; and those of St. Cyr, if dismissed from the school, are sent into the ranks as private soldiers. There appears, however, in all the schools to be an absence of the moral control over the young men which is exercised in the Prussian schools. The Commandant of each school has very extensive powers in regard to discipline, but in no case has he authority to dismiss a student from the school without the sanction of the Minister of War.

8. The principle carried out in France is that special military education should not be begun until a comparatively late age, and should be founded upon a groundwork of good general education in civil schools. The only approach to a junior military school in France is that of La Flèche, and this is mainly a charitable institution; the pupils, it is true, learn drill, but beyond this no special military instruction is given them. The course of study is the same as that at the *Lycées* or ordinary civil schools, and the pupils are under no obligation to enter the military service. Nor can the Polytechnic be called an exclusively military school; even those who enter the Artillery and Engineers from it have their education in common with civilians at the very least until the age of 18, and in the great majority of cases their strictly professional instruction at Metz does not begin till 20 or 21. The very earliest age at which a special military education commences in France is 17, which is the age of admission to St. Cyr, and comparatively few enter the school before 18 or 19. The knowledge required for admission to St. Cyr is entirely such as is acquired at civil schools, and so much importance is attached to a good general education that the degree of either *bachelier ès sciences* or *bachelier ès lettres* is made a necessary qualification for admission to the examination, while the possession of both degrees gives considerable advantage to a candidate. The principle of deferring the commencement of special instruction has even received extension since 1856; the age of admission to St. Cyr, which was then 16, has been now increased to 17, and the junior school of La Flèche has been made even less military in its character than it was at that time.

9. When a professional education has once commenced, the principle appears to be that it should be almost entirely confined to subjects which have a practical bearing on military duties. Mathematics, as a subject by themselves, do not form part of the ordinary course of instruction at any of the special schools. The previous course at the Polytechnic secures of course very high mathematical attainments in the candidates for the Artillery and Engineers who enter Metz; but at Metz itself the study of mathematics is no longer continued. In the same way at the Staff School a knowledge of mathematics as far as trigonometry is required for admission, and their practical applications to operations of surveying enter into the school course; but no part of the time spent at the school is devoted to mere theoretical instruction in pure mathematics; yet the officers of the Staff Corps are intrusted with the execution of those scientific surveys which in our service are in the hands of the Engineers.

St. Cyr offers to some extent an exception to the rule that the course of study at the special schools should be of an exclusively professional character, as the instruction given there during the first year is partly of a general nature,

embracing history and literature. This, however, arises from the fact that the students from the *Lycées* generally show a deficiency in the more literary subjects of a liberal education, and a portion of the time at the school is therefore spent in completing and improving their general acquirements. A knowledge of arithmetic, algebra, and plane trigonometry is required as a qualification for admission, but beyond a very beief revision of these subjects, and a voluntary course for condidates for the Staff Corps, mathematics are not taught at the school. It would seem indeed that, except in the case of candidates for admission to the Artillery and Engineers, mathematics do not hold so prominent a position in French military education as is generally supposed in England to be the case. For staff and regimental officers the main requisite demanded seems to be a practical knowledge of trigonometry as required for surveying.

10. Much time is devoted in all the French schools to drawing in its various branches; some hours daily are invariably given up to the subject; indeed the time spent upon purely geometrical drawing appears almost to be excessive. The great importance attached to the drawing of *machinery* is a peculiar feature in all the schools. Landscape drawing is one of the regular subjects taught to candidates both for the line and the Staff Corps.

The theoretical instruction given at every school is supplemented by visits to numerous military establishments, manufacturing departments, and fortresses. This is also a feature in the system of military education in Prussia; in both countries it seems to be thought desirable to afford young officers a practical insight into the working of the various establishments connected with the army. In the caso of officers of the Artillery and Engineers it appears in France to be made a special object to cultivate a mechanical genius, and to secure a thorough acquaintance with manufacturing departments with which their professional duties bring them into contact.

Military law and administration (comprising financial and other regulations connected with the army), and drill, riding, and fencing in the way of practical exercises, form part of the education of officers of all branches of the service; in drill, lectures explanatory of the drill-book are invariably given in addition to the practical instruction.

11. The system of instruction in all the French military schools is more or less that of the Polytechnic. Lectures attended by large numbers, enforced study of fixed subjects, the execution of all work under close supervision of the instrutors, and frequent periodical examinations, are everywhere found. Active competition is the leading feature of the system; the students are perpetually being "kept up to the mark." A fixed period of two years is in all cases assigned to the course of study; the course can not be completed in a shorter time, and the regulated period can not (unless under quite exceptional circumstances) be exceeded.

It seems also to be thought that, as a necessary consequence of the strictly competitive system, the subjects upon which the competition depends should be exactly the same for every student. No choice of studies is allowed; those which enter into the examination are equally obligatory for all. The only exception to this rule is at St. Cyr, where in languages a choice between German and English is given.

No pecuniary rewards are offered to the students at any of the schools. The bestowal of the numerous *bourses* which are granted to those admitted to the

Polytechnic and St. Cyr is regulated entirely by the poverty of the candidates, without any regard to their ability.

12. The education of officers in France is entirely concluded before any regimental duty has been done. The French system is in this respect the exact opposite of that pursued in Prussia, where no professional instruction, as a rule, is given until a certain amount of service with the troops has been performed. There are in France no establishments for the instruction of officers of some years' service, like the Staff College in England, or the Artillery and Engineer School and the War Academy in Prussia.

13. The chief changes which have taken place in the military schools of France since the publication of the Report of the Commissioners of 1856 may be summarized as follows:—

(*a.*) The modifications in the course of instruction at the Polytechnic; the abridgement of the studies previously pursued; and the slightly increased importance now attached to literary subjects.

(*b.*) At Metz, the introduction of an examination at the end of the first years' course of study.

(*c*) At St. Cyr, the alteration of the age for admission to the school from 16 to 17; the extension of the subjects of the entrance examination; the modifications in the course of instruction, and the postponement of the commencement of strictly military studies almost entirely until the second year; the introduction of a stricter system of discipline, combined with additional encouragements to good conduct and industry; and the increased advantages offered with the view of attracting to the school a higher class of professors and officers.

(*d.*) At La Flèche, the complete reorganization of the institution with the object of more closely assimilating its general arrangements to those of a purely civil school.

(*e.*) At the Staff School some modifications in the course of study and in the mode of admission to the school have been made; but the most important alterations are those adopted in July 1869, by which the number of students admitted annually to the school is increased considerably beyond the number of vacancies likely to occur in the Staff Corps, and the novel principle is introduced that admission to the school does not carry with it the certainty of permanent employment on the staff.

It may be added that there seems a tendency to diminish the importance of mathematics as an element of preparatory military education, and to attach slightly more weight to studies of a literary character. This is more particularly seen at St. Cyr and at La Flèche, and to a less extent at the Polytechnic. There is also a growing disposition to increase, in the case of the cavalry and infantry, the proportion of officers who have received a professional education.

EXPENSE OF MILITARY SCHOOLS IN 1869.

Name of School.	Sums charged to the Schools Estimate.	Military pay charged to other Estimates.	Total.	Cost to the State.‡	Each pupil.
	Frs.	*Frs.*	*Frs.*	*Frs.*	*£.*
Polytechnic	719,673	85,515	805,188	568,188	78
Artil'y and Eng'er school at Metz	99,500	416,350 *	515,850	515,850	50
St. Cyr	1,348,792	15 000	1,363,792	741,292	49
Staff school	99,000	214,870 *	313,870	313,870	168
La Flèche	539,868	15,000	554,868	457,868	45
Medical school	659,300	†	659,300	.....	...
Cavalry school at Saumur	227,000	18,500	245,500	.....	...
Gymnastics, musketry schools	36,270	"	36,270	.....	...
Regimental schools	173,600	"	173,600	.....	...
Total	3,903,003	765,235	4,668,238	2,597,068	390

* These sums include the pay of the officer students at these establishments, amounting to 288,000 frs. at Metz, and 103,000 frs. at the Staff School.

† The estimate for the Medical School appears to be exclusive of the pay of all military medical officers employed at the school, but the amount of this additional sum is not stated.

‡ For 1,520 pupils, who repaid 956,500 francs.

PART II.

MILITARY SYSTEM AND SCHOOLS IN PRUSSIA.

AUTHORITIES.

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MILITARY SYSTEM AND EDUCATION IN PRUSSIA.*

I. OUTLINE OF MILITARY SYSTEM.

According to the law of the 3rd of September, 1814, which is the basis of the present military organization of Prussia, every Prussian above twenty years of age, is bound to service in arms for the defense of his country.

The military force of the country is made up of three distinct bodies, and the whole of the adult male population is distributed among them. It consists of,—

I. The Standing Army.

II. The National Militia or *Landwehr*, divided into two portions, viz., the first *Landwehr* and the second *Landwehr*.

III. The Last Reserve or *Landsturm*.

I. The standing army is composed of all young men between twenty and twenty-five years of age. The period of service in time of war is for five years, but in time of peace the young soldiers can obtain leave of absence after three years' service;—they belong for the remaining two years to what is termed the "reserve," receiving neither pay nor clothing, and they are subject to be recalled if war should break out.

Encouragement, indeed, is given and advantages held out to induce men to stay, and to take a new engagement for an additional term of six years; but it is said that only a small number are thus obtained. The bulk of the troops are men serving for this short time; and there are many, it should be added, whose term of service is even yet shorter. For all educated young men, all, that is, who pass a certain examination, are allowed, on condition that they pay for their own equipment and receive no pay, to shorten their service from three years to one. This privilege appears to be very largely used. It should also be stated, that young men of any class may volunteer to perform their service at any age after seventeen.

The Prussian standing army amounts at the present time to

* Compiled from the "Report, and Accompanying Documents of the Royal Commission on Foreign Military Education," 1857.

about 126,000 men. It is divided into nine army-corps or corps d'Armée, one of which is named the guard, and the others are numbered from I. to VIII. In each there is a regiment of artillery and a division of engineers. A regiment of artillery consists, in time of peace, of three divisions; each division of one troop of horse artillery and four companies, of which, one is Fortress artillery with two-horsed pieces. Each regiment has thus three companies for the service of the fortress and twelve for field service. The whole of the artillery is under the command of a general inspector, and it is divided into four inspections. An engineer division is composed of two companies. There are nine engineer divisions, one in each army corps. The whole are commanded by a general inspector, and they are divided into three inspections.

The promotion in the Prussian infantry and cavalry is regimental, and by seniority, up to the rank of major; after that it is by selection; and an officer who has been passed over two or three times may consider that he has received an intimation to retire from the service. In the artillery the promotion is by regiments; in the engineers it is general.

II. The first Landwehr, or Landwehr of the *first* summons (*des ersten aufgebots,*) consists principally of young men between twenty-five and thirty-two years of age, who enter when they have completed their period of service in the standing army. They are called out once every year for service with the divisions of the standing army to which they are attached, for a period varying from a fortnight to a month; and they may be sent in time of war on foreign service.

Those who have passed through the first Landwehr, enter at the age of thirty-two in the second Landwehr, or Landwehr of the *second* summons (*des zweiten aufgebots.*) They are called out only for a very brief service once a year, and they can not at any time be ordered out of the country, but continue to form a part of the *second* Landwehr until they are thirty nine years of age.

III. After the age of thirty-nine a Prussian subject belongs to the last reserve or Landsturm, and can only be summoned to service in arms upon a general raising, so to say, of the whole population, when the country is actually invaded by the enemy.

With the standing army, the center of the system, all the other forces are kept in close connection. For every regiment of the standing army there is a corresponding regiment of Landwehr, and the two together form one brigade. In the local distribution, every village and hamlet of the Prussian dominions belongs to a certain

regiment of Landwehr, serving with a certain regiment of the army, and belonging accordingly to one of the nine army corps.

Such is the military organization, which, from the important part played in it by the *Landwehr*, is sometimes termed the Prussian *Landwehr* system. The history of its formation is remarkable, and the circumstances which led to its creation helped also to create the very peculiar education of the army.

The Prussian *Landwehr* or militia is not of modern origin; in its form at least it is but a revival of the old feudal military organization, so far as that consisted of raising the country *en masse*, instead of keeping up a permanent, trained, and limited military force. *Landwehr* or *Landsturm** was the old German name for this feudal array, before the system of standing armies was begun in Europe by Charles VII. of France, with his Scotch regiments. It was possibly the failure of the trained Prussian armies—long reputed the models of military discipline—in the attack upon France in 1792, and still more signally at Auerstadt and Jena, which partly led to the revival of the *Landwehr* as the peculiar national force of Prussia. The means by which Stein, and after his expulsion, Scharnhorst, called it into activity, was a master stroke of policy under the existing difficulties of the country. The following outline may be sufficient to explain its effects upon education.

The condition which Napoleon had exacted at Tilsit—a reduction of the standing army from 200,000 to 40,000 men—would have lowered Prussia at once to the rank of a second-rate power. It was adroitly evaded by the plan of keeping only 40,000 men in arms at one and the same time, disbanding these as soon as they were disciplined, and replacing them constantly by fresh bodies. Thus the whole population of the country was ready to rise in 1813, after the crisis of Napoleon's retreat from Russia. The plan was chiefly due to the genius of Scharnhorst, whose early death deprived Prussia of her greatest scientific soldier. The *Landwehr* then proved itself a most efficient force, though its success was promoted by the national enthusiasm, which must prevent our taking such a period as a criterion of its permanent military working. Since that time it has continued to be the national army of the country.

We were assured that this peculiarity of the Prussian army system, by which almost every man in the country serves in his turn in the ranks, has had a tendency to improve the education of the officers. It seems to have been felt that the officers would not retain the respect of intelligent privates unless they kept ahead of

* Thus *Landsturm* is the word used for the rising *en masse* of the Tyrol in 1809.

them in education. And this impression appears to have been the cause of the royal edicts passed in 1816, by which it was required that every Prussian officer should pass two examinations before receiving his commission, one to test his general education, and the other his professional knowledge.

II. HISTORICAL VIEW OF PRUSSIAN MILITARY EDUCATION.*

The Prussian system of military education stands in close connection with the general education of the country, just as the Prussian military organization is the peculiar creation of that country's history. And the greatest improvements in the army and in its scientific teaching have been made at those remarkable periods when we should most naturally have looked for them—the time of Frederick the Great and the Liberation war of 1813—1814.

The leading principles of Prussian military education consist, *first*, in requiring from every officer in the army proof of a fair *general* education before his entrance, and of a fair *military* education afterwards. *Secondly*, they encourage a higher military education in a senior school, which has almost exclusively the privilege of supplying the staff.

In this requirement of a fair education, both general and military, *universally* from its officers, Prussia stands alone among the great military nations of Europe, and this honorable distinction is in a great measure the result of the diffused system of education throughout the country, and of the plan adopted by Stein and Scharnhorst, to make the officers the leaders of the army both in education and in military science.

The military schools of Germany may be said to have begun with the Reformation wars. Some such were founded by Maurice of Saxony, the great political and military genius of Germany in that century; the example was soon imitated in Baden, Silesia, and Brunswick, and a curious sketch of military education, by the hand of Duke Albert of Brandenburg, has been lately published from the Berlin archives, in which theology and mathematics hold the two most important places.

The first school of any real importance was founded in Colberg, by the great elector, Frederick William, in 1653. This had considerable success, and both his successors, King Frederick and Frederick William I., improved it greatly, and finally transferred it to Berlin. It was the time (about 1705, 1706,) of the great advance in military engineering under Vauban and Coehorn, and a school

* The chief authority for this paper is a very detailed account of the Staff School, (*Kriegs-Schule,*) by Friedländer, pp. 1—360.

for engineering was founded, in which some of their pupils had a great share. The first Prussian trigonometrical survey also dates as early as 1702; that of England was not begun till 1784. It may indeed be said that the scientific arms began to take a more favorable place in the Prussian army about this time. They have held, and even still hold in some respects, a less distinguished position in Germany than in France, England, or Sardinia; and the first instance of an artilleryman being made a general, was in the reign of Frederick William I.

On Frederick the Great's accession he found several military schools in existence. These had been chiefly founded by his eccentric father, who had a passion for Cadet Houses and cadets, and their object is said to have been to supply an education to the nobility, who at that time were very ill-taught in Germany. After Frederick's first wars, his own attention was much occupied by the need of a better military education, and he continued to work at the subject very zealously till his death. His example on this point, as that of a great military authority, is most instructive, since his object was at first only to educate cadets *before* their entrance to the army, but was afterwards extended to completing the education of officers already on active service. His views on the last point were carried out by Scharnhorst. They were the germ of the present Prussian military education.

It is curious to observe that the Austrian Succession War and the Seven Years' War, the first great wars since Louis XIV., and which broke the Thirty Years' Peace of the eighteenth century, are periods at which scientific military education made a great step in Europe. A Treatise of Marshal Count Beausobre's on the subject first showed the existing want; it is entitled "*Utilité d'une Ecole et d'une Académie Militaire, avec des Notes, ou l'on traite des Ecoles Militaires de l'Antiquité.*" It attracted great attention on its appearance. Most of the military academies properly so called, date from about this time. The earliest warrant for Woolwich, dates in 1741. The Theresianum of Maria Theresa was begun at Vienna about 1748. The first French school was the celebrated engineer school of Mezières founded in 1749. This was soon followed by the old military school of Paris in 1751, and by the school for artillery at La Fère in 1756. Frederick's own *Ritter Academie* dates from 1764.

Frederick began this institution with his usual energy, immediately on the close of the Seven Years' War. "My fire is quenched," he writes, "and I am now only busied in improving the practice of

my men. * * * * The position of the common soldier may be left as it was before the war began, but the position of the officers is a point to which I am devoting my utmost care. In order in future to quicken their attention whilst on service, and to form their judgment, I have ordered them to receive instruction in the art of war, and they will be obliged to give reasons for all they do. Such a plan, as you will see, my dear friend, will not answer with every one; still out of the whole body we shall certainly form some men and officers, who will not merely have their patent as generals to show, (*die nicht blos patentirte Generale vorstellen,*) but some capacity for the office as well." He had, in fact, seen with great admiration the improved military school recently founded by Maria Theresa; and as it is best on such points to let this great authority be heard for himself, we shall quote his own words:—

"In order to neglect nothing bearing on the state of the army, the Empress founded near Vienna, (at Wiener Neustadt,) a college where young nobles were instructed in the whole art of war. She drew to it distinguished professors of geometry, fortification, geography, and history, who formed there able pupils, and made it a complete nursery for the army. By means of her care, the military service attained in that country a degree of perfection which it had never reached under the Emperors of the House of Austria; and a woman thus carried out designs worthy of a great man."

His letters show that he contemplated an improved school, and he says to D'Alembert: "I send you the rules of my academy. As the plan is new, I beg you to give me your honest opinion of it." Accordingly, the academy was founded. We will describe it in his own words:—

"An academy was founded at the same time, in which were placed those of the cadets who showed most genius. The king himself drew up the rules for its form, and gave it a plan of instruction, which stated the objects of the studies of the pupils, and of the education they were to receive. Professors were chosen from the ablest men who could be found in Europe, and fifteen young gentlemen were educated under the eyes of five instructors. Their whole education tended to form their judgment. The academy was successful, and supplied able pupils, who received appointments in the army."*

This school, which was opened in 1765, was Frederick's only foundation of the kind; he was occupied with it incessantly. The plan of its studies was drawn up by his own hand, and we have

* "Histoire de mon Temps."—*Œuvres*, vi., p. 99.

many of his letters of encouragement to its pupils or professors. Whether he is writing to Voltaire, Condorcet, or "My Lord Marischal" Keith, he constantly shows both his well-known attention to the economy of his new school, and a paternal interest in his young cadets and their teachers.*

Accordingly, both in professors and pupils, the new institution soon gained an European character. Out of its twenty-first directors, no less than ten were distinguished foreigners; one of the best teachers at Berlin was D'Antoni, a distinguished soldier from the Turin institution and the artillery school at Alessandria—schools which were still the representatives of the military science of the great Italian generals, of the Duke of Parma, of Spinola, and Montecuculi.

This institution was still, as it would appear, upon the old principle of juvenile army schools, nor does Frederick seem to have set on foot any school for officers after entering the service. But he evidently felt strongly the need of improving his staff officers, and of raising the science of his artillery and engineers. Thus we find him referring to the French engineer school at Meziéres; and he endeavored to raise the intelligence and education of his officers. It may, however, be suspected that the spirit of the "Potsdamer Côterie," as it was called, became gradually, and particularly after Frederick's death, too literary and speculative to suit the rough work of war; and it may, perhaps, be thought that some defect of this kind is still traceable in the excessive amount of teaching and the abstract nature of some of the subjects taught in the staff school at Berlin.

Such seems to have been the opinion of Scharnhorst, the virtual author of the present system of army education, and whom the Prussians still regard as their first authority on that subject. "Instruction is given," he says, "at the military school in all literature, in philosophy, and in many various sciences. Frederick seems to have wished to lay in it the foundation of the education at once of an officer and of a learned man. Few men, however, are able to excel at once in various branches of human knowledge, and the surest means to do so in *one* is not to attempt it in *many*."

* He gives himself, in his forcible style, the reasons for his attention to early military schools. He had found his young nobility excessively averse to such education. "They shrink from the army," he said, "because in this country it is a real training for the character. Nothing is passed over in a young officer; he is obliged to maintain a prudent, regular, and sensible conduct. . . . . This is precisely what they dislike, and one still hears the absurd and insolent expression, 'If my boy will not work, he will do none the worse for a soldier.' Yes, he may do for a mere man-at-arms (*fantassin*,) but not for an officer fit to be advanced to the highest commands, the only end of a good soldier's life, and which requires a really extensive knowledge."—*Œuvres*, ix., 117, 120.

We have referred to Frederick and his school rather to show the interest he felt in military education, than because his institution was very important. Military education was still very imperfect, and it completely languished in Prussia till Scharnhorst established it on its present footing.

Scharnhorst was himself an Hanoverian, but entered the Prussian service, and had seen by experience the defects of their system in the campaigns of 1792, 1793, and 1805. He had long devoted especial attention to military education and to all the scientific part of his profession. Along with Blucher and Gneisenau, he was considered one of the first generals of the army, and, on the exhaustion of Prussia after Jena, he was selected to remodel its whole system. He did not live to complete his work, having been killed early in 1812; but his statue near the bridge at Berlin, remarkable for its noble and thoughtful expression, records the gratitude of Prussia to its greatest scientific soldier.

"The perfection of the French military organization," says Mr. Alison, appeared to him in painful contrast beside the numerous defects of that over which he presided. * * * * Boldly applying to the military department the admirable principles by which Stein had secured the affections of the burgher classes, he threw open to the whole of the citizens the higher grades of the army, from which they had been hitherto excluded. * * * * And every department of the public service underwent his searching eye."

The work began with the commission of 1807, of which both Stein and Scharnhorst were members. And the regulation of 1808 laid down the principle broadly, that the only claim to an officer's commission must be, "in time of peace, knowledge and education; in war, courage and conduct."

On these principles, during the next three years, Scharnhorst laid the foundations of the present education. He abolished most of the existing juvenile schools, with the exception only of the Cadet Houses, intended almost solely for the sons of officers. He changed the previous war school into a sort of school *d'Elite*, consisting of a senior and junior department, in which the younger soldiers of all arms were to be imbued with such knowledge as might give them a scientific interest in their profession, and in which senior officers (also of all arms) were to have a higher course of a similar nature, success in which was to form a recommendation for employment on the staff. He began the plan of the division schools, where all candidates for commissions, but not yet officers, might conduct their

military studies along with the practice of their profession. Its idea was to make some military study *necessary*, and successful study *honorable*, in the army. Finally, he began the present system of careful examination on entering the army.

The following historical notice of the origin and successive changes of the division schools is taken from a communication by Col. Von Holleben, and a member of the General Inspection of Military Instruction to the English Commission.

The cabinet order of the 6th of August, 1808, laid the foundation of the present system of military education. It regulates the appointment of Swordknot ensigns and the selection of officers, and declares that the only title to an officer's commission in time of peace shall be professional knowledge and education, and in time of war distinguished valor and ability.

The cabinet order of the 6th of August, 1808, could only come gradually into operation; the system of military examinations had to be created, and the educational institutions had to receive a new organization, under the superintendence of a general officer. Four provincial boards of examination were successively established, and on the 1st December, 1809, a body of instructions, still very vague and general, was issued for their guidance.

A cabinet order of the 3rd of May, 1810, remodeled the military schools, directing, in addition to the cadet schools at Berlin and Stolpe, the formation of three military schools for Swordknot ensigns, (*Portepée-Fähnriche*,) one at Berlin for the marches (*Die Marken*,) and Pomerania, a second at Königsberg, for east and west Prussia, and a third at Breslau, for Silesia; and the formation of a military school at Berlin for officers. All these institutions were placed under the general superintendence of Lieutenant-General Von Diericke, who had also the special superintendence of the boards of examination. A board of military studies was created and intrusted, under his control, with the task of carrying the regulations into effect.

Before, however, the new institutions attained to any stability the war years of 1813—14—15 intervened, and the operations of the board of examinations ceased.

Soon after the conclusion of peace directions were given that the examinations should recommence, with an equitable consideration of the claims of the Landwehr officers, ensigns, and other young persons who had grown up during the war.

At first there was only one board of examination at Berlin, with large discretionary powers as to their mode of procedure. In April,

1816, a cabinet order was issued to form boards of examination for the Swordknot at every brigade, as the present divisions were then called, besides the existing board at Berlin, for the examination for an officer's commission.

Contemporaneously with the nine boards of examination, the board of military studies, by an order of January, 1816, directed the establishment of schools for every brigade, and attempted to gradually regulate the instruction they gave. The schools contained two classes, the lower to prepare candidates for the Swordknot, the higher to prepare candidates for the rank of officer. As, however, no standard of attainment was required for admission into the schools, their instruction had to commence with the first elements, and was charged with more work than it could perform. The weaker scholars stayed two, three, or more years in the lower class, and the education of the better scholars was impeded.

During this and the following period the authority over the examination boards (the *Præsidium*,) was distinct from that over the schools, (the general inspection,) and it was not till later that both authorities were vested in a single person. This division of powers, intended to secure the independence and impartiality of the examinations, led to the result that the two authorities were occasionally led, from a difference of principles, to labor in different directions. Still, in the infancy of military education, the rivalry it occasioned was favorable to a rapidity of development.

An order of the 16th of March, 1827, added French to the studies for the ensigns' examination, and fixed a higher standard of attainments in military sciences for the officers' examination.

Nearly at the same time, a cabinet order of the 27th of March, 1827, directed that there should be only one class for Swordknot ensigns in the division schools, and that after October, 1829, the candidate should obtain a testimonial of fitness for the rank of Swordknot ensign previous to admission as a student.

Accordingly young men had to be prepared for examination for the Swordknot at their entrance into their corps, or might prepare themselves by private studies and instruction during their service.

The task of the schools, still very comprehensive embracing all the liberal sciences as well as the military, was accomplished during this period in two courses of nine months, in a higher and a lower class.

A cabinet order of the 31st of January, 1837, introduced the entrance examination, instead of the examination for the Swordknot.

it being declared that every candidate for the commission of an officer, after his reception into a corps, should prove in an examination his possession of the knowledge requisite for a Swordknot ensigncy before his actual appointment. At the same time a regulation of the ministry of war, of the 17th of December 1836, remodeled and more precisely defined both the entrance (Swordknot ensign) examination, and that for the commission of an officer. This regulation, while it essentially modified the instruction given at the division schools, furnished them at the same time with a more certain clue for their guidance. The preparation of youths for the Swordknot examination during their service in the corps was discontinued. But the standard of the entrance examination was still too low, requiring only a small portion of the branches of a general liberal education, and that not in the shape in which they are taught in our gymnasia. Hence the evil result, that young men, previous to their entrance into a corps, had usually to prepare for the military profession at private institutions instead of at the gymnasia, and nevertheless brought with them a very defective amount of preparatory training; on the other hand, the demands of the officers' examination were very multifarious. It still required the general scholastic sciences by way of formal education, and the military sciences as a special education for the military profession. Thus the task of the division schools continued overwhelming, and an aim was set before them which they could not attain.

A regulation of the 4th of February, 1844, reformed simultaneously the whole system of military examination and education.

The views which guided these reforms, the improvements and advantages which were hoped to be thereby obtained, were, in general, the following:—

1. The military profession, like every other, requires a general school education intended generally to cultivate the mind, distinct from the subsequent special and professional education for which the former is the necessary groundwork.

The former is tested in the examination for the Swordknot, the latter in the officers' examination.

2. The preparatory education required from the candidate for a Swordknot is the function of the ordinary schools of the country. Nothing but what they can impart is required, and from consideration of the youthful age of the candidates (seventeen years,) the amount of preparatory training required is not the attainment of the highest class of the gymnasium, but only that required for admission into the Prima.

3. The required previous training not only gives the candidate a more certain basis for his subsequent military education, but, as being the groundwork of all professions, leaves him afterwards at liberty to cultivate the special knowledge requisite for any profession that he may prefer.

4. The division schools are freed from a multifarious course of instruction in the scholastic sciences, a task beyond their power; the result of which was that the majority of scholars were very little advanced in formal and general education, and but superficially grounded in the elements of the professional sciences, while they spent years in being drilled for an examination, instead of being educated for life.

5. If the division schools have an able staff of military teachers, they can give a good professional education. The younger officers, even if they never received the full training of the gymnasium, may still, by their professional training, raise themselves above their subordinates, (a class in Prussia often highly educated,) and are started with an excellent preparation for their professional career.

6. By the amount of liberal education required in the examination for the Swordknot, the friends of those destined for the military profession are admonished to provide them an education equal to that received by the members of other professions.

7. By the method pursued in the examinations the power is retained of raising or lowering the standard according to circumstances. When the supply of officers is deficient, the standard can be lowered; at other times, as at present, it may be raised. Since the above-mentioned regulations, the following essential alterations have been introduced:—

1. The examination for the Swordknot is again placed after admission into the corps, but no one can be admitted to attend the division schools without a testimonial of fitness for the rank of Swordknot ensign.

2. A testimonial of fitness for the university, *i. e.*, to have passed the abiturient examination, dispenses with the examination for the Swordknot. In consequence of this rule fifty abiturients on an average annually enter the army. These, as well as the selectaner of the cadet corps, must be considered, in point of scientific education, an excellent supply of officers. From the powerful impulse that military instruction has received in the last fifty years, it may be expected that the time is not distant when the candidate for an officer's commission, instead of passing the Swordknot examination,

will have to bring the finished training of the gymnasium; in other words, to have passed the abiturient examination.

3. Instead of the seventeen division schools there are now by the regulation of 1844, only nine, and a further reduction of their number to four or three is contemplated, with an improvement of the staff of teachers and a stricter supervision of the scholars.

III. SYSTEM OF MILITARY EDUCATION AND PROMOTION.

The standing army composed in the manner and under the circumstances already described, is supplied with officers who must have a good general education, and have served in the ranks, or have obtained a certain amount of professional instruction. The usual course is as follows:—

Young men obtain a nomination from the colonel of a regiment. This nomination admits them merely to service in the regiment as privates, with a recognition of their being candidates, *aspiranten* or aspirants, for the rank of officer. Before they obtain that rank, the following conditions must be fulfilled. They must pass an examination in the common subjects of a good general education, such as the sons of well-born or wealthy civilians may be supposed to receive. They must serve six or nine months with the troops; they must attend nine months at a division school, or twelve months in the artillery and engineer school, where they receive a course of special military instruction; and they must pass an examination in professional subjects before a board sitting at Berlin. They are then eligible for a vacancy. In order to obtain a commission they require further the recommendation of the officers of the regiment.

It is obvious to remark, that in obtaining a commission in the Prussian service the candidate's chance depends greatly on the recommendation of the colonel and the after assent of the officers. The effect of this is to maintain an exclusive character in the army. Above two-thirds of the commissions are obtained by the course described above; the remainder are granted to those who pass through the cadet schools.

Of these there are five altogether, four junior establishments, situated in certain provincial towns, and one senior or upper school at Berlin, to which the others are merely preparatory. They are all supported by the state; mainly for the purpose of educating the children of meritorious officers in want of assistance; but they are also open to others. With the exception of the highest class of the upper school, the *Selecta* above mentioned, the instruction given is of a perfectly general character, and there is no obligation even for

those who have received the most ample pecuniary assistance to enter the military profession. The discipline, however, is military, the teachers are mostly officers, the pupils are regularly drilled, and most of them actually go into the army. This they do in ordinary cases without going through the highest or select class in which professional instruction is given; they merely pass the same preliminary examination as the candidates nominated by the colonels of regiments; they enter the army without their commissions, and have to obtain them in the same manner as the other candidates, by serving six or nine months with the troops, and by following their professional studies in the division or artillery and engineer schools, and by passing the officers' or second examination before the examining board at Berlin. Those who do remain to go through the highest or select class receive their professional instruction in it instead of in the division or artillery and engineer schools, and they are examined for their commissions by the board while still at the cadet school.

Thus, in the course usually followed, three requisites are exacted in Prussia before a commission is given; first, a good general education; secondly, some actual military service; and, thirdly, professional knowledge gained by something like a year of military study. But the military service is not required from the upper thirty students of the *Selecta* of the Cadet House.

It will be well to mention, at the commencement, the names of the two examinations. The first, the preliminary examination, merely testing the general education, admits to a particular grade among non-commissioned officers; those holding it rank between sergeants and corporals, and in consideration of their being candidates (*aspiranten*) for a commission wear a different sword-knot, and hence have the name of Swordknot ensign or *Portepée-fähnrich*. The first or preliminary examination is accordingly called the *Portepée-fähnrich* examination. The second, the professional one, is the officers' examination, for the commission of second lieutentant.

These two examinations, for the grade of *Portepée-fähnrich* and for the officer's commission, are either conducted or controlled by the Supreme Military examinations Board, (*Ober-Militair-Examinations-Commission*) in Berlin, a body partly composed of military officers, partly of eminent civilians.

The various examining boards, the central and the local ones, which conduct these two examinations, are quite independent of the military schools, and were formerly presided over by a different

head; but in order that the system should be uniformly carried out, and as Colonel von Holleben expresses it, that "*the examinations should exercise a salutary influence on education, and that their standard should be adjusted to the capacities of the schools,*" they have now been placed under the same control as the military schools.

The whole department of military education is therefore now under the control of a single high functionary, bearing the title of the general inspector of the military schools, military education, and military studies (*das Militair Erziehungs-und-Bildungswesen,*) who reports direct to the king on all subjects relating to examination and instruction. He submits his proposals on matters of administration to the minister of war, who issues the necessary orders to the boards charged with the financial control of the various schools.

The general inspector is assisted by a supreme council or board of military studies, composed of field officers of the general staff and of the special arms, the directors of the war school, of the supreme board of military examinations, of the artillery and engineers school, the commander of the cadet corps, some of the consultative assessors (*Vortragenden Räthen,*) of the minister of worship, and of individuals selected from the general body of learned men (professors.)

The principal military schools of Prussia may be divided into five classes:—

I. Those which give a good general education to the sons of meritorious officers, but which are open to others, such as—

1. The Cadet Houses or Cadet Schools (*Cadetten-Häuser,*) which supply a certain amount of instruction in military professional subjects.

II. Such as supply professional instruction to young men who are candidates for the rank of officer in the Prussian army. These are—

2. The Division Schools (*Divisions-Schule,*) nine in number, one for each army corps.

3. The artillery and engineers schools in Berlin.

III. Those which afford professional instruction to officers already in the service, to qualify them for special duty, limited to—

4. The War School or Staff School (*Kriegs-Schule,*) in Berlin.

IV. Those intended to give special instruction for the training of non-commissioned officers and men. Such as—

5. The School Division or Non-commissioned Officers School (*Schulabtheilung,*) at Potsdam.

6. The Regimental Schools (*Regiments und Bataillons Schulen.*)

7. The Music and the Swimming Schools, and the Central Gymnastic School in Berlin (*Central Turn-Anstalt.*)

8. The Veterinary School (*Thierarzeneischule.*)

V. Those intended to give gratuitous education to the children, boys and girls, of non-commissioned officers and soldiers, whose parents are too poor to provide for them. Such are,—

9. The Military Orphan Houses (*Militair-Waisenhaüser,*) at Annaburg, Potsdam, and Pretzsch.

10. The schools for soldiers' children.

In addition to these might be mentioned the Medical Institution, particularly the Frederick-William's Institution at Berlin, and the Knight Academy (*Ritter-Academie,*) or Noble School, in Liegnitz.

The annual cost to the state of the military schools in 1856, appears to be as follows:—

NAME.	Salaries. Dollars.*	Other Expenses. Dollars.*	Total Dollars.*	Number of Students.
Department of General Inspector,	5,872	250	5,922	.....
Supreme Military Examinations Board,	5,400	300	5,700	.....
Board of Military Studies,	848	.....	848	.....
Board of Examiners for Artillery Lieutenants,	.....	60	60	.....
Cadet House at Berlin,	12,944	.....	12,944	420
" " Potsdam,	15,805	24,285	40,090	200
" " Culm,	15,738	18,436	34,174	160
" " Wahlstatt,	16,253	22,706	38,959	200
" " Bensberg,	15,935	24,853	40,788	200
General War or Staff School,	18,552	3,013	21,565	120
United Artillery and Engineers School,	15,025	1,910	16,935	240
Veterinary School,	8,514	4,165	12,679	.....
Gymnastic School,	4,046	720	4,766	.....
Division Schools,	10,800	6,195	16,995	Variable.
" Libraries,	400	1,200	1,600	.....
Miscellaneous,	.....	680	680	.....
Totals,	146,132	108,777	254,909	

Or about £38,236 annually, exclusive of the charge for buildings and repairs, and the original outlay for their first establishment. The pay of the student officers, and the pay and allowances of the military professors and teachers, are, however, drawn from their corps, so that the above-mentioned seems only to include the extra pay granted to the professors, &c.

The expenses of the Non-commissioned Officers School, of the military orphan houses, and of the schools for soldiers' children, are not given in the printed paper from which these details have been extracted.

* A Prussian dollar is equal to three shillings of English money, and 70 cents of United States currency.

IV. EXAMINATIONS—GENERAL AND PROFESSIONAL—FOR A COMMISSION.

Two examinations, one in general and the other in professional knowledge are required of all candidates for a commission upon or soon after their entrance into the army, unless they can bring a certificate of having successfully completed the regular course of a gymnasium, in which case they are excused from the first.

These two examinations, through which alone admission is obtained to the rank of officer, are so important, and hold so prominent a position in the Prussian military system, that we propose to preface our account of the nature and extent of each of these examinations by a short tabular statement of the circumstances under which the candidates for each arm of the service respectively pass them.

The following Candidates offer themselves,	for the Preliminary, Ensign's, or *Portepée-fähnrich* Examination,	for the Second or Officer's Examination (in all cases before the Supreme Board at Berlin.)
Those presented by the Colonels of Regiments,	Before, after, or during (usually before) six months' service with the Troops, before the local Division Board;	After nine months' military instruction in the Division School.
Those coming at the usual time from the Cadet House (from the class called *Prima*,)	On quitting the Cadet House, before the Supreme Board at Berlin;	After six months' service with the Troops, and nine months' military instruction in the Division School.
Those who stay an extra year in the Special or Select class (*Selecta*) of the Cadet House,	Before admission to the Special or Select class (*Selecta*,) before the Supreme Board at Berlin;	On quitting the Cadet House, after one year's military instruction in the Select class *Selecta*.
Those for the Artillery or Engineers, except when they came from the Special or Select class, (*Selecta*,) of the Cadet House,	After nine months' service with the Troops, and three months' stay at the Artillery and Engineers School, before the Supreme Board at Berlin;	After one year's stay at the Artillery and Engineers School.

1. *The Preliminary or Ensign's (Portepée-fähnrich) Examination.*

According to a special law, any young man above seventeen and a half and under twenty-three years of age, whether he be a private or a corporal, if he has served six months in the army, and can obtain from the officers of his company a certificate of good conduct, attention, and knowledge of his profession, may claim to be ex-

amined for the grade of ensign or (*Portepée-fähnrich.*) If he succeed in this examination, he is recognized as a candidate, an *aspirant* for a commission; but his prospect of obtaining a commission is subject to a variety of subsequent conditions.

In practice, a young man who aspires to a commission applies to the colonel of the regiment and usually obtains a nomination before he actually joins; and, as the examination is entirely of a civil character, he is usually glad to try and pass it at once. Having recently come from school, he feels probably better prepared than he is likely to be at any subsequent time: for on joining the corps, he will have for some time to conform to the life of a private soldier, to sleep and mess with the men, and to mount guard in his turn; and with the drill and exercises, and the marching and manœuvring with the troops, he will have enough to occupy him to prevent his preparing for the examination. The two qualifications for the ensign's grade are, the test of the examination and the six months' service; but it appears to be indifferent in what order they are taken, whether service comes first and examination after, or *vice versâ.*

The examinations take place quarterly, at the beginning of every January, April, July, and October. They are held in the great garrison towns by local military boards, consisting of a president and five examiners. Applications for permission to be examined must be made at least a fortnight before, and must be accompanied by certificates stating the candidate's birth, parentage, &c.; certificates of diligence and good conduct from the schoolmasters or other teachers who have instructed him; and of bodily fitness from an army surgeon.

The local board of examiners is appointed by the general officer in command of the army corps, the centers of examination corresponding in present practice with the localities assigned to the division or army-corps schools, nine in number, presently to be described.

The first part of the examination is on paper; a *vivâ voce* examination follows.

On paper the young men have to write three themes or compositions in German, to translate two passages, one from Livy or Sallust, another from Cæsar's Commentaries, Cicero's Epistles, or Quintus Curtius; to translate sixteen or twenty lines from French into German, and two passages, a longer and a shorter, from German into French. They have one question in common arithmetic, one in equations, progressions, or logarithms; one in geometry, one in

trigonometry; they have one in mathematical or physical geography, one in the general geography of Europe and its colonies, and one in that of Germany and Prussia. There is one question in Greek or Roman history; one in the earlier German history; one in modern; and one in Prussian history. They have also to show that they are acquainted with the common conventional signs used in representing the surface of the earth in maps; and they have to copy a small map of a group of hills.

The time allowed for each question is about three quarters of an hour or an hour; for each German theme, it is as much as an hour and a half or two hours.

The questions are of a comprehensive character; *e. g.* Give a history of the campaign of 1813, or of the life of Alexander the Great; enumerate the rivers flowing into the Mediterranean Sea, with the principal towns situated upon each of them. The German themes are, first, a *curriculum vitæ*, an account of the candidate's life, which is, however, not supposed to count in the result, and is merely for the examiner's information; second and third, two themes on some sentence or proverb, for the first of which the examiner assists the candidate by *vivâ voce* questions and corrections in drawing up the preliminary outline of arrangement; for the second he is left entirely to himself.

There is a subsequent *vivâ voce* examination in all the subjects, drawing excepted. The candidates are taken in small classes, not exceeding seven in number, and are examined together, but not in public.

The results of the examination are considered according to the system of *predicates* or epithets, sometimes also called *censures*. The candidates' answers are characterized as excellent (*vorzüglich*,) good (*gut*,) satisfactory (*befriedigend*,) insufficient (*nicht hinreichend*,) or unsatisfactory (*ungenügend*. Numerical values are attached to each of these epithets; "excellent" is marked with 9; "unsatisfactory" counts as 1; and according to the amount of importance attached to the different subjects the marks thus given are multiplied by a higher or lower number, by 5 in one case, by 3 or by 1 in others. German, Latin, and mathematics have all the highest estimate of 5, and are each five times more important than drawing, which is marked by 1; geography, history, and French, are each valued at 3. A young man who gets the *predicate* "excellent," in German, will receive 45 marks, his 9 being multiplied by 5; whereas the same predicate for history would obtain him only 15, and in drawing only 5 marks.

German,	5	
Latin,	5	
Mathematics,	5	
History,	3	Total, 25.
Geography,	3	
French,	3	
Drawing,	1	

A report is then drawn up, and according to the marks or predicates, the candidates are pronounced as admissible with distinction, admissible with honor, or simply admissible; or their re-examination after six months, their re-examination after a year, or their absolute rejection, is recommended.

This report, with the candidates' certificates, is forwarded to the supreme military examinations board at Berlin, and, if approved by them, is submitted in their quarterly report to the king; and the result, when sanctioned by him, is communicated to the respective corps.

The candidates are all informed not only of the practical result, but also of the particulars of their examinations; they are told in what subjects they have failed, and in what they have succeeded. The candidates can not, under any circumstances, try more than three times.

The young men who pass, are thus, so far as their qualification in point of knowledge is concerned, pronounced admissible to the ensign's grade. They have of course to complete their six months' service with the troops. Yet even when this is completed, a vacancy in the list of ensigns must be waited for, and months may pass before the aspirant receives the distinctive badge, the special Sword-knot, which marks his superiority to the corporals, and shows that he has gained the first step that leads to a commission.

The examination that has now been described is obviously one for which preparation may be made in the common public schools, and under the usual civilian teachers. A young man of seventeen need not have been positively destined to the military profession, nor have gone through special preparation for any length of time beforehand. The boards of local military examiners are content to take them as they are offered, inquiry only being made as to their birth and connections, and their previous behavior at school or under tuition.

In fact, those who have passed successfully through the full course of a school which prepares for the universities (a gymnasium,) are excused the ensign's examination. The certificate they have received on going away from school, upon the *abiturient's* or leaving examination, as it is called, is considered quite sufficient; except in

the case of candidates for the artillery or engineers, who are expected to show greater proficiency in mathematics; and certainly a boy in the head class of a gymnasium ought to be able to pass the preliminary examination with perfect ease and with credit. The amount of knowledge required and the particular subjects selected are not those of the first, and are scarcely those of the second class of a gymnasium; and the assertion was even made that a boy from the upper third class might very well hope to pass for an ensigncy. Possibly a little extra tuition from the preparatory establishments, which are said to have sprung up with the special function of "fabricating Fähnrichs" might in this instance be required.

The official programme is here given, and may be compared with the studies prescribed in the upper classes of the Cadet House at Berlin, (*see* the account of that school.)

1. In their own language, good legible handwriting, a correct style, free from orthographical or grammatical mistakes, facility of expression in writing and speaking; some evidence of a knowledge of German literature.

2. In Latin, facility in understanding the Latin prose writers ordinarily read in the second class of a Prussian gymnasium. A written exercise in translation from Latin into German; grammatical analysis of some passages.

3. In French, facility in reading and in translating from German into French, and French into German, grammatical analysis of French sentences, and a knowledge of syntax.

4. Mathematics:—

(*a.*) Arithmetic and Algebra;—familiarity with the ordinary rules for the extraction of the square root of whole numbers and of fractions; Proportion and its applications including questions in Partnership and Compound Proportion; the theory of powers and roots, with integral and fractional, positive and negative exponents. Equations of the two first degrees, with one or more unknown quantities; Logarithms, Logarithmic Equations, Arithmetical and Geometrical Progression, and practice in the application of the various theories.

(*b.*) The complete elements of Plane Geometry, measuration of rectilineal figures and of the circle, transformation and division of figures; the first elements of the application of Algebra to Geometry.

(*c.*) Plane Trigonometry, Trigonometrical functions and their Logarithms. Use of trigonometrical tables. Calculation of particular cases of triangles, regular polygons, and segments of circles.

In consideration of the especial importance of this discipline for officers of the artillery and engineers, a higher predicate (*i. e.* a greater number of marks) will be required in the exercises of candidates for these two services; the knowledge expected in their case will be, though not more extensive, more thorough and deep.

5. Geography:—The general principles of Mathematical and Physical Geography, knowledge of our planetary system, of the motions of the Earth, and of the phenomena immediately dependent upon them. Readiness in drawing from memory the outlines of the more important countries, with their principal mountains, rivers, and cities. General outlines of Political Geography, in the case of the mere states out of Europe; a detailed account of the elements of European statistics, more particularly in the case of Germany and Prussia.

6. History:—A knowledge of the more remarkable events in the history of great nations, of the general connection, causes, and consequences of these events; a knowledge of the remarkable men of all such nations down to the present time. Special knowledge of the history of Greece, Rome, Germany, Prussia, with particular reference in this last case to its external growth, inner

development, and to the principal events of the most important wars since the middle of the eighteenth century.

7. Readiness in general drawing, and in constructing mathematical figures; some skill in drawing plans of positions and mountains, in the way of preparation for military plan drawing.

8. The candidate may, in addition, be examined in other subjects, in which his certificates show that he has been instructed; for example, in Natural Philosophy, so far as included in his previous course of instruction.

It must be remembered that either before or after this examination some months must be spent in actual service with the troops by all but the pupils belonging to the *Selecta* of the cadet school; and that nine months of study at the division and artillery and engineer schools intervenes before the officers examination takes place.

2. *The Second or Officer's Examination.*

The second or final examination for a commission, which generally ensues when the work of the division school is over, is held in Berlin only, and is conducted immediately by the central commission, to which reference has so often been made—the supreme Military Examinations Board, the *Ober-Militair-Examinations Commission.* This board or commission, a list of the existing members of which is given in page 179, consists, for the purpose now in consideration, of a president and five examiners, selected from the larger number to examine candidates for commissions.

The examinations are held continually; two opportunities are afforded every year to the candidates sent from each of the various army corps. The requisite papers must be forwarded to the commission eight days at least beforehand, and the candidates must appear in Berlin, and take up their quarters in the buildings placed at the disposal of the board on the Friday preceding the day fixed for the examination. The examination usually begins on the following Monday, and lasts through the week. The expenses of the journey are allowed, except, perhaps, when the candidate comes up a second time.

The certificates to be presented are the following:—

1. The certificate of birth, age, parentage, &c. (This is called the *Nationale.*)

2. The *Curriculum Vitæ*, (an account of the circumstances of the candidates's past life, his education, employment, &c., &c.)

3. The certificate that he has already passed through a previous examination (the *Tentamen,*) held by the authorities of the division school.

4. A certificate of conduct during his stay at the division school.

5. A military drawing (*Croquis,*) with an attestation given by his instructor that it is the candidate's own doing.

This examination, like the preliminary one, is partly on paper and partly oral. General directions are given that the examiners in both cases shall look mainly to the question whether the candidate has sufficient positive knowledge of his subjects, and capacity to explain and express himself, that mere lapses of memory shall not be regarded, and that natural endowments shall be principally looked to.

In the written examination, the candidate has four questions given him in what is called the knowledge or theory of arms (*Waffenlehre,*) including under that term all kinds of ammunition; three in tactics; one question in the rules and regulations which touch the duty of a subaltern officer; two questions in permanent and two in field fortification; one exercise in surveying, to test his acqaintance with the common instruments, and one to try his knowledge of the principles of plan drawing (*Terrain-Darstellung;* while his general skill in military drawing is proved by his either copying a plan placed before him, or drawing one from a relief model of a mountainous district (*nach Bergmodellen.*)

There is a *vivâ voce* examination in all the subjects.

The commission meets once every month to consider the examinations held since their last meeting. The result is announced under the form of the *predicates* or epithets already more than once referred to. Honorable mention is accorded to an *excellent* examination, and mention to a *good* one. If there has been an unsatisfactory result in one of the subjects, the candidate may compensate for it by superiority in other subjects, but can only in this case be qualified as *satisfactory* (*befriedigend,*) and an adequate knowledge of "arms" and tactics is regarded as indispensable in candidates for the infantry or cavalry, and in "arms" and fortification in those for the artillery and engineers. No superior work in other subjects is allowed to make up for a deficiency in these.

If a candidate's work is marked as *insufficient* (*nicht hinreichend,*) he is sent back for another half-year, and if he has done *unsatisfactorily*, for a complete year of additional study, with leave to appear for re-examination after that interval. In a case of re-examination, the two last *predicates* (*nicht hinreichend* and *ungenügend*) entail final rejection.

The report of the board is submitted to the king; the results are communicated to the various corps. The announcements sent to the candidates state the predicates assigned to the various portions of

their work. Those who have passed, receive certificates of being qualified for the second lieutenant's commission:—

This rank, however, is not immediately granted. A vacancy may be long in occurring, and must be waited for. Promotion is given according to their seniority on the list of ensigns in the regiment. Another condition must also be satisfied. When a vacancy occurs, the senior ensign's name can not be submitted to the king for his appointment without a document stating on the part of the officers of the regiment that he has the requisite knowledge of the duties of the service, and that they consider him worthy of admission amongst them (*würdig in seine Mitte zu treten.*) If the majority is opposed to his admission, the name of the next ensign in order of seniority is, without further discussion, brought forward; if a minority or merely some individual officers take exception, they state the grounds of their opinion, which are then submitted for consideration.*

Special merit in the examination may be, at the king's pleasure, held a sufficient reason for promotion before all candidates examined at the same time.

The following is the programme of the studies, proficiency in which is expected of candidates at the second or officer's examination:—

I. KNOWLEDGE OF ARMS AND MUNITIONS.

A. *Of Gunpowder.*

1. General views on gunpowder and its application.
2. Ingredients of gunpowder; its qualities and use.
3. Fabrication of the same; principles on which the manufacturing process is based.
4. Statement of the various kinds of gunpowder in use, and their distinctive qualities.
5. Of the ignition, combustion, and power of gunpowder.
6. Qualities of good powder; examination of the same:
   - *a.* According to their external characteristics.
   - *b.* According to force developed.
     - *a.* By the mortar eprouvette.
     - *b.* By the smaller eprouvette.
     - *y.* Or, in default of such instruments, by practical experiment.
7. Manner of preserving gunpowder; characteristics and treatment of damaged gunpowder.
8. Precautions to be taken in working with gunpowder, and transporting the same.
9. The most ignitible materials for percussion caps, and the like.

* This certificate, according to a statement received in conversation, is in the first instance from the officers of the company, to the effect that the ensign in question is well conducted and likely to be a desirable addition to their number; then from the major of the battalion, and from the colonel of the regiment.

B. *Of Artillery.*

1. Classification of guns, according to species, calibre, and the kind of warfare for which they are intended. (Field, siege, and standing artillery.)

2. General qualities to be required of a properly constructed piece of ordnance.

3. Construction of the piece; description of the same according to the various kinds of guns, specifying the use of the different parts. (An exact statement in figures is only called for in reference to the length, weight, and diameter of the piece.)

- *a.* Materials; qualities required of them; enumeration of the materials generally employed.
- *b.* Interior construction of the piece; length of bore, chamber, windage, and touchhole; their influence on the range.
- *c.* External construction of the piece; appliances for pointing and managing it, and connecting it with the gun-carriage.

4. Construction of the gun-carriages; enumeration of the different kinds of the same, according to the description of gun, its destination, and materials.

- *a.* Specification of the principal component parts of the carriages.
- *b.* Distinctive characteristics of the construction of the various denominations of carriages.
- *c.* General principles for determining the proper construction of the same.
- *d.* General notions relative to the proportion of the weight of the carriage to the piece.

5. Construction of the limbers.

- *a.* Enumeration of the different kinds of limbers.
- *b.* Principal component parts and distinctive characteristics of the construction of the various kinds of limbers.
- *c.* General notions relative to the weight of the limber in proportion to the piece and the gun-carriage.

6. Statement of the various descriptions of wagons used by the field artillery, and their destination.

7. Ammunition; enumeration and description of the objects belonging to it. (Exact statements in figures are only required for the diameter and weight of the principal kinds of projectiles.)

- *a.* Projectiles; statement of the species of projectiles used for the different kinds of guns, and their construction.
  - *α.* Round shot, cannon ball, grape.
  - *β.* Shells; their various species.
  - *γ.* Light balls.
  - *δ.* Stones.
- *b.* Charges; general description of them.
  - *α.* In field-pieces.
  - *β.* In heavy artillery.
- *c.* Primings; enumeration and description of the various kinds of primings.
- *d.* Other military fireworks; statement of the principal species, and their general construction.
- *e.* Transport of ammunition by limbers and carts; packing of the same.

8. Moving and working the guns:

- *a.* General notions on the working of field-pieces.
- *b.* Different kinds of operations with field-pieces; unlimbering and limbering up.
- *c.* Position of field-pieces in firing, with regard to effect, cover, and celerity of movement.
- *d.* Principal manipulations in working the same.
  - *α.* Loading.
  - *β.* Pointing.
  - *γ.* Discharging; the process according to the different kinds of projectiles.

e. Ascertaining the efficiency of a gun previous to using it.
f. Momentary unserviceability of guns.
g. Expedients for repairing a disabled carriage.

9. Artillery practice.
   a. Exposition of the theory of firing (as far as it can be elucidated by a knowledge of the elements of mathematics;) general notions concerning the curve of round and hollow shot, and the influence of the force of powder, of gravity, and of the air's resistance upon their velocity; the curve after the first graze; trajectory of grape shot.
   b. Classification and denomination of the various methods of firing or throwing projectiles.
   c. Range; conditions on which it depends; its practical limits.
   d. Effect of projectiles.
      α. Probable accuracy of practice; circumstances on which it depends.
      β. Force of the blow; circumstances on which it depends.
   e. Recoil, jumping, or bouncing; explanation of such occurrences.
   f. Application of the various descriptions of guns, projectiles, and methods of firing, according to the nature of the mark, the distance, the position of the adversary, and the ground.

C. *Of Small Arms.*

1. Classification and denomination of small arms.
2. General principles applied to the construction of the musket, the infantry and wall-piece rifle, the carbine, the cavalry rifle, the pistol, and the engineer musket (if the candidate is in the engineers.)
3. Description of their construction and arrangement in particular; enumeration of the separate parts (an exact statement of dimensions only required for the principal ones;) object and effect of the same.
4. Estimate of the practical utility of the various kinds of fire-arms as employed by one infantry and cavalry (no technical or theoretical investigation, but only practical remarks.)
5. Ammunition, as the ball, cartridge, and patch:
   a. Its preparation.
      α. In the usual manner.
      β. In cases of need, in default of the usual implements.
   b. Preserving, packing, and transporting it, both in carriages and by the soldier himself.
6. Management of small-arms:
   a. Theory of firing (in its general scientific bearings, *vide* artillery) as applied to small-arms; repeated elucidation of the curve, line of metal, axis produced, and the relative position of these three lines in the different ranges.
   b. Practical rules for loading, presenting, taking aim, and discharging, at different elevations of the adversary, and at different ranges.
7. Cleaning and preserving the arms.

D. *Of Side-Arms.*

1. Classification and denomination of the same:
   a. Cavalry side-arms.
   b. Lances.
2. Statement of the general principles on which their construction is based.
3. Examination of the state of side-arms on receiving them (within the limits mentioned above in C. 4.)
4. Effect and management of the same.

II. TACTICAL BRANCHES.

A. *Army Organization.*

1. General sketch of the organization of the Prussian army.
2. Characteristics of the different kinds of troops (arms;) their peculiarities

(their weapons are included under the former head,) their equipment and destination.

B. *Elementary Tactics.*

1. Account of the regulations concerning the distribution and formation of a battalion of infantry, a regiment of cavalry, and a battery, in line or column.
2. Formation of the different columns from the line, forming square, deploying and forming line, movement in advance, to the rear and to the flank, changing front and direction in line and column.
3. Formation of *tirailleurs* and skirmishers; posting, covering, moving, reinforcing, reducing, and relieving the same.
4. General rules on the conduct of the separate arms in action.
   a. Engagement of infantry under fire and hand to hand, in close and extended order, in attack and defense.
   b. Charge of cavalry, attack *à la débandade*, wheeling off of the fourth subdivisions (platoons,) skirmishing.
   c. Employment and conduct of artillery in action.
5. General principles relative to the combined action of the different arms.
6. Tactical advantages of ground; level, hilly, open, close, uninclosed, and broken ground.
7. Attack and defense of localities, such as heights, woods, farm-buildings, villages, and defiles; false attacks, demonstrations.

C. *Field Service.*

1. Of Marches. General rules, method, and object; precautions, van and rear guards, covering parties.
2. Escort of transports of powder, provisions, and prisoners of war, in one's own and in an enemy's country.
3. Surprises, ambuscades, and reconnaissances.
4. Service in cantonments, camp, and bivouac, outposts, picquets, advanced picquets, reserve picquets (movable and stationary,) patrols.
5. Taking up quarters in ordinary marches and cantonments.

III. FORTIFICATIONS.

A. *Field Works.*

1. Object of breast-work and ditch profiles in plains. Plan of field-works; open works, salient angle, its dimensions.
2. Dead angle and dead ground. Removal of dead ground; flanking; line of defense; dimensions of re-entering angle.
3. Inclosed works; dimensions and space inclosed; works with salient angles only, and with both salient and re-entering angles.
4. Erection of works to be defended by artillery; firing *en barbette*, and through embrasures; platforms; magazines.
5. Communication with interior of inclosed works.
6 Artificial obstacles for strengthening field-works; requisites for their selection and application; method of construction; advanced ditches (demi and entire;) trous-de-loup; abattis; palisades and fraises; barriers; chevaux-de-frise; pickets; caltrops; harrows; sluices and inundations; fougasses; block-houses; caponiers; double, single, and demi-caponiers *à revers*.
7. Strength of garrison of field-works.
8. Defilading, horizontal and vertical, of open and inclosed works; traverses and bonnettes.
9. Construction of small open and inclosed field-works; marking out; tracing; profiling; number and employment of workmen; excavating the ditch; formation and revetment of the slopes with sods, fascines, wicker-work, gabions, sand-bags, wood, or stones; selection, preparation, and application of the revetting materials. (Of the execution of the revetment only so much as may show

whether the examinee will be capable of undertaking the direction of such works in an efficient manner.)

10. Fortification of heights and defiles.

11. Object, general arrangement, and advantageous situation of a tête-de-pont.

12. Arrangements for the defense of woods, hedges, houses, churches, and churchyards.

13. Attack and defense of a redoubt; surprise; attack by open force.

14. Repairing and destroying roads, fords, and bridges, wooden and stone; construction of foot bridges, carriage bridges, bridges across swamps.

B. *Permanent Fortifications.*

1. Construction of a bastioned front in a plain, with ravelin, tenaille, and covered way, in plan and profile, after the first system of Vauban, with the improvements of Cormontaigne; name and destination of every single part, angle, and line.

2. Brief description of a regular attack upon a bastioned fortress; sketch of the preparations for attack; lines of circumvallation and contravallation.

Description of parallels, approaches, demi-parallels, and the duties of the infantry in them; saps, trench cavaliers; carrying the covered way, crowning the glacis, passage of the ditch, escalade of the rampart. These operations to be detailed according to their object, position, and arrangement, but without special reference to their technical execution.

General notions relative to the batteries of a besieging army, their position, object, calibre of guns, and practice.

3. Outlines of the system of defense of a fortress relative to the employment of infantry and cavalry in garrison, and of the standing artillery in arming the fortress and placing it in a state of defense against a regular attack or an attack by open force in all its stages.

Especial knowledge of the duties of infantry and cavalry in garrison, in guarding, occupying, and defending the works, and in sallies, required.

4. Historical sketch of an actual siege (on which the examinee has attended a lecture,) and the principles of the attack and defense of fortresses in general.

5. Account of the situation, form, arrangement, and object of some of the means employed for increasing the permanent strength of fortresses, exclusive of the more technical points.

a. The rampart of the body of the place. Angle of the bastions and its effect; length of flanks and faces; auxiliary flanks; empty and solid bastions attached and detached fausse-brayes.

The escarp, earthen wall, revetment, demi-revetment, simple crenneled wall, arched crenneled wall, revetment *en décharge;* perpendicular and parallel casemates.

b. The main ditch, dry, wet, and dry or inundated at pleasure; sluices, coffer-dams, reservoirs.

c. Outworks. Ravelin, tenaille, counterguards, cover-faces, envelopes, tenaillons, lunettes.

d. Advanced works. Simple and double tenaille; horn-work before a bastion or redoubt; crown-work; double crown-work; advanced ditch, with advanced covered way.

e. Detached works, open or inclosed at the gorge.

f. Interior works. Cuts inside the bastions; réduits; citadels.

6. Historical notions of the characteristics of some of the principal systems of fortification, *e. g.* the old and modern Italian, the old Dutch, Vauban's second and third manner, the ideas of Coehorn, Rimpler, the French school, and that of Montalembert, compared with Vauban's first system, but without statement of proportions; in addition to this, the characteristics of the latest Prussian fortifications, always with the omission of details more especially technical.

7. Modified methods of attack; surprise, assault, bombardment, blockade; explanation and statement of circumstances in which attacks of this kind are practicable.

IV. SURVEYING AND DRAWING PLANS.

1. Knowledge of the instruments generally employed in military surveying, and their use.

a. Instruments for measuring and marking out straight lines; viz.—
Signals, bandrols, or *jalons*, common staves, picket posts, rods, measuring chains, measuring cord, the step.

b. Instruments used for protracting the lines measured, viz.—
The step measure, calliper compasses, beam compasses, dividing and reducing compasses.

c. Instruments for measuring and marking out horizontal angles:
The square, the plane table, caloptric compasses, the reflector, the sea-compass, the prismatic compass, the astrolabe:

d. Instruments for measuring vertical angles:
Lehmann's dioptric rule, Schmalkalder's holometer, the quadrant.

e. Leveling instruments:
The ordinary mason's level, the spirit level, the water level, the spirit level *à lunette*, the plumb rule, Lehmann's dioptric rule in connection with the plane table, placed horizontally, the surveyor's rule, Schmalkalder's holometer.

2. Operations in surveying with the plane table, astrolabe, reflector, and compass.

3. Topographical survey of a locality (theorectically and practically,) reconnoitring, geometrical triangulation, detailed survey.

4. Hasty or rough sketch of certain objects, and entire (but limited, sections of country.

5. Drawing plans.

a. Notion of the elements of topography; rising and sloping ground, running and standing waters, division of ground in a military point of view, and characteristics of the same; open, inclosed, elevated, hilly, mountainous, broken ground.

b. Theory of plan drawing.

α. The first elements of the science of projection, and the construction of instruments for measuring slopes.

β. Fundamental rules for plan drawing in general, and for drawing mountains in particular. Statement of the various angles of depression of inclined planes through mountainous regions.

γ. Of the horizontals, and the laws dependent upon them, relative to mountainous districts.

δ. On the laws of defiles.

ε. On ascertaining the difference of elevation, and drawing profiles.

ζ. View of the accessories of plan drawing; the choice of colors and of type, and the order in which the operations necessary for preparing a plan are performed.

c. Practical plan drawing from copies and models.

V. MILITARY COMPOSITION AND KNOWLEDGE OF THE SERVICE.

A. *Exercises in Military Composition.*

1. Drawing up reports on incidents connected with the service, and with the duties of a subaltern officer, directed to the military authorities and superior officers of every rank.

2. Instructions to subordinates.

3. Applications and memorials.

B. *Acquaintance with the General Regulations of the Service.*

1. The laws on disciplinary and military punishments.

2. The proceedings in courts-martial, drum-head courts-martial, and courts of honor.

The preparation for this second, severer, and professional test that has just been described, is usually obtained in the division schools, of which an account will shortly follow, and to which any young man once accepted as a candidate, who has served his six months with the troops, and has passed his preliminary or ensign examination, may be admitted, even though a vacancy has not yet occurred, and he has not yet received his definitive promotion to the ensign's grade.

V. MILITARY SCHOOLS FOR PREPARING OFFICERS.

The Cadet Schools or Cadet Houses.

The actual military education of Prussia commences with the cadet houses, the schools intended for pupils before entering the army. They are divided into two classes, the junior and the senior. They can not indeed be called exclusively military schools, since the education which most of their pupils receive is one which fits them for civil professions, and is not specially military; and there is no obligation even on those who have received the largest amount of pecuniary assistance to enter the military profession when they leave the cadet house. The highest class, however, of the Upper Cadet School of Berlin, called the *Selecta*, receives strictly military teaching for a year, and the schools may fairly come under this denomination, as being mainly intended to educate the sons of officers who are in want of assistance, and as possessing a military discipline, uniform, and spirit.

These are five in number, four preparatory schools, and one a finishing institution; the four first in the provinces, at Culm, Potsdam, Wahlstatt, and Bensberg, the last in the capital itself. At the four junior schools, boys may be admitted at 10 or 11, and may remain till 15; at the upper school the ordinary stay is from 15 or 16 to 18 or 19.

The whole constitute together a single body, called the cadet corps. Boys may enter the school at Berlin on passing an examination, without previously attending one of the lower schools; but those who are sent up by the authorities from Culm, Potsdam, Wahlstatt, and Bensberg, are received without examination, being already members of the corps. A single officer exercises the command of the whole; and a single commission, of which the general inspector is chairman, regulates all matters relating to the admission of candidates into the body.

The whole number at present is between 1,100 and 1,200, of whom 420 are in the Upper School at Berlin, 205 in the Preparatory School at Potsdam, and 200 at each of the other houses.

The cadets are of two kinds, the King's cadets and the Pension-

ers or paying pupils; the former are 720 in number, the latter about 420. The pensioners pay 200 dollars (30*l.*) a year for board and instruction together; the King's cadets are aided in various degrees accordingly to the following scale:—

240 pay 30 dollars (4*l.* 10*s.*) each.
240 pay 60 dollars (9*l.*) each.
240 pay 100 dollars (15*l.*) each.

Foreigners are admissible at a yearly payment of 300 dollars (45*l.*,) and a few extra day scholars (*Hospitanten*,) when the classes are not too full, are received for 20 dollars a year (3*l.*)

The King's cadetships are granted, according to the pecuniary circumstances of the applicants, to the children of officers of the standing army, or of the Landwehr, who have distinguished themselves or have been invalided in actual service in the field; to the children of non-commissioned officers who have in like manner distinguished themselves and received severe wounds in the service; and to those of any citizens who have performed any special service to the state. The sons of meritorious officers who have died in indigence or have retired upon pensions, the sons of indigent officers in general in the standing army, and the sons of meritorious non-commissioned officers of twenty-five years' standing, are also in like manner eligible.

In very special cases of poverty, the supplementary payment is dispensed with altogether.

Pensioners are admitted from all classes and professions according to priority of application, and to their qualifications as shown by their examination. A great number of these are said to be the sons of officers, of those, namely, who are not in need of pecuniary assistance. And the number of the pensioners generally appears to be steadily on the increase. In the regulations printed in 1850, the places open for this class of cadets are stated to be only 216; at present, as has been seen, provision is made for something like double that number.

The four junior schools at Culm, Potsdam, Wahlstatt, and Bensberg, are all divided for purposes of instruction upon the same uniform plan into four classes, numbered up from six to three—*Sexta* at the bottom; *Quinta; Quarta;* and *Tertia* at the top. The upper school at Berlin succeeds with three classes, the second, the first, and the special or select—*Secunda*, *Prima*, and *Selecta*. Each of these classes, however, may contain any number of co-ordinate subdivisions, all taught the same subjects, and presumed to contain pupils of the same capacity. No teacher, it is considered, can satis-

factorily undertake to give a lesson to more than thirty at a time; and the Secunda at Berlin was thus parted out in the year ending March, 1856, into eight little sets of rather less than thirty, the Prima into six, and the Selecta into two.

Junior Cadet House.

The junior cadet house at Potsdam occupies four or five buildings a little way out of the town. The class-rooms are on the usual Prussian plan, not arranged for lectures to large, but for lessons with small numbers. One distinguishing feature is the character of the arrangements of the rooms up-stairs, in which the boys pass their time out of school hours. They are very comfortable chambers, perhaps rather small for the numbers at present placed in them; they are ranged along a corridor; ten pupils are placed in each, and between every two rooms is the apartment of one of the resident tutors (*Erzieher* or *Gouverneur*,) who sees that all goes on right in these two rooms under his charge. Here the boys sit and work, and during the hours when they are expected to be preparing their lessons, are carefully looked after by their tutors.

These little apartments occupy one whole floor of the building. The floor above is that of the dormitories, containing each, perhaps, as many as sixty. The number at present in the school was stated to be two hundred and five, and the accommodation properly intended for only one hundred and sixty.

Colonel von Rosenberg, the commandant of the school, stated that eleven was the usual age at which the pupils came. This he appeared to think was rather too early, and he was inclined to attribute to this cause certain points in the character of young men who have been educated in the cadet corps. Eighty of his two hundred and five pupils were pensioners, or paying pupils; many of these also were the sons of officers. The teachers and tutors are partly civilians and partly military men, about an equal number of each. The four classes, Tertia, Quarta, Quinta, and Sexta, are subdivided into nine, so that the average number at a lesson would not be more that twenty-three.

Senior Cadet House.

The upper or central cadet school is in the older part of Berlin, in the *Neue Friedrichs Strasse*, where on the pediment surmounting the gateway the inscription, MARTIS ET MINERVÆ ALUMNIS M.DCC. LXXVI, records the erection by Frederick the Great, ten years before his death, of the large and stately quadrangle which formed the original house. Here the pupils are quartered, and in the great

court within, they go through their exercises. There are several houses on both sides of the street attached to the service of the institution, and buildings are in course of erection to accommodate additional numbers.

A large separate building contains the present class-rooms. In the first of these which we visited, thirty cadets were engaged in military drawing; in another, twenty-four of the second class, the Secunda, were busy at their Latin lesson.

The room was fitted up on what appears to be the usual plan, with a series of parallel desks on the same level, ranged along the outer wall, and a sufficient space between them and the inner wall for the teacher to pass freely up and down. His desk was at one end in front of the boys. The lesson was in Quintus Curtius. The teacher (a civilian) made them construe each a sentence, and asked questions in parsing, &c., &c., much in the English manner. There was no taking places. This in German schools appears to be confined to quite the lower classes. There is a separate lecture-room here again for lessons on Natural Philosophy and Chemistry, with a small gallery of models, instruments, &c., attached to it.

A large hall is used on state occasions, and serves the purpose also of an examination-room; it is called the hall of the Field Marshals, and is adorned with portraits of the sovereigns of Prussia from the Great Elector downwards, and of the field marshals both of the time of Frederick the Great and of more recent date, among whom is the Duke of Wellington. Here also is kept Napoleon's sword taken at "La Belle Alliance," and presented by Marshal Blucher.

Passing to the first floor of the great quadrangular building, we found ourselves in one of the sitting-rooms of the cadets. Seven boys had a couple of rooms, consisting of a common sitting-room, and a common bed-room. Five is the number for which this amount of accommodation was intended, and to five the number will be reduced when the new buildings are completed. In a second and larger pair of rooms we found twelve boys.

Here also is the library, containing 10,000 volumes, and comfortable apartments occupied by the various superintending officers.

The boys, their morning lessons completed, had been going through their military exercises under the superintendence of their officers; but they were now collected in their studying-rooms, and were seen forming at the doors, each small party under the command of its senior, ready to march into the large and handsome dinner-hall.

Into this the whole body of young men presently moved by companies, proceeding to station themselves in front of the tables. The tables are ranged in parallel lines on each side of the central passage, and accommodate each of them ten, four sitting at each side, and a senior at each end. The order was given by the officer on duty for "prayer" (*Nun beten wir*,) and a short silent grace was followed by the immediate occupation of the seats, and the commencement of the meal. The arrangements in general appeared to be excellent.

The number in the school during the past year had been 420. The four companies into which the whole body of the pupils is divided, each contain a certain proportion from each of the three classes; the senior in each company being invested with the charge of the juniors; those who are in the Selecta taking rank as under officers. In every room (*Stube* or *Wohnzimmer*) there is one *Selectaner*, who is responsible. The ordinary ages are 15, 16 in the Secunda; 16, 17 in the Prima, and as far as 19 in the Selecta. No one is, as a rule, allowed to pass more than one year in a class; if in that time he can not qualify himself for advancement, he is dismissed. The rule does not, however, appear to be strictly enforced. The general preservation of discipline appears to be a good deal intrusted, as in English public schools, to these senior pupils of the age of eighteen or nineteen. There are Resident Tutors (*Erziehers* or *Gouverneurs*) as at Potsdam, who see a good deal of the pupils, especially in the evenings, when they go into the sitting-rooms, sit with them, help them in their work, play at chess with them, &c., &c. But they do not sleep close at hand between the sets of rooms, as at Potsdam, but at some little distance off.

The official arrangements for the control of the discipline consist principally in the system of what are called *Censur* Classes. This is a peculiar system which requires some explanation. There are five *Censur* Classes quite independent of the ordinary classes of the school. A boy on entering the Cadet School is always placed in the third of these classes; if he behaves ill, he falls to Class IV. and is under restrictions. Class V. is reserved for serious cases of misconduct, and any one who incurs the penalty of descending to it, is subject to continual superintendence, and is confined to the walls. Class II. gives considerable, and Class I. still more ample privileges. The members of this class (usually only quite the elder boys) are allowed great freedom in the way of going out into the town.

In each of the studying-rooms (the *Wohnzimmer*) the list of the occupants' names hangs up on the door inside. One for example

was noticed containing twelve names. To each was attached his rank in the *Censur* Classes, as well as his position in the ordinary classes. At the head stood one *Selectaner*, who in this instance was in charge of the room; then followed the *Primaners;* and the list was completed by nine of the *Secunda.* As at the time of our visit (just after the Easter holidays and the yearly examination) the whole Selecta of the year had just quitted, the room was in the charge of the senior *Primaner.* The authority exercised by these senior boys appears to be very considerable.

The competition for admission to the Selecta, and for the after selection for immediate promotion, was spoken of as very considerable.

The number who came to the Berlin Cadet House without previously going to one of the junior establishments was said to be only a small per-centage.

The boys both here and at Potsdam were of course all found dressed in a military uniform.

The studies pursued in the Cadet Corps agree nearly with those of the common public schools, but of these there are three different kinds:—

1. The ordinary first-class school, the *gymnasium* of the Prussian States, is, strictly speaking, a school which prepares for the universities.

2. The second-class schools have the name of *Real* or *Practical Schools;* they deal with the actual application to business and work, not with the theory of mathematics or of language, and they may be said to resemble in some degree the schools occasionally attached in English towns to Mechanics' Institutes, or in the United States, to the Public English High School or the Higher Department of a Union School. Young men who have passed successfully through a gymnasium may be admitted to the army without passing the preliminary or *Portepée-fähnrich* examination. Those who complete their time at a *Real* School have not hitherto been allowed the same privilege.

3. There is a third and intermediate class called a *Real* or *Practical Gymnasium*, and to this, according to the statements of the official books, the courses of the Cadet Schools have hitherto corresponded. It appears, however, that there is only one specimen of the *Real Gymnasium* now in existence, the Coëln School in the old town of Berlin. The system here is said to be more practical than the *Gymnasium*, and less professional or mechanical than the *Real School.*

It is intended during the present year to assimilate the course of instruction at the Cadet Schools more nearly to that followed at the *Gymnasium* or University School; the studies of the senior Cadet School at Berlin will be raised to a higher standard, but Greek and Hebrew, which are taught in all gymnasiums, will not be introduced.

The two systems have corresponded as follows:—

Class in the Cadet Corps.	Age.	Corresponding Class in the *Real* Gymnasium.
6th, or *Sexta*,	12	5th, or *Quinta*.
5th, *Quinta*,	13	4th, *Quarta*.
4th, *Quarta*,	14	Under 3d, *Unter-Tertia*.
3d, *Tertia*,	15	Upper 3d, *Ober-Tertia*.
2d, *Secunda* (at Berlin,)	16	Lower Second, *Unter-Secunda*.
1st, *Prima*,	17	Upper Second, *Ober-Secunda*.

The Selecta, the Military Class, corresponds with the classes of the Division Schools, and with the first year's course of the Artillery and Engineers' School.

The plan pursued, both as regards, first, the subjects taught, and second, the amount of time, is as follows:—

The instruction consists throughout, from *Sexta* up to *Prima*, of lessons in Latin, German, French, Arithmetic, History, Geography. Natural History begins in the *Quinta*, at 12 or 13 years old, with Botany and Zoölogy; Mineralogy follows, at 14 or 15; Natural Philosophy at 15 or 16. The first elements of drawing, with the use of rulers, compasses, &c., begins also in *Quinta*, at 12 or 13. Practice in regular plan-drawing is gradually and increasingly given in every year. The first elements of geometry are taught in the *Quarta*, and Euclid I. 47. *Pythagoras*, has to be mastered at 14 years old. Theoretical Arithmetic, in combination with Algebra, is commenced apparently in the *Tertia*.

The subjects taught in the *Secunda*, *Prima*, and *Selecta*, that is, the course of the Upper School at Berlin, has hitherto been as follows:—

In the Secunda:

Quintus Curtius, Cicero's Orations, and Ovid's Metamorphoses; in Mathematics, the completion of Plane and commencement of Solid Geometry; Quadratic Equations; the Physical, Statistical, and Ethnographical Geography of Europe; Ancient History, and History of the Middle Ages, down to the Thirty Years' War; a first course of Natural Philosophy; French and German Composition continued; Theory and Practice of Military drawing.

In the Prima:

Livy and Virgil; in Algebra, Progressions, Logarithms, Exponential Equations; Trigonometry, Mathematical and pure Physical Geography in general; Modern History; second course of Natural Philosophy, Heat, Electricity, Magnetism, Sound, Light; French, Exercise in Speaking, &c.; History of German Literature; Composition, extempore Exercises; Military Drawing continued.

In the Selecta:

Arms and Munitions, and Artillery; Fortification, Tactics, Military Literature Practical Exercises, Military Drawing and Surveying; exercises in French and German; Mental Philosophy; Chemistry; and the Differential and Integral Calculus for those who propose to enter the Artillery or the Engineers.

The Secunda have weekly—

6	hours	of Latin.
3	"	of German.
4	"	of French.
5	"	of Mathematics.
2	"	of History.
2	"	of Geography.
2	"	of Natural Philosophy.
2	"	of Lessons in Drawing.
2	"	of Religious Instruction.
2	"	of French Conversation.
Total,.....	30	hours weekly.

The Prima—

The same amount in Latin, German, French, Mathematics, Natural Philosophy, French, Conversation, and Drawing; in History 3, and in General Geography 2, and Mathematical Geography 1; of Religious Instruction 1. 33 hours weekly.

The *Selecta* have—

4	hours	of Tactics.
2	"	of Military Literature.
1	"	of Military Law and Regulations.
5	"	of Artillery.
5	"	of Fortification.
2	"	of Plan Drawing.
2	"	of Mental Philosophy, or English.
2	"	of Chemistry.
2	"	of Mathematics.
2	"	of French.
2	"	of German.
Total,.....	29	hours weekly.

The lessons appear to be going on from 8 to 11 or 12 in the morning, and from 2 to 4 or 5 in the evening. The pupils have two hours' drill twice a week. They get up at half-past 5, have breakfast, and an hour's preparation before lessons begin. There are similar hours of study in the evening from 6 to 8; and some of the pupils also take private lessons from the teachers.* During these special hours of study (*Arbeitstunde,*) the chambers are visited by the officers and tutors, assistance is given and diligence enforced. From 8 to half-past 9 they study as they please; the tutors are a good deal with them in the rooms; at 10 all are in bed. Wednesday and Saturday are half holidays; on Sunday they

* Not from the Tutors, but from the non-resident Professors and Teachers.

attend morning service in the garrison church, and after that is over, are allowed to be more or less absent in the town, to be with their parents, relations, and friends.

For the 420 cadets of the Institution at Berlin, there appear to be about twenty professors and teachers not residing in the school, the majority of whom are civilians; and in addition to these, twenty tutors and superintendents resident in the buildings. Of these, sixteen are military officers, half of whom are permanently attached to the corps, and half on duty from various regiments, and four are civilians. The cadets being divided into four companies, each containing so many of the Selecta, so many of the Prima, and so many of the Secunda, to each of these companies are attached one captain, one first-lieutenant, and two second-lieutenants, all of whom, however, take some part in the instruction; and one civilian (*Civil-Erzieher*) is added with the especial duty of looking after and assisting the studies of the cadets of the company.

The holidays are one month in summer (in July and August,) ten days or a fortnight at Christmas, eight days at Easter, and four at Whitsuntide.

The rules for the entrance of cadets into the army are as follows:—Those who complete their year in the Prima are considered to be sufficiently prepared for ordinary admission. They are sent in to an examination before the Supreme Examinations Board (the *Ober-Militair-Examinations-Commission*,) before examiners entirely independent of and unconnected with the instruction of the cadets; and the majority, if they pass, are admitted simply as *Portepée-fähnriche*, on the same conditions as the young men already spoken of who enter upon the recommendation merely of the commanding officer of a regiment and the approval of the commanding officer of an army corps. Like these, they serve in the regiment, they attend the Division Schools, and in due time offer themselves for examination for a commission.

Out of this number, however, the sixty who do best are retained, and reserved to receive in the special military class of the Cadet School the instruction which the others are to seek in the Division Schools. These remain another year in the Cadet House, and undergo at its close, before leaving the Cadet House, their officers' examination before the Supreme Board. The thirty best are once more selected, and receive immediate promotion. Their patents are signed and they join their regiments at once as second-lieutenants. The other thirty, if they have satisfied the examiners, receive a certificate of qualification, and enter with the rank of *Portepée-*

fähnrich, and with the prospect of receiving commissions without further examination, as soon as vacancies occur. Any one who fails to pass his examination must enter, if at all, simply with the rank of *Portepée-fähnrich*, and has to qualify himself in the Division Schools for attempting a second time the examination for the officer's patent.

Such is the system as recently modified. Till quite lately only thirty were promoted from the Prima to the Selecta, and these thirty, unless they failed wholly, obtained immediate commissions at the end of the year. It has been found desirable to introduce the stimulus of competition, to offer a definite reward in the way of superior advantages to the best students, and to make it obviously worth a young man's while to exert himself, and to be thoroughly diligent during this final year in the Selecta at the Cadet School.

Young men who, after passing the examination in the Prima, desire to enter the artillery and engineers, follow the usual course leading to the Artillery and Engineers' School. They enter an artillery regiment, or a division of the engineers; they serve for nine months, they enter the special school, they are eligible after the first quarter to the grade of *Portepée-fähnrich*, and at the close of their first year are examined for their lieutenant's commission. Those who remain in the Selecta have the great advantage of passing from the Cadet School immediately into the Artillery and Engineers' School as lieutenants, and commence their course there accordingly at the beginning of the second of the three years. As, however, the school-year closes at the end of April, in the Cadet Houses, and begins in the Artillery and Engineers' School on the 1st of October, these select cadets also pass five months with their regiment in actual service before recommencing their studies.

The average number who pass in this manner into the Artillery and Engineers' School is stated by the authorities of the Cadet House to be three annually from the Selecta, and six or eight from the Prima.

It can hardly have escaped observation, that the studies pursued as a qualification for entering the army are, with the exception of the Selecta, almost entirely non-professional, even here in this part of the general system, which is in other respects most military in its character; and the tendency seems to be to carry out to a still greater extent the theory of continuing to as late an age as possible a good general education. There is evidently a general desire in Prussia to take the officers of the standing army exclusively from the well-educated or the higher classes.

In the arrangements for the lessons, the very temperate or even timid use of the stimulus of competition deserves to be noticed. It appears, however, to have been lately employed with advantage in the highest class. At the same time, the provision made for giving really good instruction, and for placing all the boys in close relation with their teachers, can not but excite admiration. The small numbers of which the classes consist, and the care which seems to be taken in providing good teachers, both deserve attention.

The domestic arrangements, without being remarkable for the scrupulous cleanliness or the magnitude of the new institutions in Austria, certainly in some respects are more in accordance with English feelings. The greater privacy afforded by the use of rooms where few live together, is certainly more analogous to what has been found most desirable for English boys in large English schools, though most likely the contrary system is not less well-adapted to the national character in France and in Austria.

2. *The Division Schools.*

There are nine Division Schools for the whole army, one for each army corps, and they are placed at the following towns :—

Potsdam, Königsberg, Stettin, Frankfort on the Oder, Erfurt, Glogan, Neisse, Münster, and Trèves.

Here the young aspirant finds himself with nine or ten companions and a body of teachers amounting to about half that number, appointed by the commanding officer of the army corps, and differing considerably in different districts in their talents and ideas of education. They are often, though not always, selected from officers who have been at the Staff School, and afterwards at the Topographical Bureau. Their additional pay for teaching is uncertain; it depends upon the surplus remaining after the expenses of the household, and the money paid in purchasing books, instruments, &c., is deducted from the yearly allowance made to the school by the government. At best it is not high. It is calculated by the number of lectures, and at the most amounts to something more than 4*l.* 10*s.* (30 thalers) for the lectures on a single subject, given, it must be remembered, during the course of little more than six months in the year. The highest pay given in the Potsdam School to any one professor amounted to something more than 15*l.* (100 thalers) yearly for lectures on three subjects, averaging ten or twelve lectures weekly for about six months. This must be estimated by a Prussian, not an English standard, being nearly equivalent to five-twelfths of the annual pay of a second lieutenant in that service.

Still the sum is very low; and this, with some other obvious deficiencies, injures the working of the schools.

The young candidate for a commission begins a course of Tactics, Fortification, theory of Drawing and Surveying, Military Literature, Artillery, &c., Military Essays, and Drawing of Plans, which must be finished at the school in nine months, although it may be continued longer in private if the candidate is not prepared to pass his examination. As long as it lasts, twenty-three hours a week are devoted to study, besides the time occupied by questions, which the teachers are required to set from time to time, in order to keep up the pupil's previous knowledge of French and Mathematics. The course is divided into the purely theoretical and practical divisions, the first of six and a half months, the latter of two and a half. We have already given a very full account of the studies in p. 188.

The arrangement of studies is systematic, and the number of hours devoted each week to lectures on the various subjects of study and to gymnastic riding and fencing, is as follows:

WEEKLY:

	Hours.
Fortification,	4
Artillery, &c.,	3
Tactics,	4
Military Surveying (theoretically,)	4
Military Literature,	2
Instruction on Military Duties,	1
Plan Drawing,	5
Gymnastics,	2
Riding,	2
Fencing,	2
Total,	29

The subjoined plan gives the exact employment of time for each day during the week:—

PLAN OF LECTURES AT THE DIVISION SCHOOL IN POTSDAM, 1855–6.

Hours.	Monday.	Tuesday.	Wednesday.	
8— 9	Fortification.	Military Literature.	Tactics.	Dinner time, 3 o'clock. Time for studying, from 6 till 8 o'clock, or from 7 till 9 o'clock every evening.
9—10				
10—11	Instruction on Military duties.	Artillery, &c.	Plan drawing.	
11—12				
12— 1	Plan drawing.	12½–2½ Gymnastics.		
	Thursday.	**Friday.**	**Saturday.**	
8 — 9	Fortification.	Artillery	Tactics.	
9 —10				
10 —11	Military Surveying (theoretically.)	Plan drawing.	Military Surveying (theoretically.)	
11 —12				
12½—2½	Riding.	12½–2½ Fencing.		

The lecturer has to draw up what is called the thread of the lecture (*leitfaden,*) a sort of programme containing its leading heads, intended to assist the memory of the pupils in giving a full account of it afterwards; and the contents of the different lectures on Tactics, Arms and Munitions, Fortifications, &c., are written out very minutely by the students. Ten pages of close print are devoted to these programmes in Helldorf; and the translation already given (pp. 188–194) will show that the list of military subjects adverted to is considerable.

At the end of the nine months spent at the Division School, the "*Officier Aspiranten*" go to Berlin for the examination for their commission. If they can not pass this, they return to study by themselves for their second trial. Unless by special permission from the King, they can not try more than twice.

The examination is conducted by the Supreme Commission for Examinations at Berlin, and has been already described.

The Division Schools were founded at the end of the great War. Their germ appears in Scharnhorst's general order in 1810, which, among other things, instituted three War Schools for the candidate for commissions (*Portepée-fähnriche.*) These three War Schools seem to have been changed into the Division Schools in 1813 and 1816. At first, indeed, they were much more numerous than at present, as their name implies, there being two Divisions to each Army-Corps. There are now, as we have mentioned, nine; and Corps School or Army-Corps School would be the more correct designation.

Their importance as the institutions for special military instruction to all "*Officier-Aspiranten*" of the army led us to inquire carefully with regard to their efficiency, and in particular from two distinguished officers, on whose judgment and scientific experience great reliance might be placed. One of these, it may be added, possessed constant means of knowing all the details respecting them.

I. Formerly, it appears, it was not possible to limit these schools to their true object, purely military instruction. This was the special object of their creation; but owing to the defective *general* education which candidates often brought with them into the army, the Division Schools were too much used as a means of meeting this deficiency.

II. The opinions we obtained were certainly not favorable with regard to the present efficiency of these schools. It seemed to be agreed, that from various reasons, the military education given was

susceptible of much improvement; that some of the Division Schools were really defective in teaching, whilst none could be pointed to as strikingly good. But it was also admitted that these blemishes arose from remediable defects in the working of the schools; that their principle was in itself sound, and capable of being carried out more perfectly, and excellently adapted to the object of giving some military instruction to all desirous of becoming officers of the infantry and cavalry.

III. The causes assigned for the present defects in the efficiency of the Division Schools were chiefly the following:—

(*a.*) That they were far too numerous.

Educated and scientific as Prussia may be called, it is not found practicable to supply *nine* army schools with exactly the sort of men fitted for the work of education. The pay, it must be added, is insufficient to attract many, and thus (as we were informed,) although many officers of intelligence are sometimes not unwilling to leave the life of drill for the life of education for a year or two, few do so with the serious purpose of doing it *well*. Neither the position nor the emoluments tempt them to make it a profession. Officers in command of the district have made the appointments, and often have "good-naturedly," as it was said, appointed unfit persons, known as studious men.

(*b.*) The small number of pupils in each school was also spoken of as a very great disadvantage, as doing away with all emulation amongst themselves.

(*c.*) The independence which each school has enjoyed, and the want of any central body to watch its working and regulate its system, is also said to have had bad results. The teaching has been far from uniform,—in one school energetic, in another lax; in one school the most important subjects taught, in another, a little of everything; in a third, some special crotchet of a teacher. This has acted badly on the examinations, since it was thought hard to reject an "*aspirant*" who had done parts of his work well, and had been evidently ill taught or superficially instructed in others.

The remedies suggested were,—

(1.) Considerably to diminish the number of these schools. This, we were told, was about to be done by reducing them from *nine* to *three*. Such a course would obviously tend to remedy two of the evils complained of. It would give a larger choice of teachers, and afford more liberal means of remunerating them, and a larger attendance and competition of pupils.

(2.) To place the schools under the more direct regulation and

management of the Central Educational Department at Berlin. This step would improve their teaching by subjecting it to constant inspection and reports. It would insure uniformity in the system of instruction and subjects of study; and, when combined with the presence of able teachers, it would enable the Board of Examiners at Berlin to pursue a more strict and unvarying course in rejecting ill-qualified candidates. By these means the teaching in the school would probably become more definite and higher.

One other point was mentioned to us as doubtful. It was thought that the time for attending the Division School came too soon after a young man's entrance into the army, when he had but recently obtained his liberty, and was likely to be much more unwilling to be sent to school again than might have been the case a year or two later. General von Willisen, who urged this objection to us, was consequently for deferring the attendance at the Division Schools several years in an officer's life.

We should add, however, that as in Prussia a young *Officier-aspirant* is still partly a private soldier, we were told that many were glad to exchange the severity of regimental discipline for the Division School.

3. *The United Artillery and Engineers' School at Berlin.*

Young men desirous of obtaining commissions in the Artillery or Engineers follow the course which has already been described. They join either with a nomination from a colonel of artillery or engineers, or as scholars from the Cadet House. They submit themselves for examination for the grade of Ensign (*Portepée-fähnrich*); they serve their time with the troops, they go through a course of professional study, and are examined in it for their officer's commission by the Board at Berlin. If they come from the highest class, the *Selecta* of the Cadet House, they have the privilege of joining the corps with the rank of officer.

In these respects the system is the same for them as for the *Aspiranten* in the other arms of the service.

The distinctions are, that first, in the preliminary or Ensign's Examination, a somewhat greater acquaintance with mathematics is required from them; secondly, that they prepare for the Officer's Examination, and follow their professional studies, not in the Division Schools, but in a separate Special Arm School at Berlin. Moreover, nine months' service with the troops, instead of six, is required before they can enter the Special Arm School. They enter it also with the rank only of corporal, and are not eligible to the

grade of Swordknot Ensign until they have passed three months at least in the school.

Their Officer's Examination before the Supreme Board at Berlin takes place after nine months more, at the end of the first year at the school, and after passing they are eligible to the rank of officer.

When a vacancy occurs their claim to an actual commission is considered, and the usual formalities are fulfilled. Their names are submitted for approval to the officers of the corps, and with that approbation laid before the King; and they thus in due time obtain their rank as Sub-Lieutenants respectively of Artillery or of Engineers.

This rank, however, is provisional, and their position is that of supernumeraries. Their education as officers may be complete, but their education as officers of Artillery or of Engineers has scarcely in fact commenced. They have before them a third examination, that of the Special Arm, their *Vocation-trial* or *Berufs-prüfung*. Or, more correctly speaking, they have not one but two to pass, for the third examination is divided into two stages, one to be passed at the end of each of the two years which yet remain of the course. It is only when these are completed, after a three years' stay, that the young man is finally allowed to join his corps as a second-lieutenant.

Failure in the officers' examination at the close of the first year is attended with the penalty of returning to the corps and resuming service in the ranks with the troops. Whether or not the rejected student may be permitted to return after an interval to join again the classes of the first year, or after passing, upon a second trial, the officers' examination, to enter the classes of the second year, will depend upon the extent of his failure.

Failure in the examination at the close of the second year is similarly visited with the punishment of return to the corps. As they have already passed the officers' examination, they may endeavor to effect a transfer to a regiment of the line; or, under certain circumstances, they may be permitted to study privately in preparation for the third year's course, and may offer themselves for a second trial.

If a student fails in his last examination at the close of the third year, he may be allowed, in like manner, under favorable circumstances, to re-enter the third year's classes, and try to qualify himself by an additional year of study, losing, of course, his seniority. Otherwise, he joins the corps as a supernumerary, with the pay of an infantry officer, and waits till he can obtain a commission in the line.

Candidates for commissions in the engineers enter the corps, it should be observed, originally as volunteers, finding their own clothing, and receiving no pay; but as soon as they enter the school they are regularly paid by the state, and receive their pay in the usual course of the service from the division to which they belong.

The studies of the three years are arranged in accordance with the system that has just been described. Those of the first year are common to the two arms, and correspond, in a general way, with what is taught in the Division Schools or in the highest class of the Cadet House. Those of the second year are devoted to the special arm subjects. In Mathematics, Artillery, and Fortification, the lectures are common to the artillery and engineers; in drawing they are divided.

In the third year a considerable separation takes place. Mathematics are still taught, and there is a special class of the most advanced students in the Differential and Integral Calculus, the Higher Geometry, and in Analytical Mechanics and Hydraulics; this, however, is purposely restricted to about one-third of the class, by raising the requirements, if necessary.

The course is divided in each year into the theoretical and the practical part. The year commences in October with the former, and the studies for the nine months succeeding are for the most part theoretical only. In June the examinations take place. July, August, and a part of September are given up to practical exercises. Something like the last three weeks of September are allowed for a vacation.

The general control of the school is in the hands of the General Inspectors of the two services, the artillery and the engineers. These two are the *Curators* of the school and form the *Curatorium*. They make their reports to the General Inspector of Military Education, of whom mention has already been made. The immediate management is intrusted to a director, who is a field officer of artillery or engineers, of the rank of commandant of a regiment, and he has a captain, appointed by the *Cutatorium* as his assistant.

There is a Board of Studies, of which the Director is chairman, consisting of the Senior Professor of Mathematics, of the Instructors of Artillery and Engineering in the third Cœtus, and of an equal number of officers of the two services named by the Curators.

Four officers, three from the artillery and one from the engineers, acting under the captain, are charged with the care of discipline and order; these are the *Direction* Officers.

There are twelve military and eleven civilian professors and

ers. Among the military professors and teachers may be included any of the direction officers.

The examinations of the first year are conducted by the usual Board, the Supreme Military Examinations Board; but for those of the second and of the third year, there is a separate board, chosen from the two services by the Curators, and otherwise unconnected with the School.

The numbers in the school vary from 216 to 240. In time of peace about five are yearly admitted for each regiment of artillery, and two or three for each division of engineers. The great majority have entered the army from the usual places of civil education, a few from the Prima of the Cadet House, on the same terms as the others, and a small number, who are usually among the best pupils in the school, from the Selecta, who come as officers, and after a short service with the troops, enter the second year's classes, provided there is room, preference being always allowed to the students already belonging to the school, who have succeeded in passing the examination of the first year.

The Artillery and Engineers' School buildings stand in Berlin itself, in the principal street, *Unter den Linden*, No. 74, near the Brandenburg Gate. They bear the following inscription: *Artillerie und Ingenieur Schule. Stiftung Friedrich Wilhelms* III. M.DCCC.XXII.

On the occasion of our visit to the school, we were allowed by the kindness of the authorities to be present at some of the lectures. The students of the second year were attending the course on the History of the Art of War, and the immediate subject was an account of and criticism on the battle of Blenheim. The young men, about forty-five in number, were ranged in desks facing the Professor, but not in the manner of an amphitheater. The lecture was interesting, animated, and generally instructive; it was perfectly professorial in character, and the young men took notes. A class of the students of the first year, thirty-five in number, were engaged in topographical drawing. The artillery division of the third year students were in another room, listening to and busily taking notes upon a lecture (also professorial) on the construction of gun-carriages: the number was about forty-five.

Only the students of the first year are lodged in the building; and owing to the unusually large number lately admitted, an adjoining house has been taken to afford additional room. The accommodation in general is rather limited. Two stories in the upper part of the building are occupied by the somewhat scantily fur-

nished chambers; there appeared in some cases to be two young men in one room, in other cases four, or as many as six or seven to a bedroom and sitting-room. The students who lodge in the building dine together in a mess-room; and there is a billiard-room, with coffee-rooms adjoining it, for the general use, looking out from the ground floor front into the Unter den Linden. There is a library, a small laboratory attached to the lecture-room employed for the subjects of Chemistry and Natural Philosophy, and a small collection of apparatus required for illustration on the latter subject.

On quitting the school, the engineer students, as soon as they obtain their commissions, are employed for three years with a Division of Engineers; then for three years in a fortress to superintend buildings; and then again with a Division of Engineers. They are then eligible to promotion as first-lieutenants.

The artillery students, in like manner, join and serve with their regiments.

Promotion in the artillery is by regiments, in the engineers it is general throughout the whole corps.

We should not omit to call attention to the fact, that the only instance which has come to our knowledge of the promotion of *officers in their own arm of the service*, being made contingent on their passing an examination, is to be found in the Prussian Artillery and Engineers. First-Lieutenants belonging to those corps must pass an examination before they can be promoted to the rank of captain. This regulation does not exist for any other part of the Prussian service, and it is considered a great grievance by the officers of those corps, as it may be exacted at the age of forty, from the most highly educated officers of the Prussian army.

The pay of subaltern of engineers is somewhat higher than that of the artillery, infantry, and cavalry. Above the rank of subaltern, the pay of the artillery, cavalry, and engineers, is on an equality, but superior to that of the infantry. The engineers have, moreover, a prospect of employment of a civil nature when they return from active service; to lucrative positions of this kind they are not unfrequently appointed.

It should be mentioned before quitting the subject, that all the officers of the artillery and engineers are bound, in consideration of three years' maintenance in the school, to serve a period of six years, before they can exercise the usual privilege allowed to Prussian officers of withdrawing from the service.

[*A particular account of the Course of Instruction in this School will be given in a separate article under the title of the Institution.*]

VI. SCHOOL FOR STAFF OFFICERS AT BERLIN.

The War School (*Kriegs-Schule*) in Berlin has undergone many changes since its foundation in the time of Frederick the Great. It is now the Staff School of Prussia, *i. e.*, the only, or almost the only, means of obtaining a staff appointment is by passing through it, and the education given is particularly intended to form staff officers. Its plan and methods of teaching differ, indeed, from the very commencement from the French Staff School, and bear much more resemblance to the senior department at Sandhurst, with the exception that the senior department is not at present a necessary means towards a staff appointment.

Thus the *Kriegs-Schule* does not take young men of twenty-one or twenty-two and educate them (like the French Staff School) for the staff and the staff alone. Its pupils are men of twenty-five or twenty-six, officers of three years' standing, or five years' service since their first entering the army. At this comparatively ripe age they become candidates for entrance to the Staff School, and, if admitted, they spend there three years of laborious study, with no very brilliant prospects to crown it, as only a very small number obtain what may be called the lowest prize, admission to the Topographical Department; and out of these only two or three yearly of the most distinguished pupils gain the Staff. The rest return to their regiments, and are employed as adjutants or as teachers in the Division Schools.

The process of entrance is as follows:—An officer of three years' standing desires to go to the Staff School. Any one may send in his name as a candidate for the entrance examination to the minister of war, having obtained a certificate from his superior officer that he understands his regular duty, has no debts, and is capable, both as regards his abilities and bodily strength, of making a good staff officer. Little difficulty is made about admission to become a candidate, nor is there any regulation to limit the number from any one corps or regiment, so that there may be often found in the Staff School more in proportion from the infantry than the cavalry, and *vice versâ*. Some regiments, we heard, hardly ever send officers to the school. Practically, indeed, the regulation requiring three years of active service bears hard upon the artillery and engineers in comparison with the other services; for, as the officers of these two corps only enter their own school after they have been near a year in the service, and spend three years there, they must have been in the army nearly seven years before they can enter the Staff School.

The candidate for the Staff School is examined in the capital of the province in which his corps is stationed. The examination is early in April, and it is held at the provincial town instead of Berlin, in order to diminish expense. But the questions are sent from the board of examiners in Berlin, and the same are given in the different provincial towns at one and the same time. The examination is much on the same subjects, and requires about the same actual knowledge as that which was passed at least three years before for a lieutenancy, but owing to the difference of age, the questions are put and are expected to be answered in a much more scientific form than on the first occasion. Thus, we were told, such an essay as "Give an account of the wars of Francis I. and Charles V.," would at the *Kriegs-Schule* Examination rather be stated thus: "What was the influence of these wars on the policy and religion of Europe?"

The examination is entirely upon paper; it occupies from ten to twelve days of about five hours daily, the superintending staff officer in the province presiding over it. But his business is limited to reading out the questions sent to him, and taking care that no books are brought in, or any improper means used. The answers to the questions have to go through a double ordeal, the military ones being first examined by some of the staff of the general commanding in the province, and afterwards by the commission of examiners at Berlin. The final decision rests with the chief of the Prussian staff, who recommends the successful officers to the minister of war.

There is an average of sixty or seventy candidates yearly. Only forty of these can be taken. If some additional case seems meritorious, the officer may obtain a promise of appointment, but his entrance is deferred. It is not uncommon to try more than once.

The entrance examination passed, the school opens on the 1st of October, to continue its lectures, with a fortnight's break at Christmas and at Easter, till the first of June. It has its 120 pupils, divided into their three classes, one for each year, working (with only little of practical work) under professors, military for the lectures of a military, and civil for those of a non-military character. No difficulty, we understood, is found here, as we had heard to be the case at St. Cyr, in enforcing the fullest attention to the lectures of the civilian professors; each is respected according to his knowledge of the subject, and it would be thought as absurd for a military professor to undertake a non-professional subject, as *vice versâ*.

The method of working is that so commonly followed in the

Prussian universities of listening to numerous lectures, and taking copious notes upon them. Nearly five hours daily, from eight in the morning till one, are often continuously occupied in this manner; for although only twenty hours of attendance are absolutely exacted weekly (an amount which to our own students would seem more than ample) ten more are said to be necessary to enable an officer to do any justice to the various subjects of which he is expected to show some knowledge at his examinations.

These lectures are usually read aloud; there is no questioning and answering. The student, after five morning hours, must spend at least five or six more in copying them out, or in writing an essay on the subject of some of the lectures. Of these one is given about every three weeks, but only on military subjects. They are carefully corrected and sent back to the student with the notes of his teacher, and their merit influences the final estimate of his whole work.

Besides this daily work, the examinations are at once a stimulus and a means of testing proficiency. These occur every three months, but the yearly ones are the most important. They are entirely upon paper. In the quarterly ones the papers are only given for two hours at a time daily, and take the place of two common lectures; in the other examinations they are daily for four or five hours. They are entirely essays upon the numerous subjects lectured on in the school, History of War, Philosophy, Tactics. &c.

Perhaps there is no better way of giving an idea of the mode of studying than by a statement of some of the subjects of these essays. They have been supplied to us by the kindness of Lieutenant Berger, of the 28th Infantry, from whom we have received much valuable information on the subject.

General Essays.

On Tactics:—1. A Prussian Division, added to which is,—
1 Regiment of Infantry,
1 twelve pounder Battery,
1 Cavalry Regiment,
is in retreat from Goldberg to Jauer (in Silesia.) The enemy is following. A position is to be taken up to stop his advance, whatever his numbers may be.

A map of the position being given:—
(*a.*) Describe the position.
(*b.*) Draw up the troops.
(*c.*) Write an explanatory criticism.
(To be worked at home in two days.)

Three Corps d'Armée march against Berlin from different points. The army in Berlin is ordered to meet them. (To be done in five hours.)

Permanent Fortification. For what purpose are the fortifications in the main ditch intended, and how are they to be constructed? (Five hours.)

Military Geography. The Saxon land between the Elbe and Saale, and its influence upon the operations of war in North and South Germany. (Five hours.)

Criticism on the organization of the French Battalion. (At home in one day.)

Examination Essays, Staff School.—Military History, Tactics and Administration.

1. In what respects did the earlier form of military art, strategetically and tactically, favor defensive wars *generally*, and in particular assist Frederick II. in the Seven Years' War? (Two hours.)
2. The duties of the Staff in time of peace. (Two hours.)
3. Position of Landwehr Officers on and off duty. (Two hours.)
4. What is the value of the Cavalry formation *en échelon*, with particular reference to the Austrian mode? (Two hours.)
5. Is only one sort of Infantry necessary, or is Light Infantry essential? (Two hours.)
6. How may the mobilizing of an Army be best expedited? (Five hours.)
7. Describe the different sorts of fieldworks particularly used in war. (Two hours.)
8. How is the Artillery of a Corps d'Armée to be used in the different emergencies of battle? (Five hours.)

Literary and Scientific.

1. The Geological characteristics of the country between the Carpathian Mountains and the Vistula on one side, and the Valdai Mountains and the Dnieper on the other. (Two hours.)
2. By what political conjunctures was the power and influence of England peculiarly advanced in the 18th century? (Five hours.)
3. On the magnetic effects of the electric stream. (Two hours.)
4. Characteristics of Greek literature, and its chief authors in the time of the Peloponnesian War. (Two hours.)

The knowledge required is seen in the account of the Staff School, (p. 395) and in the list of the Lectures given above. Besides military jects, it includes a very full course of Ancient and Modern History, an addition to the History of War (which last alone occupies seven hours weekly for the last year,) a good deal of Logic and Philosophy of Art and Literature, and of Political Economy. Some of these lectures have probably been introduced from the school, having a double object, that of giving a diplomatic as well as a military education. This was the original idea of Frederick the Great, who, in all his plans of military teaching, laid a great stress on the general literature which he himself valued so highly. This diffusive study is a strong contrast to the principle of "little, but well," and to the constant practical exercises in the laboratories insisted on by the early teachers of the Polytechnic School in France.

The following is the plan of the lectures for the three years. Twenty lectures a week are the minimum:—

Course of First Year.

Obligatory.		For Choice.	
Tactics,	4 hours.	Universal History,	4 hours.
Artillery,	3 "	Universal Geography,	3 "
Field Fortification,	2 "	Physical Geography,	4 "
Military and Political Administration and Economy,	2 "		10 hours.
Mathematics, Pure and Mixed,	6 "		
	17 hours.	Total, 27 hours.	

Course of Second Year

Obligatory.		For Choice.	
Tactics,	4 hours.	Universal History,	4 hours.
Permanent Fortification,	2 "	Mathematics,	6 "
Special Geography and Geology,	4 "	Logic,	4 "
		Physics,	4 "
		Lectures on Horses,	2 "
	10 hours.	Total, 30 hours.	20 hours.

Course of Third Year.

Obligatory.		For Choice	
History of War,	7 hours.	General History of Literature,	4 hours.
Staff Duty,	3 "	Mathematics,	6 "
Art of Sieges,	2 "	Higher Geodesy,	3 "
Military Jurisprudence,	1 "	Chemistry,	4 "
	13 hours.		17 hours.
		Total, 30 hours.*	

It will be seen that the above course is entirely theoretical; no practical work (as in France) relieves the sedentary labor of ten

* Lectures each week in the War School, Prussia.

War School.	First Year.	Second Year.	Third Year.
Mathematics, Pure,	3	3	3
" Mixed,	3	3	3
H. Geodesy,	..	..	3
Physical Geography,	2	..	..
General "	4	..	..
Special "	..	4	..
Universal History,	4	4	..
General History of Literature,	..	..	4
Logic,	..	4	..
Physics,	..	4	..
Chemistry,	..	..	4
Veterinary Art,	..	2	.
Tactics,	4	4	.
Artillery,	3	..	.
Fortification, Field,	2	..	..
" Permanent,	..	2	..
" Sieges,	..	..	2
Military Administration,	2	..	..
History of War,	..	..	7
Staff Duty,	..	..	2
Military Law,	..	..	1
French,	6	6	6
Russian,	4	4	4
Total,	37	40	40

It would be impossible to enter on a detailed criticism either of these lectures or of the essays mentioned in the note above which evidently imply great study. We invite a comparison with the French plan, which we have given elsewhere, but the difference of age must be taken into account. The mathematical course at this school is,—

1st year. Plane and Spherical Trigonometry, Quadratic Equations, involving several unknown quantities, the Binomial Theorem, and the Elements of Analytical and Solid Geometry.

2d year. Analytical Geometry and the Differential and Intregal Calculus.

3d year. Mechanics, Statics, Dynamics, Projectiles, and slight Applications.

Only the first year is obligatory.

hours daily for more than eight months of the year. But as soon as the first year's course is ended, all the officers who are supposed to know drawing before coming to the school, are sent into the country for three weeks to practice military drawing and surveying; and those of the third year go through (also for the same period) a similar course of staff duty. These last are sent under the direction of the officer who is Professor of Staff Duty at the School; each student officer gets his separate orders, and they meet and are told off every morning for their day's work, reconnoitering fortresses, surveying the frontiers between Austria and Prussia, &c., &c. During the remaining three summer months the students are sent in successive classes to those arms of the service which are not their own, and after the usual military exercises are completed they must bring back with them a certificate of proficiency from the commanding officer. This amount of time was spoken of as being too little.

If we are surprised at not finding a greater amount of practical work included amongst the labors of the school, we must remember that it is chiefly postponed to a later period of the officer's career, when the probability of his being required to use it on the staff is greater. This is when he has gained his place in the Topographical Department, and is working there upon trial to test his fitness for the actual staff. He is then employed during winter in working on the Theory of War, and during summer in military surveying and drawing.

Such is the method and extent of the officer's work at the Staff School; a few more words are needed on the character of his examinations, which here as everywhere else must greatly influence the character of the work.

There are no less than nine examinations during the three years, one for every three months, but the final one at the end of each year is the more important, as a sort of summing up of the year's work. In marking for this the merit of the essays done at home is taken into account. The result in each branch of work and on every examination is entered by the several professors in a book kept at the directory, and the pupils have a right to inspect the report of their own work. The net result of his own three years' work is also sent to the officer after leaving the school through the authorities of his regiment. The certificate of this contains the criticism on each branch of his work in detail.

The subjects given for essays will show the nature of the chief examinations (*i. e.* those at the end of each year;) four or five hours

is the time generally allowed to a difficult subject, the examination stretching over a number of days, in proportion to the subjects taken up. The pupil may bring in his notes of lectures, on which extraordinary care is bestowed, and which must contain everything that can be said on the subject. Much value is said to be attached to the rapidity with which an essay is worked, as showing a quality valuable in an officer. There is, as we have observed, no *vivâ voce* of any kind in this School. Some competition exists in the Staff School, (and it is almost the only Prussian school where we find it,) for the knowledge that only eight or ten out of the forty pupils can obtain the Topographical Department, and only two out of these eight or ten, the staff, acts as a competitive stimulus. We must add, however, that although a minute account of the *positive* merits of the pupils is drawn up and sent to them at the end of their career, they have no means of ascertaining their *relative* positions; and this may always leave room for doubt, whether the places in the Typographical Department and on the Staff are strictly given by merit, or whether patronage does not here step in. Another ambiguity may be remarked in the fact that the relative importance of the subjects of study is not known. It may of course be surmised, that a knowledge of the Peloponnesian War is not marked so highly as that of the Seven Years' War; but any indefiniteness as to what is or what is not important, will generally lead to an attempt to know something *of all* the subjects mentioned, and it would undoubtedly be better to affix its definite value to every subject. It would prevent what seem to us valid objections to the present system of the Staff School, the attempt to crowd in too many subjects, instead of mastering thoroughly a few.

The final examination having been completed in June, the student goes through the three weeks of staff duty we have described, and finishes his last three summer months in that branch of the army in which he has not yet served. He then returns to his regiment, where he receives the certificate of his three years' work. But no list is published of the order of merit in which the officers stand. If the certificate is satisfactory, he forwards it to the Chief of the Prussian Staff, with a request to be employed in the Topographical Department of the Staff. If this is granted, he receives an order to join it in about two years, *i. e.* about nine or ten years after first entering the service.

About eight officers are yearly sent to the Topographical Department, and serve there for two or three years, surveying and drawing in summer, working at military science in the winter. The

correction of the Topographical Map of Prussia is in their hands. Finally, two out of these are selected for the Staff; the remainder return to their regiments, to become adjutants or to teach in the Division Schools.

The most immediate advantage of being in the staff corps is promotion to a captaincy at any age, which, considering the extreme slowness of promotion in Prussia, may be termed an early one. This is generally gained within two or three years after joining the corps, *i. e.* at thirty-three or thirty-four. In other corps hardly any one has a chance of becoming captain till after forty.

We may add, that the number of officers in the Topographical Department is about forty, on the staff itself sixty-four. No one belonging to the staff is below the rank of captain, or above that of colonel. Every general of division has one officer of the staff attached to him, and two adjutants, the first nominated by the chief of the staff, the two last by the king, and these two belong rather to the officer than to the general. They are not removable with him. The adjutants are not officers of the staff, though they are often chosen from amongst those who have been at the Staff School. They are nominated by the king upon reports sent into him by the generals of division, and the appointment is not considered a great prize, as it implies neither extra pay, promotion, nor permanency; the adjutants are promoted in the usual course, and then, upon promotion, return to their regiments. The adjutants of battalions and regiments are appointed, like our own, by the officers commanding. The name of aide-de-camp does not exist in the Prussian service, but that of adjutant is used in its place.

VII. ELEMENTARY MILITARY SCHOOLS FOR NON-COMMISSIONED OFFICERS.

1. MILITARY ORPHAN-HOUSES.

There are three Military Orphan-Houses in Prussia for the children of soldiers, two for boys, one at Potsdam, and the other at Annaburg, and one for girls at Pretzch. Although intended for orphans, they receive children whose parents are too poor to provide for them. They receive a good elementary education and are brought up for trades, and can make their selection between a civil and a military career. The English Commissioners report that they found 800 pupils in the Orphan-House at Potsdam, of whom 200 were under the charge of female teachers; 520 were in the senior department, including thirty-six in the music class, who will go into the Regimental Bands, and about twenty who formed a separate military class, who would probably enter the Artillery School.

The School at Annaburg, and the subsidiary Girls' School at Pretzsch, are both Protestant in character; no religious teaching is supplied for Roman Catholics. Roman Catholic boys are all sent to Potsdam, and Roman Catholic girls are provided for in ordinary schools, and in private families, and payment made on their behalf out of the funds of the institution.

Dr. Bache in his "*Report on Education in Europe*," gives the following account of these institutions.

Military Orphan-House at Potsdam.

This institution was founded in 1724, by Frederick William the First of Prussia. The reputation of Franke's Foundations induced this monarch to rival the benevolence of the clergyman, and to establish on a scale proportioned to his greater means, a house for the education of the orphans of his soldiers. While, however, the recipients of Franke's bounty are free to choose their career in after life, and only so far bound to the institution, as a sense of gratitude may prompt, the youth who passes through the Military Orphan-house of Potsdam, must enter the military service for twelve years. Three of these, indeed, are the term of service of every citizen, and I believe the three years in the non-commissioned officers' school are now counted as part of the twelve, and thus the actual number of extra years of service is reduced to six. The institution began with one hundred and seventy-nine children, both girls and boys being received; this arrangement continued until a few years since, when the girls' school was removed from Potsdam, and the establishment at present is for male pupils only. There are between three and four hundred in the elementary or boys' department. In the early history of the orphan-house two attempts are recorded to introduce manual labor, as a profitable speculation; neither of which appears, however, to have succeeded. The first of these, the manufacture of Brabant lace, was introduced in 1743, and after various modifications of the mode of applying the labor of the children, it was finally abandoned in 1795. In 1744, the culture of silk was introduced extensively throughout the kingdom, and especially enjoined at the orphan-houses; but this attempt was not more successful in the end than the other, and the culture is not kept up in this institution.

The present spacious buildings were chiefly constructed under the reign of the founder and of Frederick the Great. Additions have, however, been made from time to time since, and the whole plan is hardly yet completed. The institution may be considered as divided into three departments or schools; an elementary school, (called the Boys' House, *das Knabenhaus,*) a trade school, and a music school. The buildings for the elementary school are erected about a spacious court, which serves as an exercising and play-ground. On the ground floor are the refectory, in which all the youth from the different schools composing the institution, meet three times a day, and the study and play-rooms, lavatory, &c. The study-rooms form a long range, and when the doors of communication are opened, one teacher can superintend the whole of the classes. The school-rooms are on the first and second floors, and are calculated for divisions of forty boys each. There are six dormitories, furnished with wooden or iron bedsteads, the latter having been more recently introduced and found to

answer well. The bedding consists of a straw bed beneath, and a mattress of hair above. Each dormitory is superintended by a teacher, who sleeps at one end of it. There are also dwelling-rooms for the teachers, officers, &c., and in the court a very large wash-house, with a drying-room above it.

The buildings occupied by the trade and music schools are separated by a street from the others, and with the dwellings of the officers, a room for gymnastic exercises, and musical practice, and the workshops, form a second immense series of structures. The infirmary is near to them, and is under a separate direction; subordinate, however, to the general executive body. It is divided into rooms assigned to patients suffering from different complaints. A schoolmaster gives instruction to the convalescent. The arrangements in the dormitories of the trades' school, are similar to those used in the army, and the superintendence and discipline are strictly military.

The part of the building occupied by the music school, contains separate rooms for practicing by individuals, class-rooms, and dormitories. There are rooms in the main pile for the meetings of teachers, for a small library, &c.

The executive board of this school depends partly on the ministry of war, and partly on that of public instruction; the former, however, is the controlling authority. Under this board is the military superintendent, or director, to whom the chaplain, the secretaries, the economist, the military superintendent of the day, the teachers, commandants of companies, the inspectors of the trades' and music school, and other officers, are directly responsible. The clergyman is the superintendent of the elementary school, and has a general charge of all the intellectual and religious instruction.

The orphan children of soldiers are received for maintenance, at any age, by the authorities of the establishment, but if under six years, are boarded with their friends or others until six, and then admitted into the house at Potsdam; they remain there until fourteen or fifteen years of age, and, if of sound constitution, are transferred to the trade, or to the music school, where they remain four years, and whence they pass, if their conduct has been good, to the school for non-commissioned officers. I have never seen a body of young men all so well physically developed as the pupils of the trade school, a result produced by constant attention to their education on this point. Children who are not healthy, or who have failed in the elementary school, are apprenticed at fourteen, and the institution ceases to have the charge of them.

In the *Elementary School*, the usual branches taught in the common schools of Prussia are pursued, including reading, writing, arithmetic, the German language, geography, drawing, religious instruction, and a little natural history. The boys are divided into four classes, according to their proficiency, and all the classes below the first are subdivided into two sections, each being under the charge of a teacher, and having a separate recitation room. These sections contain about forty pupils each. A monitor of order from among the pupils, has charge of a section on entering and leaving the school-room, and render such service as the master requires during the lesson; he is assisted by one of the class in the distribution of the books, slates, and other implements of instruction. The teachers keep each a roll, upon which the character of the recitation and conduct of the pupils is entered, and which is examined weekly by the chaplain, and submitted to the board of teachers at their meetings. No youth, who is below a certain grade upon this roll, is permitted to enter the trades' school. There are about five hours of instruction on four days of the week, and

about twenty-three in the whole week. The holidays are, a week at Easter, four days at Michaelmas, a fortnight in the latter half of July, and from the twenty-third of December, to the second of January. For those who have no friends to go to, the Christmas festivities are kept up in the school, as in the private families of the country.

The board of teachers meet once every fortnight, and the director, or his substitute, or the chaplain, presides. At their meetings, all matters relating to instruction and discipline are discussed.

The form of the discipline of the school is military, but a spirit of mildness tempers it, suiting it to the age of the pupils. The boys, in general, are divided into four companies, each of which has a commandant, (a non-commissioned officer of the highest grade,) who has charge of the instruction in military exercises, and ranks with the teachers of the school. These companies form a battalion, and are drilled without arms, and inspected by the director, or an officer appointed by him. In turn the commandants of companies, acting as officers of the day, have general charge of the military and police duties. Two of the teachers, also, in turn, act as inspectors of the day, and have the general superintendence of the pupils in study and recreation hours, in the duties of personal police, at meals, and in the dormitories, relieving each other at different parts of the day. They are co-ordinate in authority with the officer of the day, and he is expected to relieve and aid them in the maintenance of order. These officers report immediately to the director.

The four companies are subdivided into sections of eleven, over each of which one of the boys is placed, with the title of overseer, or corporal, and he is responsible for the good order of his section, and may be assisted in his duties by one chosen from it. From among these corporals one is selected for the general control and superintendence of the others, and marches the company to the lavatory, to meals, to the dormitory, &c., being responsible for them whenever they are collected as a company. The boys composing a section are placed at meals upon the same side of the table with the corporal who has charge of them. The younger pupils do not join these companies at once, but are kept together in a division which is under female superintendence, has a separate overseer, and is under different regulations as to rising, going to bed, and other particulars of discipline and police from the elder pupils.

All the duties of domestic and personal police, and some of those of domestic economy, are performed by the boys enrolled in the four companies. They clean their own shoes, brush their own clothes, attend to the police of the different parts of the building, serve the meals, and make their beds. That the various duties may be attended to in an orderly way, there are, besides those already spoken of, special overseers appointed among the pupils, who have general charge of them while engaged in certain duties, and of particular localities. Thus there is an overseer of the room where the clothes and shoes are kept, who has charge of the exchange of the Sunday for week day dress, and vice versâ; an overseer of the room where the shoes are brushed and blacked; an overseer of the lavatory; four superintendents of cleanliness, who direct the pupils while washing and combing their hair; one of hair cutting; two of serving the table, who have charge of a detail of thirty pupils, who serve and clear the tables and clean the knives and forks; one, of the manual labor classes; one, of the sick in the hospital; one, of those who are unwell, and must report to the physician; one, of the lights; one, to prevent the passing of bounds; one of

the pupils who sing the liturgy in the church; one to conduct the pupils, whose shoes require repairs, to the shoemaker; besides, those for the classes and the younger boys, already mentioned, and a few others. I make this enumeration in order to show the minuteness of the arrangements for police and discipline, and the extent to which they are conducted by the pupils themselves. The selections for appointments are made by the teachers and officers, and submitted to the chaplain and director for their approbation. A part of the pupils employed as superintendents recieve small pecuniary allowances, and all enjoy many privileges.

Some of the pupils, who are found to have a taste for music, receive special lessons, and are employed, when sufficiently proficient, to give the signals for the different duties of the day. Eight pupils are thus selected to be taught the bugle and fife, and twelve the drum.

In regard to conduct, the pupils are divided into four grades, according to the reports of the teachers and officers, a revision of the classification taking place every quarter, and the director having, in the meantime, the power to displace a pupil in a case of emergency. The first class grade is composed of pupils distinguished for unvarying good conduct, and on holidays its members are allowed to leave the orphan-house alone to make small purchases at discretion, and are neither subject to corporal punishment nor to the stoppage of their meals. The second class is composed also of meritorious pupils, but of a lower grade of conduct than the first; they are permitted to leave the school sometimes, but not so often as the others, and are generally under supervision. From these two grades only, the superintendents or overseers are taken. Pupils of the third grade stand between those who are decidedly good or bad, and are treated accordingly. They are the last who are permitted to pass from the elementary to the trades' school, on completing their course in the former. Those of the fourth, or lowest grade, are kept constantly under supervision, have no allowances, no leaves of absence, are separated, when possible, from the rest of the pupils, and are even punished by an inferior diet.

The health of the pupils is promoted by frequent bodily exercise, and, when the weather permits, in the open air. Thus they have regular gymnastic exercises four times a week, are drilled by companies four times, and by battalion twice a week, take frequent walks, and in summer, bathe every day. The regular manual labor in this department of the school is confined to knitting and tailoring. The gymnastic exercises are conducted by two teachers, each taking charge of one of the companies, of which two attend the lesson at the same time, and assisted by pupils selected from among the most proficient in the exercises. There are two swimming lessons given to each company, in summer, every week. In the ordinary division of the day, in summer, between two and three hours are allowed for manual labor, the same for recreation, two hours for exercise, and nearly eight for sleep.

Their clothing is a neat uniform jacket of blue cloth, of a military fashion, gray or white pantaloons for the winter, and a brown linen jacket and white linen pantaloons for the summer, and their officers are distinguished by badges similar to those worn in service. The diet is generous, and, besides the three meals, bread is served as a luncheon in the morning and afternoon intervals.

An opportunity is given to those who are to pass into the trades' school, to ascertain the trade which they may wish to follow, by a trial during the last year of the elementary course.

The order of the day, with merely slight variations during four days of the week, in summer, is as follows:—The pupils rise at a quarter before five o'clock, and proceed by companies to the lavatory, two companies occupying it at once and alternating, the other two being, meanwhile, engaged in cleaning their shoes. Wash and comb their hair. At half past five the boys detailed to serve the meals proceed to the refectory under their two superintendents. At a quarter before six the bugle sounds, and the companies assemble, by sections, in the court-yard. Morning prayers and breakfast. Those who are slightly sick report to the physician. At a quarter before seven, the boys assemble according to classes, and at seven are marched to the school-rooms. At a quarter before nine a luncheon of bread is served out to them. School closes at eleven, and the pupils are free for three-quarters of an hour. Dinner at about a quarter before twelve. The pupils brush their clothes, and are inspected by the officer of the day. From a quarter past one to half-past two, review the morning lessons in school. From a quarter to three until five, are occupied with manual labor in the work-rooms. Part of the pupils receive instruction in music, and the first and second classes in drawing; a stated number take a swimming lesson; the drummers, fifers, and buglers also have a lesson. A luncheon of bread is distributed. One of the companies is at drill, one at gymnastics, and the other pupils bathing or walking until seven. Evening prayers in the refectory, and supper. Wash, and have recreation until nine, when they retire. The younger pupils retire at half-past eight.

In winter, the different occupations of the day are each one hour later than in summer, until half-past two, when the hour of review of the lessons is omitted, and the exercises, as far as appropriate to the season, follow in the same order as in summer, until half-past five, at which hour the pupils go to the school-room, and remain until a quarter before seven.

On Wednesday and Saturday, an hour is devoted to religious instruction, the other lessons being omitted, except the physical exercises on Wednesday. Stated days and periods of the day are assigned for the exchange of the week-day clothes for those of Sunday, for taking clothes or shoes requiring repairs to the tailor or shoemaker of the establishment, for hair-cutting and combing, for washing the neck and shoulders, the feet, and for other minute matters.

The object of the *Trade School*, is, in part, to economize the funds of the institution, by making within its walls articles of clothing required for the pupils, but more to secure the acquisition, not only of general mechanical dexterity, but of a trade, which may serve to increase their emoluments when they enter the military service. There are, at present, one hundred and four pupils.

In order to pass into the trades' school from the elementary division, the pupil must have reached at least the second class, have been above the fourth grade in conduct, be between fourteen and fifteen years of age, and of a bodily constitution fitting him for the military service. The course lasts three years. The school has a special inspector, or superintendent, who is responsible to the director of the whole institution, or, in fact, to his substitute.

The different trades now taught here are those of blacksmiths, saddlers, tailors, shoemakers, and lithographers. The last named has but seven pupils admissible to its school, and the next to the last forty-four. These numbers depend upon the demand for the occupation subsequent to leaving the establishment, the space required for the operations of the trade, the difficulty of teaching, &c. As each pupil is in general permitted, on advising with the inspector,

to choose his employment, it sometimes happens that boys are sent into the town to learn a trade not taught in the school. Changes of occupation are very rare, but are sometimes permitted. The blacksmiths are principally engaged in the repairs of arms, the saddlers make the caps and accoutrements, &c., used in the house, the tailors all the uniforms, the shoemakers supply not only this orphan-house, but that of the girls with shoes, and the lithographers are occupied in copying forms for the school or war department, manuals, &c. They work about seven hours a day, under a master-workman from the town.

An hour of each day is spent in gymnastic or military exercises in the open air in summer, and in winter in the large room before spoken of. The military exercises, besides the ordinary ones, comprise some which are peculiar to the Prussian service. The usual exercises of gymnastics are introduced, omitting any which seem to have a tendency towards the tricks of the mountebank. For instruction in these exercises, the whole school is divided into two parts, and each again into squads, so that the teacher need have but twelve to fourteen under his charge. Non-commissioned officers are the under teachers, and in turn are superintended by higher teachers, and by an inspector.

There can be no doubt that to these well regulated and perseveringly continued exercises it is, in great part, due that the physical development of these youths is, on the average, so perfect. Judicious recreation, a proper diet and clothing, great cleanliness, a proper number of hours of work, of instruction and sleep, no doubt, are necessary, each and all in their degree, but great influence must be besides allowed to the gymnastic exercises.

The pupils have two hours of instruction during the day, intended to keep up their knowledge of the branches taught in the elementary school, rather than to teach new ones. Military drawing is, however, added.

When not in the shops, nor in school, nor at exercise, they are superintended by non-commissioned officers. The discipline in this school is military in spirit, as well as in details.

Those pupils who have manifested a decided musical talent in the lower school, are here instructed thoroughly in the theory and practice of music. The object is to supply musicians to the regimental bands. These pupils have a separate superintendence from those of the other schools, and different hours of exercise and duty. They keep up the knowledge acquired in the elementary school, as is done in the trades' school.

Military Orphan-House at Annaburg.

The following plan of instruction was prepared by Dr Harnisch, one of the most distinguished teachers of Prussia, formerly Principal of the Teachers Seminary at Weissenfels.

In order to rise to the place of a non-commissioned officer, the pupil must have gone through the lowest classes of the Upper School, where there are the following studies:—

Religious instruction, arithmetic, singing, the German language, calligraphy, geography and history, algebra, geometry, trigonometry, and drawing.

The courses in the different branches are arranged as follows:—

FIRST. *Religious Instruction.*

LOWER SCHOOL.

Class VII Bible stories, psalms and hymns, appropriate to the season. Four hours per week.
Class VI. Histories from the Old and New Testament, portions of the history of the Christian church, catechism. Four hours per week.
Class V. Reading and explanation of the Bible, and of its arrangement. The gospel and

historical works are selected, and the history is connected with the geography of the Holy Land. Catechism. Five hours.
Class IV. Doctrines of the Lutheran church, taught by Luther's catechism. Five hours.

UPPER SCHOOL.

Class III. Moral instruction, duties to God and man. Three hours.
Class II. Reading the Bible with comments, the pupils making abstracts. Three hours.
Class I. (Two years.) The first year a repetition of Luther's catechism. The second, a history of the Christian dispensation. Three hours.
Every class commits verses from the Bible to memory.

SECOND. *Arithmetic.* Mental and written arithmetic are taught together, that the readiness afforded by the one, and the accuracy of the other, may both be cultivated.

LOWER SCHOOL.

Class VII. The four ground rules, with three places of figures mentally. Application to questions in weights and measures. Three hours.
Class VI. The same rules extended. Three hours.
Class V. Fractions, with applications to weights and measures. Three hours.
Class IV. Proportions. Three hours.

UPPER SCHOOL.

Class III. The applications of proportions to questions of weight, strength, value, time, and general quantity. Two hours.
Class II. Exercises in practical algebra. Two hours.
Class I. Review of the course. First year, practical operations. Second, theory of arithmetrical processes. Two hours.

THIRD. *Vocal Music.*

LOWER SCHOOL.

Classes VII & VI. Practice of songs, adapted to youth of a cheerful, serious, military, or religious cast, with one part. Two hours.
Classes V & IV. Choral and other songs, with the different parts. Elements of music. Two hours.

UPPER SCHOOL.

Classes III, II, & I. More difficult choral pieces. Theoretical instruction continued. One hour. There is, besides, instruction given to a select choir, intended to conduct the vocal exercises of the church.

FOURTH. *Reading* In the lower classes, a readiness in reading, and in the higher, the style of reading, is attended to especially. Pieces learned previously, by heart, are recited.

LOWER SCHOOL.

Class VII. A good pronunciation, and some facility in reading. Six hours.
Class VI. Readiness in reading, and repeating the substance of what has been read. Familiar illustrations. Five hours.
Class V. Reading some work in reference to knowledge useful in common life. Four hours.
Class IV. Reading, with attention to emphasis. Four hours.

UPPER SCHOOL.

Class III. Reading the Bible and sacred melodies, with the view to correct reading in this kind of composition. Two hours.
Class II. Reading various selected works, in and out of the class.
Class I. Reading continued, and recitations from works previously read.

FIFTH. *Orthography and Writing.* These may be taught together in the same way as mental and written arithmetic; the teacher is, however, at liberty to follow his own method.

LOWER SCHOOL.

Class VII. Copying on slates from the blackboard. Four hours.
Class VI. Copying on paper, from the board, and from books. Four hours.
Class V. Writing from copy-slips, from books, or from dictation. (Practice in spelling and writing.) Four hours.
Class IV. Similar exercises continued. Four hours.

UPPER SCHOOL.

Class III. Copying useful papers, such as registers, accounts, contracts, &c. Two hours.
Class II. Calligraphy, with Roman as well as German letters; practice in orthography; reading of letters and documents in various handwritings. Two hours.
Class I. Copying papers relating to the management of the institution, as a practical introduction to business. One hour.

SIXTH. *Useful knowledge taught by induction*

LOWER SCHOOL.

Class VII. The pupils give their ideas, verbally, of surrounding objects of the most simple kind, of the commonest productions of nature and art. Conversations relating to them. Drawing the most simple mathematical figures on the slate. Three hours.
Class VI. Descriptions of animals and plants, the former in the winter, the latter in the summer term. Written remarks on these, serving to afford exercise in the formation of phrases and in orthography. Four hours.

Class V. The most essential parts of physics and natural history, the pupils taking notes of the lessons. Four hours.
Class IV. Compositions on various subjects. Letters relating to civil and military affairs. Four hours.

UPPER SCHOOL.

Class III. History of Prussia, and drawing of maps. Four hours.
Class II. General geography, particularly that of Europe. Passing from physical to political geography. Civil geography in connection with the former. Five hours.
Class I. Universal history. One year is devoted to ancient and one to modern history. Selections are made of the more important parts of history. Five hours.
The remaining studies only belong to the higher school.

SEVENTH. *German grammar and style.*

UPPER SCHOOL.

Class III. Logical and grammatical instruction of the German language taught.
Class II. Idiom of the language. Compositions on military subjects, with especial reference to correctness of grammar.
Class I. Acquaintance with the best writers. Exercises of composition on subjects taken from history.

EIGHTH. *Geometry.*

UPPER SCHOOL.

Class III. Teaching the names and properties of mathematical figures by induction, in connection with drawing.
Class II. Equations, with application to problems of common life.
Class I. Elements of trigonometry.

NINTH. *Drawing.*

UPPER SCHOOL.

Class III. Drawings from common objects, varying the positions, &c.
Class II. Copying flowers, or drawings of implements.
Class I. Architectural drawing with instruments, drawings of furniture, &c.

Dr. Bache makes the following remarks on the above plan:

I have allowed myself to present this extended programme, because it conveys, in as brief a compass as possible, excellent ideas of the succession of courses in an elementary school, and in a technical or trade school, for such the higher school must be considered. It should be remembered that the main purpose is the preparation of youth for the military service, and hence that the wants of the service are especially consulted. Another fact must be remembered, namely, that this is a Lutheran school, and therefore the religious instruction is adapted to the particular views of that church. The course of morals of the third class, I must say, however, seems to me out of its place, for although our duties to God and our neighbor are of course best learned from his Word, yet their inculcation by precept and example can not commence too early.

In the arithmetical course, the union of mental and written arithmetic is absolutely essential. The gradation appears to me good, and the application to questions of common life gives a zest to such studies, attainable in no other way. The theory of arithmetical processes, however, should accompany or follow more nearly their practical acquisition. Indeed, if they are taught as they ought to be, by induction, the theory goes with the practice.

If the youth at Annaburg take the same pleasure in the exercises of song, from the elements to the completion of the musical course, as those of the school* actually superintended by the author of this project, the success will be complete.

The connection of orthography and writing, especially if combined with early reading, is natural.

The exercises of induction, which in the lower classes are well drawn out, deviate from the appropriate track in the fourth class, and in the geographical and historical courses do not return to it. The system in both these branches is rather synthetical than inductive. There is a great temptation to break away from this method, into that of giving positive instruction, from the apparently greater rapidity of progress of the pupil; some teachers have abandoned it altogether, as too slow, though ultimately to their cost, as appeared to me in cases where I had an opportunity of comparing the results.

The writing is preceded by an introductory course of drawing, which might

* Seminary for Teachers at Weissenfels.

with excellent effect be so extended as to branch out into complete courses of drawing and writing.

As this plan results from an extended experience, the number of hours of instruction, per week, necessary to secure the results, is an important datum, and as such I have retained it, whenever it was inserted in the original programme.

II. THE SCHOOL DIVISION OR NON-COMMISSIONED OFFICERS' SCHOOL.

A military school of a somewhat peculiar character for training up young men for the duties of non-commissioned or *under* officers exist at Potsdam, and is known as the School Division.

The rules of the Prussian Military system, which require only three years absolute service in the standing army in time of peace, evidently entail a great practical difficulty in this respect. The soldiers, as a rule, prefer to quit the service at the end of their three years' time, and require great inducements to persuade them to remain. As one inducement, the state has declared that twelve years' service gives a non-commissioned officer a formal claim to civil employment; as, for example, on the railways or in the custom-houses. Their pay also as non-commissioned officers goes on increasing according to the length of their service; and it was stated to be the usual practice not to advance soldiers to be non-commissioned officers until they had signed an undertaking to serve for a longer period than could be exacted of them otherwise.

A further means of supplying the want has been sought, and appears to have been found in the School Division. The circumstances of its origin have placed this establishment in immediate connection with the Corps of Guards, to which, in a military sense, they belong, at whose head-quarters, the town of Potsdam, their buildings are situated, and whose garrison duty in the town they occasionally undertake.

At its first commencement the pupils chiefly came in drafts from the Military Orphan-Houses. But the applications from the country in general have been so numerous that this practice has been, it is said, abandoned, and a higher class of admissions has been attempted. The Commander of the Battalion of *Landwehr* for the Circle (*Kreis*) receives all applications in that Circle; he sees that the candidate is examined on the spot, in reading, writing, and cyphering; and forwards the name, height, age, and other particulars (the *Nationale*) to the authorities. The decision is said to be mostly made by the candidate's height, and his medical certificate, and to be rather a difficult matter. Only one-third of the applications are successful. A new boy had just presented himself with

his father at the time of our visit; both son and father were well dressed, and apparently belonged to the middle rather than the lower classes. There seems every reason to be satisfied with the amount of acceptance with the country which the school had begun to receive.

The age of admission is from seventeen to twenty, and the youth on entering the school takes a military engagement to give two years of service in the standing army for each year of his maintenance at the school, in addition of course to those three years of military service to which every Prussian is bound, but with the privilege of counting as military service the period spent at the school.

The usual school course is one of three years, and his engagement is thus for a term of nine years; that is, deducting three spent at the school, six years' time with the troops.

The School Division is 496 strong; there are four companies of 124 men. The whole body is commanded by a captain, or major, who has an adjutant. To each company are attached four officers and fourteen non-commissioned officers; the latter teach in the two first years, the former in the third. The school course begins on the 1st of October; the afternoons of three days in each week are employed in ordinary school instruction, but the remainder of their time in winter and their whole time in summer is devoted to military training. The school instruction is not carried beyond reading, writing, and arithmetic up to the rule of three; geography, drawing skeleton maps, and copying, and learning the significance of military representations of ground. Some very respectable specimens of their skill in copying maps were produced; it appeared to be a favorite exercise.

About 150 are admitted yearly, an extra number being taken to supply possible vacancies; about 130 yearly are drafted into the army, six usually as *under* officers at once, forty at least with certificates of being qualified to receive the grade in a short time; and the whole number who go out have generally obtained their appointment before twelve months are completed. The highest number that may go out at once as under (or non-commissioned) officers is twelve; three for each company. Many, however, have latterly, it is said, become so within six weeks after their leaving.

Where the young men are strong and full-grown, they are allowed to join the army at the end of two years; their whole service (two years for each at the school) being therefore reduced to six years.

Young men, on the other hand, who show no disposition or like-

lihood to turn out good *under* officers, are sent off to complete the usual time as privates.

The proportion of non-commissioned officers in the standing army who are taken from the School Division was not easy to ascertain. It differs extremely in different regiments. In one, it was stated that out of the ordinary complement of 180, fifty came from hence. On the other hand, it was asserted that the general proportion was not more than one in forty. A certain number have obtained commissions; but no prospect of such promotion appears to be held out, and any tendency to carry forward the studies with a view to it is discouraged and checked.

The buildings, in the outskirts of Potsdam, are large, new, and handsome, forming three sides of a spacious court or imperfect quadrangle. The dining-rooms are used also as exercise-rooms, and it was made a point to let us see a portion of the pupils go through their gymnastics and exercises; and more particularly their sword and bayonet exercise. Twenty or thirty young men, very healthy and strong-looking, went through the latter exercise in two lines; after which came a single combat with the bayonet, all under the direction of an officer.

The sleeping-rooms are fairly large, and well ventilated, on the same floor. Twelve slept in each. During the day the wooden bedsteads are placed one above another. It was said that iron bedsteads are being generally introduced. Each young soldier is provided with a small cupboard above his bed. The non-commissioned officers had horsehair, the young men themselves straw paillasses. There was a stove in the room, but it was said not to be used.

The school-rooms are on the upper floor. The skeleton maps already referred to were here produced; one, of the two hemispheres, others illustrating Prussian history, showing the original size of the Prussian territory, its extent and condition under Frederick the Great, the whole course of its gradual extention, &c., very fairly drawn, and creditable to the young men.

The time devoted to the training which is given in the School Division appears long. What is now done in three years might as well be done in half that time. The object, however, is secured of retaining the service of the men during a lengthened period in the standing army.

III. REGIMENTAL SCHOOLS.

The Regimental Schools are chiefly intended to train up non-commissioned officers. This is more particularly the case in the artil-

lery, which does not obtain its *under* officers from the School Division at Potsdam.

IV. THE NOBLE-SCHOOL AT LIEGNITZ.

The Noble-School at Liegnitz is merely an endowed school, founded by the Emperor Joseph I. while Silesia was yet an Austrian dependency, and specially intended for young men of good birth in that country. There are some military foundations in the school for the sons of officers of good birth; and the two military men who take part in the instruction are paid by the state, on the same footing as officers employed in the State Military Schools.

[Of one of the Institutions above described (The Artillery and Engineers' School at Berlin) we shall give a fuller account, and in the meantime we close this comprehensive survey of military instruction in Prussia with the following reflections of the English Commissioners.]

VIII. GENERAL REMARKS ON THE SYSTEM OF MILITARY EDUCATION IN PRUSSIA.

1. Attention has often been drawn to the peculiar feature of Prussian Military Education, the double examination for the rank of officer. The principle adopted seems to be the exaction of a proof from *all* officers that they have received a good, general, and professional education, rather than the selection of a smaller number for higher training in a military school. The decree of 1808 first laid down the rule for the whole army, "that the only title to an officer's commission shall be, in a time of peace, education and professional knowledge,—in time of war, distinguished valor and ability."

2. The spirit of emulation is not so much called out in Prussia as it is in France. Early distinctions are acknowledged and appealed to, but somewhat sparingly. The following words express the view taken on this point:—

"A testimonial of fitness for the University," says Colonel von Holleben, (*i. e.*, to have passed the Abiturient examination) "dispenses with the examination for the ensigncy. In consequence of this rule fifty *Abiturients* on an average annually enter the army. These, as well as the *Selectaner* of the Cadet Corps, must be considered in point of scientific education, an excellent supply of officers."

3. It will be seen that in the above words there is no reference to those rewards and advantages which are the stimulus of competi-

tion. There appears some want in this respect both in the earlier and later training of officers. Thus, in the instance of the Cadet House, there are numerous *free places*, but these are assigned to young men, not from any proof of merit or exertion, but entirely because they are the sons of officers or state servants. The most distinguished pupils, the *Selectaner* gain nothing more than to be permitted to pass these two examinations before, instead of after, entering the army. Honorable mention, is, however, made of the candidates for commission who distinguish themselves in the Division Schools. But in the Staff School—the natural resource of energetic young officers—the competition (which the school asserts as its principle by its entrance examination) loses some of its force, by the order of the pupils on leaving the school not being distinctly marked. It should be mentioned as an explanation of these facts, that in the general civil education of Prussia, competition is little encouraged, less than in our own, and far less than in the French, or even in the Austrian education.

4. The military system of Prussia, and in some degree its military education also, appear to have various objects in view. Thus the Cadet Houses, where the free places are chiefly given to the sons of military men, seem intended to keep up a military *esprit de corps*, and it is impossible not to be struck by the strong class spirit prevailing in the Prussian army. At the same time means are taken, as above stated, to obtain a good supply of highly educated officers.

5. Prussian military education seems to have been constantly correcting and extending itself. Of this the Division Schools are a striking example; and they deserve attention, both because their plan is peculiar to Prussia, and for the improvements they have received. The Prussians at first established numerous Division Schools, but they afterwards greatly diminished their number; and the general inspector of military education now contemplates, both for the sake of the instructors and their pupils, a further reduction to three or four. A large military school in three or four towns in Prussia, intended to teach professional knowledge to young officers after some short practical experience in the army, is thought a better mode of giving such knowledge than to place isolated, or few teachers, in regiments or army divisions.

6. One chief means of improvement has been the bringing the whole education under a single head. At first there were distinct boards for the examinations in Prussia, and for the schools, with a view to maintain the independence of each. It was found, however,

that this led to a want of harmony between the schools and the examinations; and accordingly, whilst the board of examiners and the school professors are kept perfectly distinct, they are both subjected to the general inspector, who controls all the departments of military education. The effect of this has been to give more unity to all the teaching; an essential point where that teaching is entirely on the same subjects. By constant inspection of the schools, and the receipt of periodical reports from them, the general inspector of military education is able to compare the results of each, and to keep the whole system going at an even rate of progress.

7. Attention should be drawn to the somewhat complicated system for working the Military Schools in Prussia. There are two distinct boards, as we have noticed above, the supreme board of studies and the examinations board, one of which reports to the inspector-general on all examinations, whilst the other acts as his assessors and advisers with regard to the schools and on all other subjects of military education. Besides these bodies, each school has its own board of studies, which is generally formed by some one person belonging to the school, combined with distinguished officers or professors. Suggestions with regard to each school appear to originate chiefly from these latter bodies.

8. The department of military examinations and education is under the control of the general inspector, who "lays his proposals on matters of administration before the minister of war, but reports directly to the king in all matters relating to instruction and examinations."

THE ARTILLERY AND ENGINEERS' SCHOOL

AT BERLIN.*

OBJECT AND COURSE OF STUDY.

The object of the Artillery and Engineer School is to give to such young men of the Artillery and Engineers as have been found fitted for promotion, the education necessary for the proper performance of the duties of a Subaltern Officer, and to enable them to draw profit afterwards from their private studies and the practice of the service.

The complete course of study lasts two years and three quarters. The instruction is divided into three courses, bearing the name of *cœtus;* on joining the institution, the young men enter the first cœtus. Before the commencement of the studies, that is, about the 1st of October, the General Inspectors of the two corps direct the young men who are to enter the school to come up from their regiments and divisions. They receive their pay and clothing from their regiments until they are promoted to the rank of Officer.

The first nine months of each year of study are principally devoted to theoretical instruction, the three last exclusively to practice. In the third cœtus, the course finishes with the theoretical instruction on the 1st of July.

The instruction of the first cœtus is directed to prepare the students for the ordinary Officers' Examination, and at the same time to enable them to follow with advantage the further studies of the school. The instruction, during the first year, is common to all the students. Those who pass the Officers' Examination enter at the commencement of the second year into the second cœtus.

In the second cœtus the greater portion of the instruction, but not the whole, is common to the two arms. In the third cœtus an almost entire separation of studies takes place.

In all the studies which are common to the two arms, if the number of students is too great for a single class, parallel classes are established.

* Translated from Helldorf's "*Dienst-Vorschriften der Königlich-Preussischen Armée.*"

THE STAFF AND AUTHORITIES.

A.—The Superior Authorities.

The *Curatorium* of the School is composed of the General Inspectors of the two corps. To it belongs the authority of issuing orders and regulations; no important change in these can be made without its sanction.

The General Inspector of Military Instruction receives yearly at fixed periods, reports upon the state and progress of the school.

The accounts are under the control of the War Department, with which the Director of the School is in immediate communication. Questions of principle and unforeseen cases of importance are decided by the *Curatorium*.

The Inspector of the School, who is an Engineer Officer when the Director is an Artillery Officer, and *vice versâ*, has the immediate oversight of it. It is his duty to see that the orders and regulations are strictly followed.

B.—The Executive Authorities.

The Director is appointed by the King. He is a Field Officer of either Artillery or Engineers, and has the rank of Commandant of a regiment. He has as assistant, a Captain appointed by the *Curatorium*. The Director is immediately responsible for the discipline and the finance of the establishment, and conducts its ordinary details, assisted by the Captain. He is also President of the Board of Studies; as such he exercises a general control over the instruction, and regulates the ordinary examinations.

Under the Director and the Board of Studies are four officers, three taken from the Artillery and one from the Engineers. They have the immediate charge of the students, and are themselves under the direct orders of the Captain.

The duties of Paymaster, Librarian, &c., are divided among them. They must also give at least two hours of instruction weekly to the pupils.

The Board of Studies consists of the Director of the Institution as President, and usually of the Senior Master of Mathematics, and the Instructors of Artillery and Engineering in the third cœtus. In equal numbers are likewise added Superior Officers of the Artillery and Engineers appointed by the *Curatorium*. The duty of the Board is to control the whole of the instruction, and to give an opinion when required, upon the performance and capacities of the teachers and students.

C.—The Teachers.

The teachers are to be selected as much as possible from among the Officers of Artillery and Engineers. Where this can not be effected, civilians of proved ability and experience are to be appointed.

The number of teachers is to be arranged with reference to the amount and extent of the studies, in such a manner that in the event of illness among them, no interruption in the instruction may arise. In addition to the teachers, there is a certain number of assistant-teachers, partly civilians, partly taken from among the fire-workers of the Artillery. The latter are employed under the Librarian, and in the practical instruction; they may also, in case of necessity, assist as clerks.

THE STUDENTS.

The maximum number of students who enter each year is 80; 60 from the Artillery, and 20 from the Engineers. In addition, a few young men may be received from the smaller German States. In the event of the number from one corps being short, an increased number may be admitted from the other.

The number in the second cœtus is variable. It consists, first, of the students previously in the first cœtus who have passed the Officers' Examination; and, secondly, of such young officers as are appointed to the Institution by the General Inspectors.

The students of the first cœtus lodge, as far as room will admit, in the school buildings; the remainder, as well as the ensigns of the second cœtus, not yet promoted to officers, are quartered in a neighboring building. At least two of the direction officers lodge in the school buildings; a third lodges in the other.

The Director may grant permission to a student, as a matter of favor, to lodge with his parents.

The students quartered in the school and the neighboring building dine together in the mess-room of the school.

The officers (students) of the second and third cœtus live in lodgings in the town, and mess where they choose.

ENTRY INTO THE SCHOOL, AND PASSAGE THROUGH IT.

The entry into the first cœtus of the institution is conditional on the applicant having passed, in the manner officially prescribed, the examination for ensign. The necessary certificates are forwarded to the Director of the School.

The instruction in the first cœtus embraces in general the subjects

required for the ordinary Officers' Examination, that is to say, the elements of Military Science, so far as every Subaltern Officer is obliged to know them. To this is to be added instruction in mathematics, in French, and in free sketching.

At the commencement of the instruction the teachers inspect the whole of the Ensign-Examination papers of the newly-arrived students, which are laid before them by the Director, in order the better to judge of their acquirements. During the first quarter they take pains to ascertain the ability as well as the amount of acquirements of each student, so as to be able to give a confident opinion upon him at the end of the quarter.

After the close of the first quarter a conference of the teachers, under the presidence of the Director, takes place, to form a report upon the students, and to furnish data for recommendations to the rank of ensign of such students as have given satisfaction by their conduct and progress. The students about whom the teachers have not yet been able to speak confidently, who, in certain studies, as in mathematics and the special branches of their arm, are behindhand, as well as those whose conduct has not been without blame, are proposed to the higher authorities for permission to continue to remain at the school. On the other hand, the Board of Studies proposes for dismissal from the institution, students whose conduct has been unsatisfactory, and principally who give too little hope of a favorable career. The Board is to express an opinion whether any prospect may be held out of a future recall to the institution, according as its unfavorable report has been founded on the want of ability or on the want of industry of the student.

The students favorably reported on are immediately, by the General Inspectors, appointed ensigns, subject to vacancies. The *Curatorium* decides regarding the further stay at the institution, or the dismissal of the others.

After the end of the second quarter, those pupils who can not yet be recommended for promotion to ensign are only in special cases allowed to remain till the end of the theoretical instruction of this year; if they can not then be recommended, they are sent back to their regiments.

Fourteen days before the close of the theoretical instruction for the year, that is to say, about the middle of June, the teachers give an opinion regarding each student of the first cœtus, as to whether or not they consider him capable of undergoing the Officers' Examination, and to pass into the second cœtus. These reports, joined to that of the Director, as regards the conduct of the students,

enable the Board of Studies to propose to the higher authorities either that permission may be granted to undergo the Officers' Examination, (and, if successful, to enter the second cœtus,) or that the student be sent back to his corps. Students who have been refused permission on grounds not altogether unpardonable, from presenting themselves for the Officers' Examination, or who in the course of instruction have been sent for any reason to their corps, with the prospect of being afterwards called back to the school, may, on the proposition of the Board of Studies, through the *Curatorium*, be granted a second and final entrance into the first cœtus.

The *Curatorium* decides in every case whether a student who has not qualified himself for entry into the second cœtus, may return to the first cœtus after having left the institution, or in case he shall have in the meantime passed the Officers' Examination, whether he may, as an exceptional case, enter the second cœtus. In a case of the latter kind, the applicant can not present himself for the Officers' Examination without having previously passed a preliminary examination at the school, to do which, the permission of the General Inspector of his corps is necessary.

The theoretical course closes at the end of June. During the month of July the students of the first cœtus are employed in surveying operations. It is during this month that the examination for the rank of officer before the General Examining Board takes place. The students who pass this examination enter afterwards into the second cœtus; those who fail are, at the expiration of the practical course of their year, sent back to their corps.

The students who pass the Officers' Examination, and are found qualified to enter the second cœtus, are then proposed for election to the officers of their corps. If the decision be favorable, their names are submitted by the General Inspectors to the King, to be appointed, on vacancies occurring, to the rank of Supernumerary (*Ausseretatsmässigen*) Second Lieutenant.

To assist the Officers of the Corps in making their election, an extract of the reports above alluded to is sent to them, so far as it concerns the students who have successfully passed their Officers' Examination.

It is an indispensable condition for entering the second cœtus, that, if a student of the first cœtus, he should have passed the Officers' Examination, or if he should now enter the school for the first time, that he should have the rank of Officer. The sum of acquirements necessary for the Officers' Examination forms the basis of the

instruction given in the second cœtus. In it the instruction ceases to be entirely common to the two arms.

At the end of the theoretical course of the second cœtus, a report of progress and conduct is drawn up, as in the first cœtus, by the Board of Studies, on the data furnished by the teachers as regards the studies, and by the Director as concerns the conduct of the students. In forwarding this report to the *Curatorium*, it is stated for each student whether or not he is considered qualified to pass the *former part* of the Special Corps Examination. Those who are unfavorably spoken of in this respect return to their corps, if there are no mitigating circumstances which permit a further stay in the second cœtus, following the decision of the *Curatorium*. They may either endeavor to obtain a transfer into another branch of the army, or by study and good conduct prepare themselves for admission into the third cœtus at a future period. But in this case they must not only be recommended by their corps, but they must also pass the *former part* of the Special Corps Examination.

The students recommended to present themselves for the *former part* of the Special Corps Examination undergo it before a Board appointed by the chiefs of the two corps in the beginning of July. It extends over the subjects of professional science which have been taught in the second cœtus. A particular regulation defines the mode of this examination, which is entirely written; it decides whether the student shall enter or not into the third cœtus.

The successful students pass, by direction of the *Curatorium*, into the third cœtus, while the unsuccessful ones, as well as those who have been reported unfit to undergo the examination, return to their corps. By good conduct and study they may obtain permission to come up again at the next examination for the *former part* of the Special Examination. Their definite return to the school depends upon their passing this examination, and upon the express order of the *Curatorium*.

The instruction in the third cœtus is chiefly directed to supply the special scientific knowledge required by each of the two arms. The students of the two corps, therefore, receive separate instruction. A further object of the instruction is to enable the students to make use of the knowledge which they have acquired, on which account instruction and practical application go hand in hand. Practice and theory go thus together in this the highest portion of the instruction, so that they both terminate at the same time, namely, at the end of the month of June.

Previous to leaving the School, the *latter part* of the Special Corps Examination is undergone before the same Board as for the *former part*. This examination tests their qualifications in their special arm, and proves their fitness for Artillery or Engineer Officers. The results of this part of the examination and of the former part of it passed at the close of the second cœtus, are combined by the Board, and forwarded to the *Curatorium*. Along with these reports is submitted a proposition for those who have passed the examinations to be admitted into their corps. In the preparation of patents (for commissions) they are antedated to the time of passing the Officers' Examinations, proper regard being had to the results of the Special Corps Examination for arranging the officers among each other.

Any officer who does not pass the Special Corps Examination, remains with the pay of an infantry officer in his corps until he either enters into another arm, or having obtained permission to re-enter the third cœtus, he qualifies himself for the final examination. A successful passing of the Special Corps Examination at this second trial can give, under the most favorable circumstances, no higher seniority than that of immediately after the officers who have passed their examination the previous year.

A.—*The Instruction in General.*

The general instruction may be divided into—

1. The theoretical part, designed with the view to the practical professional requirements of the students, and their further self-improvement.

The instruction ranges over—

(*a.*) Artillery.
(*b.*) Military Engineering.
(*c.*) Hydraulic Construction.
(*d.*) Elements of Tactics.
(*e.*) History of the Art of War.
(*f.*) Mathematics.
(*g.*) Theory of Surveying.
(*h.*) Physics.
(*i.*) Chemistry.
(*k.*) French Language.
(*l.*) Rules and Regulations of the Service.
(*m.*) The Horse.
(*n.*) Plan Drawing.
(*o.*) Free Sketching.
(*p.*) Descriptive Geometry.
(*q.*) Artillery Drawing.
(*r.*) Artillery Constructions Drawing.
(*s.*) Fortification Drawing.
(*t.*) Architectural Drawing.

2. The practical part of the instruction, designed by a series of practical exercises to exhibit the application of the theory taught, and to extend the knowledge previously acquired.

The practical part includes—

(*a.*) Visits to the Military Establishments and Institutions in Berlin and Spandau, examination of the objects, collections, models, &c., which they contain.
(*b.*) Chemical manipulation.
(*c.*) Examination of raw materials, of cannon, limbers, and ammunition wagons, of shot and shells, and of small-arms.
(*d.*) Management of machines.
(*e.*) Practical exemplification of the rules for placing guns with reference to the ground, and to tactical considerations.
(*f.*) Marking out and tracing batteries and field-works.
(*g.*) Drawings from Artillery objects, and from buildings, &c.
(*h.*) Being present at the practical operations of the Engineer Division of the Guards.
(*i.*) Solution of problems in the attack and defense of fortresses.
(*k.*) Practice in elementary tactics.
(*l.*) Practical surveying.
(*m.*) Artillery practice.

3. A course of Military and Gymnastic Exercises, requisite to prepare Officers for active military service.

They are divided into—

(*a.*) Exercises on foot.
(*b.*) Exercises with the different kinds of guns in position.
(*c.*) Fencing and gymnastics.

B.—*Instruction in Detail.—The Theoretical Part.*

The theoretical studies commence each year on the 1st of October, and end on the 30th of June. They may be reckoned, after deducting the vacation and holidays, to include a period of thirty-five weeks.

As a general rule, the studies take place only in the forenoon, namely, during the five hours between eight and one o'clock. Occasionally only are there hours of study for a small part of the students in the afternoon. A portion of the afternoons, during the theoretical course, are employed for drills and practice, but in no case more than twice a week, in order that the students may have the necessary time for recreation. The students are required (those who are officers excepted) to remain in their quarters in the evening, to prepare the work which has been allotted to them by the teachers.

The parallel classes of each cœtus, with the exception of the drawing classes, are, as a general rule, to be under the same teacher.

The theoretical instruction is distributed as follows:

AMOUNT OF STUDIES, WEEKLY.

Nature of Study.	1st Cœtus. Artillery and Engineers.	2d Cœtus.		3d Cœtus.	
		Artillery.	Engineers.	Artillery.	Engineers.
Artillery,	4	3		8	0
Military Engineering,	4	3		0	10
Hydraulic Construction,	0	0	0	0	2
Elements of Tactics,	4	0	0	0	0
History of the Art of War,	0	3		0	0
Mathematics,	6	6		In two divisions. 4	
Theory of Surveying,	2	0	0	0	0
Physics,	0	4		0	0
Chemistry, Lectures,	0	0	0	4	
Chemistry, Manipulations,	0	0	0	4	
French Language,	2	2		2	
Rules and Regulations of the Service,	2	0	0	0	0
The Horse,	0	0	0	2	0
Plan Drawing,	4	2	4	2	3
Free Sketching,	2	0	2	0	0
Descriptive Geometry,	0	1		0	0
Artillery Drawing,	0	2	0	3	0
Artillery Construction Drawing,	0	2	0	2	0
Fortification Drawing,	0	4		0	4
Architectural Drawing,	0	0	2	0	3
	30	32	34	31	36

REMARKS.

In the first cœtus.—All the instruction in this class is common to the two arms, and is equally divided among the six forenoons of the week.

In the first and second cœtus.—With reference to the mathematical instruction, it is particularly ordained, that each of the two mathematical teachers shall give instruction to the same students in the first and second cœtus, so that the one who teaches in the first cœtus one year, teaches in the second cœtus the year following.

In the second cœtus:—

1. The larger portion of the instruction, as the table shows, is common; in Plan Drawing the only difference is that the Engineers receive two hours' additional instruction.
2. The instruction in French, for a select number of the most advanced students only, takes place on two afternoons.
3. The instruction in Free Sketching for the Engineers takes place also on two afternoons.

In the third cœtus:—

1. About one-half only of the instruction in this class is common; in Plan Drawing the Engineers have one hour more instruction a week.
2. The Chemical Manipulations (in which a very small number only of the students share) take place on two afternoons.

3. The instruction in French, in which only those already selected in the second cœtus take part, also is given on two afternoons.
4. For mathematical instruction the class is formed into two divisions. The first consists of those pupils who, in the opinion of the teachers, are able to follow profitably the instruction in the higher mathematics. The remainder form the second division, and go over a second time what they have already learned, to which is added a variety of questions in applied mathematics, important to the Artillery and the Engineers.

TENOR OF THE STUDIES IN GENERAL.

First Cœtus.

Artillery.—Elementary Description of all the *matériel* of the Prussian Artillery, and of the basis of its arrangement. Effect of the different natures of guns, and the simplest rules for their employment.

General Military Engineering.—The elements of field and permanent fortification. The principles of the attack and defense of fortresses. General notions on the construction of military bridges.

Tactics.—General organization of an army. Formation of the different kinds of troops. Fundamental rules for the placing, moving, and fighting of the separate arms, as well as their combination. Occupation of ground. Attack and defense of positions. Field-service.

Mathematics.—Algebra and Arithmetic. Simple and higher equations. Progression series. The binomial theory for integral exponents. Series of powers and logarithms. Analytical trigonometry. Plane and analytical geometry. Plane trigonometry.

French Language.—Translation from French into German, with parsing.

Rules and Regulations.—Official correspondence, with examples. Discipline. Military code. Courts-martial. Courts of honor. Service in and out of garrison.

Plan Drawing.—Theory of representing ground. Principles of topography. Surveying. Drawing from copies and simple models. Knowledge and description of the different conventional marks.

Free Sketching.—Drawing of straight lines, broken lines, and angles. First principles of figure drawing. Hatching with black chalk. More difficult studies in figure drawing.

Second Cœtus.

Artillery.—Description of the organization of the Prussian Artillery. Rules for the employment of artillery in the field and in sieges.

Special Military Engineering.—Extension of the course of field and permanent fortification, given in the first cœtus. Extension of the instruction on sieges. Formation of camps. Specialities of military engineering, in so far as it is of interest to artillerists.

History of the Art of War.—History in early times, in a very general manner; that in the middle ages, as they approach modern times, in greater detail; in modern times, very fully. Organization of the armies and mode of conducting war at each remarkable period, illustrated by the description of some campaigns and great battles.

Mathematics.—Solid geometry. Spherical trigonometry. The theory of projections. Theory of co-ordinates and conic sections. Statics, geostatics, and hydrostatics.

Physics.—General properties of bodies. Laws of the equilibrium of solid, fluid, and aëriform bodies. Heat. Application of steam and gases. Measurement of heights. Hygrometry. Acoustics. Optics. Magnetism. Electricity. Electro-magnetism. Magneto-electricity.

French Language.—Exercises in translating German into French, for a select number of pupils, about one-third of the whole.

Artillery Drawing.—Use of drawing instruments and scales. Drawing of the *matériel* of the artillery, and principally of the separate parts of an object in different views and sections, to a certain scale, without the original.

Artillery Constructions Drawing.—Construction of the different limbers, gun-carriages, &c., and the principles of their arrangement, forms, proportions, and admeasurements; in greater part, however, intended only as illustrations of the rules of perspective.

Fortification Drawing.—Instruction in the composition of drawings; the practice includes representations of projects of fortresses and their details in plan and section, and in cavalier's perspective (bird's-eye view); both etched and shaded with Indian ink, and colored. The chief object is to qualify the pupils to understand, and to prepare correctly, drawings and plans of objects in field and permanent fortification.

Plan Drawing.—Further practice in drawing of ground, with objects, buildings, &c., marked in black and colors. Further progress in geodesy. Sketches and reconnaissances.

Architectural Drawing.—Perspective. Drawings of architectural decoration in outline, with the lines of shadow, but without further detail.

Free Sketching.—Further figure-drawing. Landscapes and the drawing of ornaments, for the more skillful students.

Descriptive Geometry.—The theory of descriptive geometry. Projections of various bodies in space, upon planes. Drawing according to proportional scales. Theory of light and shade of drawings.

Third Cœtus.

Artillery.—History and Literature of artillery. Review of the general relations of the artillery system in the principal states of Europe. Scientific basis of artillery objects, and their technical description. Theory of the parabola and of projectiles. Organization and employment of artillery, considered in its highest point of view.

Exclusive Military Engineering.—Special application of the rules for sieges under given circumstances more or less connected. Complete instruction in building, and its application shown by projects for given sites.

Hydraulic Constructions.—General principles of the science. Knowledge of the construction of such works, of which the principles should be known to engineer officers. In this is chiefly to be considered fascine work for the protection of the banks of rivers and canals, the construction of bridges and sluices, and the laying the foundation of heavy masonry in water.

Mathematics.—(For the first division, about a quarter of the class.)—Differential and integral calculus. The higher geometry. Analytical mechanics and hydraulics.

(For the second division, about three-quarters of the class.)—Repetition of the most important part of the studies already gone through in the first and second cœtus, with practical useful problems. Mechanics and hydraulics, as well as some instruction necessary for artillerists, but so as not to require the higher analysis, and more of a practical than of a theoretical nature.

Chemistry (Instruction.)—The necessary preliminary knowledge of theoretical principles. Treatise of separate substances (of the metalloids and their indifferent combinations, of the acids, of the metals,) all illustrated by experi-

ments. To conclude with a survey of the composition and alteration of the surface of the globe from a chemical point of view.

(Manipulation.)—Instruction in the principles of qualitative chemical analysis, illustrated by experiments. Manipulation by the students under the superintendence of the instructor. Instruction in the principles of quantitative analysis. Analysis by the students, of substances employed by the artillery. (Only four or five of the best qualified take part in these experiments.)

French Language.—Select conversation (only for the already selected students in the second cœtus.)

The Horse.—Natural history and anatomy of the horse. Good and bad points. Food. Internal and external sickness, with the mode of discovery and cure of of the same, as far as practicable, by the means to be had on actual service. Shoeing.

Artillery Drawing.—Continuation of the instruction. *Matériel* of the artillery, represented as combined artillery objects, partly on a given scale, partly drawn from a real object, by the more skillful students.

Artillery Construction Drawing.—Construction of each description of cannon. Principles of their forms, proportions, and sizes. Problems on the construction of existing and not existing guns, carriages, &c. Construction of the artillery *matériel* of foreign powers.

Fortification Drawing.—Projects of field fortification, to be constructed of earth, or of earth and gabions, with application to the nature of the ground. Drawings with the use of Von Prittwitz' copies of the fortification of places, as a continuation of the fortification drawings begun in the second cœtus. For all these exercises in projects and drawings, the concert of the teacher of exclusive engineering is required.

Plan Drawing.—Practice in copying and reducing large plans. Drawing of plans of battles with the position of the troops, and of plans of sieges, with the trenches and batteries.

Architectural Drawing.—Architecture in its application to military buildings, done in India ink. Finally, practical exercises in copying buildings.

PRACTICAL EXERCISES.

These are carried on, as has been already remarked, in part during the nine months of theoretical instruction, on some of the afternoons, but they principally take place during the three summer months of July, August, and September, in the forenoon. They commence early in the morning, and often last till the afternoon, on which account there are no evening hours of study during this period. As the students of the third cœtus return to their corps at the beginning of July, those of the first and second cœtus only take part in this practice. The visits to the Fortress and Military Establishments of Spandau, and the preparation of projects of military constructions, and of reconnaissances, must be made during the period of theoretical instruction. It is therefore suspended for one day for the students of the first cœtus, and for three days for the Artillery, and five days for the Engineer students of the third cœtus.

The distribution of time for each cœtus is as follows:

DURING THE NINE MONTHS OF THEORETICAL INSTRUCTION.

	Number of Days employed.				
	1st Cœtus. Artillery and Engineers.	2d Cœtus.		3d Cœtus.	
		Artillery.	Engineers.	Artillery.	Engineers.
Visits to the Artillery Workshops,.....	2	0	0	4	0
To the Collection of Arms in the Arsenal.....	1	0	0	0	0
To the Models of Fortresses in do....	1	0	0	0	0
To the Ordnance, Gun-carriages, Ammunition-wagons, &c., in do.....	4	0	0	0	0
To the Foundry and Boring Machinery	2	0	0	2	0
To the Iron-foundry, and to one of the large Manufactories of Machinery in Berlin,.....	0	0	0	2	0
To the Fortress of Spandau, the Powder-mill, and Small-arm Factory,..	1	0	0	0	0
Working in the Laboratory,.....	12	12	12	0	0
Examination of Ordnance,.....	0	0	0	6	0
" of Gun-carriages, and Ammunition-wagons,.....	0	0	0	6	0
Examination of Shot and Shell,.....	0	0	0	2	0
" of Small-arms,.....	2	0	0	0	0
Practical representation of the Rules for placing Guns:					
With reference to the ground,....	0	2	2	0	0
On given tactical conditions,.....	0	0	0	4	0
Solution of problems in the art of Sieges, with reference to an actual fortress and the country surrounding it (Spandau,)	0	0	0	3	5
Practice in Elementary Tactics,.....	4	0	0	0	0
Drawings of Ordnance, Carriages, &c...	0	12	0	0	0
" of Buildings, &c.....	0	0	0	0	14
Practice in Geodesy,.....	12	0	0	0	0

DURING THE REMAINING THREE MONTHS.

Practice in Geodesy,.....	16	28	32	Nil.
Practice in Fortification of the 1st cœtus, with the Engineers of the Guard.....	12	0	0	"
Practice in Fortification of the 2d cœtus,	0	10	10	"
Visits to the Models of Fortresses in the Model-house,.....	0	2	2	"
Gun Practice, proof of gunpowder, the management of machines, &c.....	14	14	14	"

Remarks.—The employment of time in the last three months above given, requires the whole of the months of July and August, and about the first third of the month of September, after deducting fourteen days for the Officers' Examination for the first cœtus, and occasional days lost through bad weather. The remaining two-thirds of September are given for vacation, as well to afford recreation to the teachers and students as to allow of the repairing and cleansing of the school-buildings.

MILITARY AND GYMNASTIC EXERCISES.

The month of October is appointed by the Director to the fitting and making uniform the regimental clothing brought with the stu-

dents from their corps. Military exercises then take place once a week for two hours in the afternoon, till the 1st of April, or for about five months.

The military exercises are carried on under officers of the garrison, namely, a Captain and two Lieutenants of the Artillery of the Guard. They put themselves in communication with the Director to arrange the time, nature, and extent of the exercises.

The exercises consist of—

1. *Exercises on Foot.*—The whole of the first cœtus here take part, but only so many of the second cœtus as are required as non-commissioned officers. Considering the composition of the squad, (Artillery and Engineers,) and the object of the exercise, the perfection of the students in company-drill is less to be attempted than the endeavor to give to each a good position and carriage in the front as well as in the ranks, and more particularly to accustom them to military order and precision.

2. *Exercises with different descriptions of Guns in Position.*—In preference, the light field-pieces of the year 1842 are to be used for drill, and correct, united and prompt execution required. With the siege-guns, every student is instructed and practiced with at least one calibre of each nature.

In addition to their military exercises, there are also—

3. *Fencing and Gymnastics.*—In these exercises the students of the first cœtus only take part, and for two hours of the afternoon each week, during the first six months. There is neither time nor appliances to admit of the students arriving at a high state of excellence. The practice in fencing is only intended to give confidence in the use of arms, that in gymnastics to produce activity, and to afford bodily exercise to young men much occupied in study.

EXAMINATIONS AND CENSURES.

In addition to the several examinations already enumerated, by which the fitness of the students for a certain rank or for promotion into a higher cœtus is shown, some other examinations take place.

1. For the purpose of enabling the Director and the Board of Studies to learn the progress of each separate student, and to confirm by their own knowledge the opinion given by the teachers, there is twice in each quarter an oral repetition of some portion of such instruction in the first and second cœtus. The period of the examination is previously named by the Director.

2. To give a general view of the progress of the entire year, and

to incite the students to study, a public oral examination of those in the first cœtus takes place at the close of the theoretical instruction, in presence of the higher authorities of the school, superior officers of the two arms, and other persons interested.

As a further incitement to the students, and as a warning to those whose diligence or conduct has not been satisfactory, the quarterly "censures" are read out to the assembled cœtus. In general the names of the students are not mentioned, a number known to the individual only being used instead. The best pupils are, however, openly commended by name.

In the first cœtus, on the other hand, those pupils who have obtained very bad "censure" are mentioned by name.

FINANCIAL RELATIONS.

The annual expense of the School is fixed at 16,049 dollars. The sum is distributed as follows:—

Personal.

Salaries and allowances of Teachers	10,731	
Pay and allowances of the Staff	3,478	
		14,209
Practical exercises	520	
School necessaries	720	
Keeping up materials for instruction	110	
Cleansing the rooms	130	
Lighting	100	
Bureau expenses	210	
Covering unforeseen expenses	50	
		1,800

In the event of war, and if the instruction is suspended for an indeterminate period, the salaries of the civil teachers cease. Application is not to be made to the King for the grant of a provisional indemnity, except under very peculiar circumstances.

The payment of the salaries and allowances is made monthly and in advance.

The administration of the funds is directly under the supervision of the Director. The Treasurer carries out the details. The superior orders for the administration of royal grants are most strictly to be followed.

The annual accounts are forwarded by the Director to the War Department.

The property of the School consists of—

The Library, the Collection of Instruments and Models for Artillery and Engineers, the Collection of Physical Instruments, the Collection of Chemical Apparatus, and the School Utensils.

The principal object of the Library is to serve as materials of instruction for the teachers and students, and the Officers of Artillery and Engineers present at the Institution. After that, as a center, for the collection of all the best works, old and new, on Artillery and Military Engineering.

The Director and Board of Studies take care that the instruments and apparatus for the studies are always kept complete and in good order. As the means of the school do not thoroughly admit of the collections keeping pace with the progress of science, special care is taken that at least the most necessary articles are not absent.

The utensils of the school are kept always complete, under the supervision of the Director.

The property of the school is examined yearly by the Director and Board of Studies, and a report to that effect sent in with the annual accounts.

PROGRAMMES OF THE PRINCIPLE SUBJECTS TAUGHT

IN THE

ARTILLERY AND ENGINEER SCHOOL AT BERLIN.

I. ARTILLERY.

THE instruction must commence with the first elements of the science, since the new arriving students have little preparatory knowledge. It must be carried on to such an extent that the pupil may be able, after going through the first cœtus, to pass his *officer's examination*, and after the completion of the entire course, not only to show at his *special* examination that he possesses the positive knowledge required for the ordinary duties of the service, but also to prove that he is qualified for continuing his studies by himself.

The Engineer pupils who close their instruction in artillery at the end of the second cœtus, are to be instructed in the composition of artillery, in the effect and the use of cannon, but more especially in its employment in sieges.

From this general notice of the limits of the course it is evident that neither a perfect exposition of the theory nor complete practical exercises are expected. Still to train the students properly in the different directions which an artillery education requires, the instruction must not consist only in a theoretical lecture, but be aided by judicious directions for drawing, and be perfected by practical exercises. For the attainment of the two latter objects special prescriptions are given, to which we refer.

Instruction in artillery is closely connected with the lectures on mathematics, physics, chemistry, tactics, fortification, and veterinary science.

a. As special points may be mentioned, *in mathematics*, calculation of contents, and fixing the centers of gravity, of cannon and its parts; calculation of piles of shot; strength, direction, and distribution of recoil on the separate portions of a piece of ordnance; theory of machines, of carriages, of parabolic and projectile curves, and calculation of the flight of rockets. In all these cases the mathematical lecturer develops the necessary formulas for the artillery student, but their application belongs to the course of artillery.

b. In physics.—Explanation, notice, and determination of the specific gravities of the materials used in artillery. The law of gravity. The absolute and relative strength of woods and metals. Friction. Resistance of the air. Expansive power of gases, especially of those generated by gunpowder.

c. In chemistry.—The general laws of chemical action of bodies on one another. The simple elements of the materials used in artillery. The chemical properties of their combinations. The acids exhibited in the combustion of gunpowder and their action on metals; the processes used in the reduction and manufacture of metals up to the point where they are fit for use in artillery; chemical analysis of gunpowder and of the most common metal-alloys. The action of the atmosphere on substances exposed to it, which are used in artillery.

d. In tactics.—The organization and tactics of artillery, so far as they stand in direct relation to other arms. A complete account of the conduct of artillery when coöperating with other troops.

e. In fortification.—Everything referring to the tracing, the relief, and the

construction of fortifications; attack and defense of field-works by infantry and cavalry; complete exposition of the art of besieging, with a discussion of all the duties of an engineer, a sapper or miner, both in the attack and the defense of a fortress, also the use of infantry and cavalry in sieges, with the omission of the points specially belonging to artillery.

f. In the veterinary art:—The anatomy and physiology of the horse; general rules for feeding, treatment of diseases, and disinfection of the stables and utensils.

The instruction in the first cœtus must, as already mentioned, be so calculated, that the students at the end of the course of lessons may be able to satisfy perfectly the requirements of the *Officer's examination.*

As a further prosecution of the same subjects of instruction in the second, and again in the third cœtus, would lead to a great loss of time and to tiresome repetitions, the lectures are to be so planned that the separate subjects to be treated in the first and second cœtus, taken together, are of sufficient extent for the Engineer pupils in general; the further developments necessary for the Artillery pupils are reserved in preference for the third cœtus.

A. IN THE FIRST CŒTUS.

The separate subjects of the lecture are—

1. Definition and distribution of arms.

2. Theory of gunpowder: component parts—manufacture—ignition—force. Proving. Storing. Transporting. Necessary precautions in manufacturing. Marks of damaged powder, and the possibility of restoration. Mention of the substances which may be used in place of gunpowder for various military purposes.

3. Cannon. Materials. Dispositions. Manufacture. Proving. Storing, and duration.

4. Gun-carriages. Limbers and other artillery carriages. General explanations on the construction of carriages, with particular reference to those used for artillery. Materials. Distribution and composition of gun-carriages. Limbers and wagons. Their examination and storing.

5. Military combustibles. Elementary notions. General account of laboratory work and regulations; also with reference to later proceedings in a laboratory, and, omitting all figures not absolutely necessary, a description of the preparation of fire-works, matches, ammunition both for artillery and for small-arms, signal lights, and particular kinds of combustibles. Their packing and storing.

6. The service, working, and moving of cannon, and of artillery carriages, with account and description of the machines in use by the Prussian artillery; but without special explanation of the official regulations.

7. Firing. Theory of the movement of projectiles, of the effect caused by their movement, and the mode of turning this action to the best account for military purposes. Elements of the theory of firing. Practice. Various descriptions of fire; their effect, and their employment for various sorts of guns.

8. Small and side-arms. Purpose and description of the composition and arrangement of small-arms. Their manufacture, storing, and the practical rules for their use. Purpose and description of side-arms. Fabrication, proving, effect, and use of them.

B. IN THE SECOND CŒTUS.

The instruction in the second cœtus is a continuation of the lectures of the first cœtus, and embraces the use of artillery in the field and in sieges. Its object is to bring the Artillery students to that point that they are able, at its close, to discharge satisfactorily the ordinary practical duties of the service, and be prepared to follow the course of the third cœtus, and to give to the Engineer students, who, in the third cœtus no longer receive instruction in artillery, all the knowledge of the subject required for their future profession. The instruction must therefore be complete enough for the Engineers, and give the Artillerist a solid and thorough preparation for the third cœtus.

Instruction in the second cœtus should comprise, in particular—

1. The organization of the artillery: purpose and considerations in the putting together of all parts of artillery material, both in tactical and administrative respects, with historical mention of the diversities of practice of other Powers.

2. The use of artillery in the field. Marching and tactical movements. Taking up position. The engagement itself, and conduct in some particular cases; for example, in defile fighting, in entrenchments, passage of rivers, &c.

3. Use of artillery in sieges:—

a. *For Attack.*

Planning and throwing up the batteries. Preparation and use of the different kinds of materials of construction. Different sorts of batteries. Methods of construction. Repairing of damaged batteries, and the calculation generally of all the materials necessary for constructing them.

Purpose and equipment of besieging batteries, with the preparations, special and general, for a regular attack.

Proceedings in the regular attack, and their modifications in irregular sorts of attack, occasioned by the situation of the fortress with reference to the surrounding ground, or by the special nature of the defenses.

Proceedings after capture, and when the siege is raised.

b. *For Defense.*

The equipment of the fortress. Determination of its artillery. Preparations in the fortress when it is declared in a state of siege. Conduct of the artillery in the regular attack, and against irregular modes of attack, as well as in particular cases, such as when in detached isolated works, when the place is relieved, or when the garrison fight its way out.

C. IN THE THIRD CŒTUS.

In the artillery course of the first and second cœtus, the students have gained a general knowledge of the materials of artillery, as well as its organization and use as an Arm; but the lectures were for the most part limited to what was of the greatest immediate consequence, viz., the description of the actual condition and relations of the Prussian artillery.

The object of the instruction given in the third cœtus is, on the one hand, to expose the scientific laws of artillery and its various parts, and, on the other, to track the historical development of the Arm, so as by this means, and by consideration of the constitution of foreign artilleries, to extend the views of the

students beyond our own practice, thus to form their judgment, and induce them to think and contrive for themselves.

In the comparison of our own and foreign existing systems with the results of scientific considerations, the teacher should proceed with caution, and not raise in the young men the inclination to or the habit of crude and officious criticism. Investigation of things as they exist must, therefore, not confine itself to the mere search after defects; it can be only profitable when employed to test our own powers at improvements, and to discern thereby the difficulties and impediments that accompany them The value which speculative reasoning has for the purposes of the artillery ought to be properly esteemed by the students, but, in face of the results of experience, not be estimated too highly; and in the comparison of different artilleries one with another, the influence must not be overlooked which the peculiarities and the history of a country ever exert on its institutions.

The final aim of the artillery instruction in the third cœtus must be a higher degree of preparation for the future practical ability of the students. As regards the material portion of the artillery, the students are to acquire a general knowledge of the construction, fabrication, and proving of the *matériel*, and for the tactical part, it is above all things to be made an object that they be made capable, by the instruction given them, of greater dexterity and confidence in dealing with special cases in the field or in siege operations.

The instruction commences with:—

1. Organization of the artillery service. The general relations of the artillery service are to be explained according to its different purposes, as an arm both in technical and administrative respects, then the principles for the organization of the service and of its separate portions in peace and war are to be developed, and comparison made with those carried out in the principal foreign artilleries.

At the same time, on the one hand, more details are to be gone into on the different branches of the artillery service (field, siege, fortress, and coast artillery, the technical and the administrative branches,) than was done in the second cœtus; and on the other, those considerations must be kept sight of in which the artillery appears as a portion of a greater whole, as in its relation to the Army and to the State.

2. Artillery, regarded as an arm. Since the elementary rules for the use of artillery in war have been given already in the second cœtus it will be the object in the third cœtus, first, to develop the principles of artillery tactics in the field, and in sieges, from an extended point of view, and then to apply the rules for the movements, placing in position and fighting of the artillery to the bodies now actually used in war, and to examine the great questions that may hence arise. For the field artillery, the tactics of single batteries and of masses of artillery and the collective relations of the artillery of a *corps d'armée* and of an army, must be shown. For sieges there will be less occasion to treat of the separate means of defense by artillery than of the various combinations under different circumstances, of its diversified applications.

To give this instruction its most practical tendency, historical examples of battles are to be taken, and not merely their results adduced, but the circumstances gone through in detail. These are to be compared with the rules previously given, and the causes and effects of any discrepancies, as far as practicable, and with caution, explained.

Themes are then given out of campaigns and sieges, in working which the students are to show applications of tactical rules under given circumstances.

As regards the preparation for the field and the conduct in marches, quarters, camps, or bivouacs, what was necessary has already been taught in the second cœtus, as far as concerns a corps of artillery as large as a battery. In the third cœtus, therefore, only more extensive and important relations have to be explained.

Finally, as the students at the close of the third cœtus are to enter immediately into active service in the regiments, it will be useful to give them a general view of artillery duties in time of peace, of which no mention was made in the first and second cœtus, and to show the principles on which they rest. Further, the education of the men, the selection, management, and care of the artillery horses, instruction in riding and driving, the various exercises in serving and moving the guns, artillery practice, the different fatigue duties, conduct in manœuvres, detachments, &c., are to be particularly explained.

3. Artillery in a technical and administrative point of view. In the instruction given in the first and second cœtus, a descriptive notice only was given, as regards artillery material, of the arrangement and effect of what actually exists; and the reasons for this arrangement were added only so far as was necessary for this principal object.

In the third cœtus the pupils are to learn by the inductive process how, according to existing principles of natural science and of tactics, with the known mathematical and technical aids, artillery material must be contructed, manufactured, and proved, so as to obtain the desired end in the highest degree; and then our existing material and that of other countries are to be compared in the manner above stated with the results thus obtained.

To this end, in the lectures, first, the necessary explanations of artillery requirements are to be brought forward from the doctrine of mechanics; after that the fabrication, proving, and action of gunpowder are to be introduced; and finally, the construction, fabrication, and examination of cannon, carriages, and ammunition of the artillery and of small-arms.

Of course the details of powder-mills, of cannon foundries, of artillery workshops, of laboratories and small-arms manufactories, are here to be explained.

The action of projectiles and the mode of applying it, are to be scientifically explained, by the aid of the parabolic and projectile theory, as well as the principles upon which artillery experiments are to be conducted.

Finally, the principles of the management of the artillery material in the artillery dépôts are to be explained.

4. The course of instruction will be closed by an historical description of the progress of artillery, and by an historical review of its literature.

D. GENERAL DISTRIBUTION OF THE TIME.

The total number of hours is, according to the constitution of the school—

For the first cœtus,	35	weeks of	4	hours	= 140	hours.
" second "	35	"	3	"	= 105	"
" third "	35	"	8	"	= 280	"

The exact number of hours dedicated to each division must be stated by the teacher in the first instance in his special plan for lessons, as they in part depend

upon his general experience. But, at all events, all the above-stated subjects for the first cœtus must be taught in the prescribed periods.

The lecture in the first cœtus must by no means be a mere mechanical preparation for the *Officer's examination;* even here the understanding of the pupil is not to remain unoccupied, though the memory is to be had recourse to in a very high degree, and the historical form, that is, description of objects as they are, predominates.

The principles of the arrangements can only be taken up in their chief features, (partly because) time will not allow a farther advance, and partly because the progress of the students in the other studies is not yet sufficiently forward.

In the second cœtus the advantage has been obtained that the students have gained a knowledge of the entire material of artillery in its various relations, and the lecture gives, therefore, an introduction to the use of artillery in the field and in sieges; and with special regard to a fundamental knowledge of the details, and with the view to what is necessary to complete the Engineer pupil and make an efficient preparation of the Artillerist for the third cœtus, aims at a somewhat more scientific treatment, without going into the full comprehensive details reserved for the latter student. For the same reason, this portion of the lectures is confined nearly throughout to the explanation of existing conditions of our artillery, and only where the necessities of the Engineer student may demand it, can mention be made of the earlier material, or of the most important matters of foreign artilleries.

The instruction, therefore, of the first and second cœtus is directed more to the general and historical, that of the third cœtus, more to the special and scientific culture of the student; the materials were there collected which are here to be worked up.

From this general point of view proceed also the methods which are to be observed by the teachers in each cœtus.

The principal point to be kept hold of in all three cœtus is, that everything that can be shown the students, or which they can learn by their own manipulation, should be brought visibly before them, and as far as time and circumstances permit, should be actually put in practice. The material objects, in their actual state for use, must as often as possible be shown and explained, for which the Practical Exercises offer the best opportunity to which reference is here therefore made.

After these, a collection of models, diagrams, tables, and literary notices are necessary, which may be partly used for immediate instruction in the class, and partly furnished the pupils as a necessary and time-saving aid to the memory.

Deficiencies in these aids to the lectures are to be laid before the Direction and Board of Studies by the teacher, and supplied as far as the existing means allow.

Those cases in which the proceedings are fixed by certain regulations require special mention; for instance, the transport of powder, examination of cannon, drills, harnessing of horses, stable and camp service, &c.

All these regulations are grounded on certain principles, from which no deviation can take place without evil. The method of drawing them up is, however, variable, on which times and circumstances, and even the views of the superior authorities, have influence.

It is, therefore, highly necessary that in this respect the essential be carefully in the instruction separated from the accidental, and by omitting the latter, not only gain time, but hinder that the students accustom themselves in a slovenly manner to look only to forms, and to seek in them the true being and life of artillery.

A true exposition of the principles on which these regulations rest ought not to be omitted from the lectures. They will suffice to prepare the students to act correctly in every case that occurs, for which actual service gives them, moreover, the separate instruction. The more completely the teacher keeps this point in view the less need he fear to form his pupils to immature critics, since the well-informed officer will more easily enter into the spirit of each such regulation, and more exactly carry it into execution for the benefit of the service, than he who has been accustomed to keep without reflection only to the dead letter; this, in the varied phases of practical life, will often enough leave him without guidance, unless he knows how to find it within himself.

As amongst the many existing class and hand-books for the artillery, none is entirely adapted to form a basis for the lectures, the formation of a special plan of lectures for each cœtus is indispensable, that the lecturer may have a defined path, and the students an assistance in their repetitions.

II. GENERAL AND SPECIAL ENGINEERING IN THE FIRST AND SECOND CŒTUS

The lecture commences with the first principles of fortification, supposes no previous knowledge, and comprises—

(*a.*) Field fortification, attack and defense of a redoubt, communication in the field, and,

(*b.*) Permanent fortification, the art of besieging, with the example of a siege that has actually taken place.

In the first cœtus it must be so far carried out that the pupil is capable of passing his *Officer's examination* according to the regulation of the 26th March, 1846. In the second cœtus the general knowledge of field and permanent fortification acquired in the first is carried on in such a degree as both Artillery and Engineer officers require to form a good foundation for the particular professional study of both arms in the third cœtus.

In the formation of the special plan of the lecture the instruction-regulations for artillery and exclusive engineering in the third cœtus are to be kept in view, so as to prepare for these subjects by the nature and the method of the instruction.

The principal contents of the lecture are—

A. IN THE FIRST CŒTUS.

a. *In Field Fortification.*

A correct description of the profile, the ground plan, the technical obstacles and modes of strengthening, the construction, and elementarily also, the use of field-works; attack and defense of a redoubt, and the military communications in the field, as roads, fords, and bridges.

b. *In Permanent Fortification.*

Exposition of the essential principles for plan and profile; acquaintance with the parts of a bastioned fortress with the outworks; special acquaintance with

a work on Vauban's first system, and its improvements by Cormontaigne. Knowledge of the characteristics of the Italian, Dutch, and French fortification, of the ideas of Rimpler and Montalembert, as well as of the latest fortifications in Prussia; lastly, a knowledge of sieges as regards a regular attack and defense. The art of construction is taught to the Engineers in the third cœtus.

B. IN THE SECOND CŒTUS.

Applied art of fortification, and, namely, attack and defense of the various sorts of field-works, castrametation, permanent fortification, provisional fortification, and sieges. At their proper places, are to be introduced the precepts of military constructions which are suitable alike to the Artillerist and the Engineer, as well as the conduct of infantry and cavalry, and the duty of the Engineers in sieges.

Distribution of Time.

The first cœtus receives four, the second three hours weekly; therefore, in thirty-five weeks, the first 140, the second 105 hours. The number of hours which are to be dedicated to each portion will be indicated by the teacher in his special plan of the lectures, as it in part depends upon his experiences. All the above-named subjects must, however, be gone through within the prescribed period.

Before every principal division of the lectures, a general statement of its purport and essential principles is given; then follows a short historical exposition which is to explain the connection, the employment, and the thence arising conditions of the subject under consideration in reference to the other parts of the art of war.

The precepts hence deducible on the form of the parts of a fortification, and on the subsisting relations of fighting, are to form the latest and principal portion of each lecture.

The lecture is to be given in detail in such a manner, that its precepts may be deduced from one another in a way suited to the powers of perception of the pupils, and their mental powers accustomed to the carrying out of principles, rather than to a blind adherence to absolute regulations. To avoid repetition, the details of those doctrines which belong to different places are to be given only once, namely, where they are first required; and afterwards reference only made to them.

The military element, as indispensable both for the Artillerist and Engineer alike, is to be kept continually in view.

As regards the principal divisions, oral repetitions may be made from time to time for greater clearness; and, since individual and continued attention and self-reflection alone render a well-grounded progress in the student possible, written themes, besides those prescribed, are particularly recommended. It will not be necessary to submit each individual essay to a separate correction, but the teacher may content himself each time with giving a general view of important defects in the treatment of the subject, and then reading aloud one or more of the essays that have best succeeded, and showing by their analysis how the subject could be best treated.

In both cœtus, the existing models and full sized drawings in the school, as also the models in the arsenal, and for the second cœtus more especially the models of fortresses in the model-house, are to be used.

The means employed to complete the instruction in both cœtus, are fortification drawing, practical exercise in field-works, and an inspection of the fortress of Spandau.

The lectures are given without any fixed hand-book, from manuscript drafts or notes.

III. EXCLUSIVE ENGINEERING IN THE THIRD CŒTUS.

The instruction in General Engineering in the first cœtus was intended to teach the Artillerist and Engineer so much of the art of fortification, of sieges, and of field-works as is requisite for officers of every arm, and is necessary for the students to pass their *Officer's examination.*

In the second cœtus this instruction was enlarged, and connected with its application to field and permanent fortification, to such extent as the kindred arms of the artillery and engineer corps required equally to know, that they may execute effectually their separate duties in fortification and sieges.

The instruction in Exclusive Engineering in the third cœtus is, however, intended solely for Engineers, as it teaches only professional matters which the engineer shares with no other arm of the service; while, on the other hand, the Artillerist receives a special instruction in those branches which are only necessary for the artillery officer.

Since the lectures would receive a too great and heterogeneous extension, if to them were to be added that portion of hydraulics which the engineer officer ought to know, without being immediately connected with his military constructions, and if further, civil architecture applied to military buildings was touched on, these subjects will be taught contemporaneously in the third cœtus by special instructors, and are therefore in the lectures on Exclusive Engineering not to pass the limits of that instruction. Their respective teachers must receive reciprocally special information of each other's plan of lectures, and give mutual help by communications and inquiries where the studies might come into collision.

The teacher of the Exclusive Engineer class must learn the extent of those subjects of instruction which have been already treated in the lectures on Special Engineering in the second cœtus, and not only by inspection of the programme, but by personal consultation with their respective teachers.

In more remote relation, the instruction connects itself with the earlier lectures on artillery, tactics, history of the art of war, mathematics, physics, chemistry, and the exercises in plan-drawing and surveying. The special programmes of instruction of these branches of study are also to be taken notice of by the teacher, that nothing may be twice taught, and that where the use of doctrines from those studies is necessary, he may merely refer to them historically.

This instruction comprises, after an introduction, the following principal divisions.

1. The application of the rules for sieges already given to particular cases, with a general regard to the ground, more especially of irregular fortresses, shown by various remarkable sieges.

2. A theory of construction as auxiliary science in the execution of engineering works for field or permanent fortification, and in the execution of military constructions: building materials, modes of building, and the application of both for given purposes.

To this part belong—

a. A knowledge of the different building materials from the animal, vegetable, and mineral kingdoms; their production and preparation for various building purposes, and the data, so important in practice, regarding their durability and mode of employment.

b. The theory of the use and combination of these building materials for constructive purposes, and of the building of separate portions of an edifice.

c. The foundations of buildings and the means of improving the foundation bottoms.

d. Construction of ordinary buildings, as inclosures, inclined or unloaded revetments, loopholed walls, barracks and hospitals, dwelling and guard-houses, military prisons, stables, magazines, such as arsenals, wagon sheds, provision stores, bakeries, powder magazines, laboratories, communications, mines, weirs and stop-sluices, ice-breakers, &c.

e. Principles of machinery, with explanations of the forces necessary to move machines, with notice of the most common for raising and moving weights, for pumping, draining, dredging, &c.

3. The art, to apply the knowledge gained by the foregoing lectures by means of projects for certain special purposes, and under given circumstances of ground, such as his service may require of an Engineer Officer. The application of field fortification to given portions of ground is alone excepted, since the teacher of applied Fortification-drawing has this especially assigned to him, who still is only to give out his projects in unison with the teacher of Exclusive Engineering.

There belongs to this part—

a. The method of preparing plans and estimates of buildings, in the manner treated of under 2, at (*c*) and (*d*,) illustrated by frequent practice in making out such plans.

b. Practice in plans for special objects and given ground, which latter is to be chosen in the neighborhood of the fortress of Spandau.

c. Instructions generally conceived on the duties in a fortress of an Officer of Engineers, and on the practice of building in Prussian fortresses.

d. As appendix, notices on the formation and preservation of hedges, and plantations of shrubs and trees.

The time fixed for this instruction amounts in thirty-five weeks, at ten hours each, to 350 hours, which, according to the importance of the different sections, may, as a general rule, be appropriated as follows:—

Introduction and details of the first principal section, about	20	hours.
Theory of building, namely; the lectures on materials and their use,	140	"
Lectures on constructions,	80	"
Lectures on machinery,	30	"
Details of the third principal section,	80	"
Total,	350	"

The more particular distribution of this general division of time is matter of the special lesson plan, and it only remains to be observed, that with the approval of the Director, some afternoons are to be taken for viewing the most remarkable buildings in Berlin and neighborhood; and in conjunction with the

teacher of applied Fortification-drawing, three days are to be set apart for a recognizance of the works of the fortress of Spandau, relative to the projects of fortifications mentioned under 3 at (*b.*)

The two first sections of this instruction, namely, the continuation of the instruction on sieges, and the theory of construction, keep their place in the regular lectures of the school, though naturally they have an immediate applicability to practical service, and the lectures therefore ought to be made his own by the pupil by frequent exercises and detailed plans.

The projects for a given ground, on the contrary, must be worked out by the pupils in conformity with the instruction given, as much as possible independently, and as on service a young officer would do under the guidance of his superior. The drawings need not be entirely shaded, but may be partially executed by lines only, but they must be distinct and clean. Here, as in Fortification-drawing, the prescriptions of the Engineer regulation of the 25th of April, 1820, are to be observed, a copy of which is therefore always present in the drawing-room, that they may be seen by each student. Attention is to be given also to the correctness of the scale, to correct coloring, entry on the drawing of the date when done, and of the name as well as the rank of the student, as directed by the above regulation.

In the exercises all propositions for improvements which vary from the mode of practice now in use are excluded.

The teaching auxiliaries are the books and models of the school.

IV. HYDRAULIC CONSTRUCTIONS IN THE THIRD CŒTUS.

The instruction in hydraulics is to comprehend:—

1. Those general principles of hydraulic architecture which in the lectures on Exclusive Engineering in the third cœtus of the school could not be specially explained without extending them too far, and therefore were there taken for granted.

2. Such hydraulic works, as do not immediately come within the scope of military buildings, and therefore could not be included in a lecture on Exclusive Engineering, but which on account of their connection with the profession of an Engineer Officer in general, independently of military construction proper, ought to be known by him in their most important principles.

Since in the instruction in engineering in the third cœtus, opportunities offer for projects of fortification, with application of the theoretical principles given above (at 1,) the exercise problems for the instruction in hydraulic architecture need only extend to those hydraulic works (at 2,) not referring to fortification.

The instruction is in immediate connection with the lectures on mathematics, physics, and exclusive engineering, the last of which will be lectured on at the same time as hydraulics; the lectures on physics and that portion of mathematics which is here necessary, with the exception of hydraulics, have been already treated in the first cœtus. In arranging the plan of the lectures, and in carrying it out, the plans for those sciences must be considered, and conferences held with the teachers it may concern, to prevent the frequent repetition of the same subject.

The entire number of hours is seventy, two of which are given weekly,

which, that they may fall in at the same time with the lectures on exclusive engineering, are thus distributed:—

	Hours.
1. Introduction and laws of the motion of water in open channels and pipes, wells, suction and forcing pumps, about	5
2. Motion of water in streams, hydrometrical measurements,	3
3. Regulation of streams by dams, cuttings, &c., explanation of ice-floats, and of the means to prevent their destructive power,	5
4. Execution and construction of these works and of securing the banks by dikes, packing, and weirs,	14
5. Historical description of the works for internal navigation, canals, sluices, towing-paths, &c.,	4
6. Draining and irrigation works, inundations,	4
7. Harbors, moles, sands, lighthouses, roadsteads, &c.,	6
8. The principles of foundations under water, with accompanying notice of the usual pile and scoop machines,	12
9. The general principles of bridge building; historical relation of the most remarkable works executed of this kind,	17
Total,	70

To make the lecture plainer, and to exercise the student in comprehending existing hydraulic buildings, eight afternoons, at the choice of the teacher, after a previous consultation with the director, are to be appropriated to the inspection and drawing of hydraulic constructions, at Berlin, namely, the sluices and mills.

Although this instruction embraces a large field in a very short period, it must not be extended over too many objects, but rather to be confined to what is indispensable to the practical use of the engineer; the matter of these, however, to be treated fundamentally and thoroughly, and all superficiality be avoided.

The lectures are to be given from private notes, without any prescribed hand-book.

V. TACTICS.

In the First Cœtus.

The Students of the first cœtus are to receive a thorough instruction in elementary tactics, and the employment of the different arms, both separately and united. The object is not merely that they may pass the *Officer's examination*, but that they may gain true general ideas on these subjects, which ought not to be strange to a well-informed officer of any arm. A frequent illustration of the lectures delivered, by examples and problems for actual ground, is particularly recommended.

Lectures on tactics are closely connected with those on artillery, fortification, rules of the service; and in certain respects the lectures on plan-drawing and veterinary art, as well as practical exercises in surveying.

More especially—

a. In artillery: Construction of cannon, of small-arms and side-arms, choice and training of horses for artillery service: organization of the artillery; regulation for the artillery on march and in camp; use of artillery in the field, as regards the specialties of its position, movement, and mode of fighting. The use of artillery in general, in attack and defense, with the use of the reserve

artillery in more important battles, in village skirmishes, passage of rivers and defiles, and field fortifications, belongs to the lectures on artillery, but only in the second cœtus; these subjects are therefore to be treated historically with tactics, as far as knowledge of them is required for the *Officer's examination.* As a general principle, however, all the relations of detail in the constitution or the specialties of artillery are to be treated in the lectures on that science; in the tactics, on the contrary, only the more general relations which concern all the arms of the service, and where the artillery acts in union with infantry and cavalry.

b. In Fortification; the designing and construction of field-works and all means of obstruction. The manner in which ground in general, and the given position in particular, is to be used for the throwing up field-works. Attack and defense of field-works. Complete exposition of the art of sieges.

c. Veterinary art. Natural history, physiology, and general nourishment of the horse.

d. Plan-drawing and surveying. Everything that is to be said on the general physical laws of the form of the earth's surface, and specially on a knowledge of topography and its representation.

e. Rules of the service. A knowledge of military style. Discipline in all its various branches. The internal service on detachments, convoys, and separate commands, and some historical remarks on the provisioning of an army.

The lectures embrace the following principal sections:—

1. Introduction. General ideas of war. War materials. Aim of war. Conduct of war. Tactics and strategy. Army organization.

2. Organization of the Prussian army. Raising and equipping the troops. Formation and strength. Replacing of men and materials. Supplies.

3. Special ideas of tactics. Forming, changing position, and combat. Close and open fighting; distant and near fighting. Offensive and defensive. The enemy. The ground. Characteristics of the different sorts of troops. A short sketch of the development of tactics up to their present state.

4. The proscribed tactics of the infantry, cavalry, and artillery according to the Prussian regulations.

5. Ideas on the combination of the three Arms and order of battle.

6. Influence of ground on the use of troops. Classification of ground and cognizance of the individual objects on it.

7. Occupation, attack, and defense of objects on the ground, as heights, valleys, woods, river lines, farm-buildings, inhabited places, defiles, bridges, dykes.

8. Security of troops on a march. Service of advanced posts. Reconnaissances. Special duties for detachments, as escorting convoys in our own or enemy's country; foraging, surprises, ambuscades, covering of works in the field. In conclusion, some remarks on partizan warfare.

The total number of hours comprises, according to the regulation, in thirty-five weeks at four hours each, 140 hours, of which are to be employed:—

For the first and second	principal	sections	about.....	15	hours.
" third	"	"	.....	20	"
" fourth	"	"	.....	40	"
" fifth and sixth	"	"	.....	15	"
" seventh	"	"	.....	25	"
" eighth	"	"	....	25	"
Total,...			.....	140	"

The lectures on tactics furnish the student with the positive knowledge that is necessary as a general basis; but further care is particularly taken that by the application of the problems put before the students their knowledge is not made up of mere dead knowledge, but that throughout their understandings are exercised. It is, therefore, a special duty of the teacher to frame his lectures accordingly, and as well by a development of the basis upon which the organization, the elementary tactics, and the art of war is founded, as also by very frequent exercises given to the pupils on the lectures to press towards this end.

For the solution of the tactical problems, a number of plans of ground is necessary. They are obtained on the requisition of the teacher through the Director.

It is further necessary to illustrate the use of the different troops upon the ground itself, as well for attack as defense, and to have the examples and problems given by the teachers sketched by the scholars. For such exercises four days of two or three hours each will suffice.

Of the existing hand-books, none appears perfectly qualified to serve as a basis for instruction. The filling in, therefore, of a sketch of the lectures, and of a special plan of instruction, is indispensable to give the teacher a fixed basis, and the scholars an assistance in their repetitions.

VI. MATHEMATICS.

The mathematical lecture, besides its general tendency to sharpen the intellect, is to make the scholars acquainted with all those theories and laws which are indispensable to the Artillery and Engineer officer to enable him to solve with certainty and ease those problems which so often meet him in the service.

Since these problems in part require the application of rules of the higher branches of mathematics, lectures on these ought not to be wanting, and consequently the mathematical instruction for at least a portion of the pupils must embrace (with few exceptions) the entire field of this science.

In order, however, that this demand be accommodated to the time at disposal and the capabilities of the students, the following rules are to be observed:—

1. The students of the first cœtus having already passed their examination for *Portépée ensign*, and the Predicate *ziemlich gut*, in their mathematical examination, being requisite for entry into the School, it is to be presumed that they enter with a good or at least sufficient preparatory knowledge. Still, as it is not to be expected that the necessary requirement in arithmetic and algebra will be possessed throughout, the first part of the instruction must be considered as the most important, and be given thoroughly and fundamentally.

2. Such portions of mathematics as are less necessary for Artillerists and Engineers (for instance, astronomy and the higher geodesy,) are to be entirely omitted from the lectures.

3. As even in such portions as fall within the scope of the lectures, there is much that can not be exhausted, therefore all that belongs solely to speculative views, or possibly only serves to the rounding or perfecting a system, must be passed over. The instruction in mathematics stands in near and frequent connection with the lectures on artillery, architecture, mechanics, physics, theory of surveying, and with drawing lessons, as well as with practical mensuration.

These belong specially—

a. To Artillery: architecture, mechanics; the application of all those formulas which the mathematical lectures have to deduce and to prove.

b. To Physics: the theories of dioptrics, and catoptrics, which the students require to a perfect understanding of the construction of telescopes and reflecting instruments; what is necessary from aërometry and aërostatics.

c. To Drawing lessons: practical working out of the theory of perspection, and the construction of shadows.

d. To the theory of Surveying: a knowledge of all the instruments requisite for mensuration and leveling, and the principal theorems, with their application to cases occurring in mensuration.

The lectures on mathematics form of themselves a continuous, closely connected whole; consequently, the same teacher who gave instruction in the first cœtus is to retain his pupils in the second, so that each of the two teachers commence with the first cœtus in alternate years.

For the third cœtus there will be a selection made of those students who have made themselves noticed in the second cœtus by distinguished ability, special application, and peculiar talent for the study of mathematics, and have thus raised hopes that they may be conducted with success into the higher branches of the science.

They form a separate division, whose number should always be small if the selection be guided strictly by the contemplated purpose. All the other students of the third cœtus form a second division, in which the entire field of what they have already been taught in mathematics is again gone over, with a view to its application; and at the end of this course some other subjects necessary to the Artillerist and Engineer are to be treated, without, however, mere scientific speculations.

For each of these divisions a separate teacher is appointed.

A. THE LECTURES IN THE FIRST CŒTUS EMBRACE,—

I. *Arithmetic and Algebra.*

1. Algebra, with sums, differences, products, quotients, whole numbers, roots, powers with real exponents and logarithms. The qualities of fixed numbers, fractions, decimal and continued fractions. Extraction of square and cubic roots in figures and letters, practical use of logarithms.

2. Algebra, equations of the first and second degree, with one or more unknown quantities, proportions, and the higher numerical equations.

3. Arithmetical and geometrical progression, calculation of interest, theory of combination, binomial theory for real exponents, series for powers and logarithms and analytic trigonometry.

4. Cubic and biquadratic equations, pure equation of the *n*th degree, reciprocal equations. (4½ months.)

II. *Plane Geometry.*

Similarity of figures formed by straight lines, their contents. Theory of the circle; measurement of the circle and of its parts. Geometrical analysis and application of algebra to geometry. (2½ months.)

III. *Plane Trigonometry.*

Trigonometrical functions and their logarithms. Calculation of triangles and polygons, certain parts being given. Application to the circle. (2 months.)

B. THE LECTURES IN THE SECOND CŒTUS COMPRISE,—

I. *Geometry.*

1. Geometry of solids. Place of lines and superfices in space. Solid angles, solids, determination of their superfices and contents. Applications, with consideration of the weights of material bodies.
2. Solid trigonometry, with its application to the superfices of the earth.
3. The theories of projection and co-ordinates.
4. Conic sections. ($4\frac{1}{2}$ months.)

II. *Statics.—Geostatics and Hydrostatics.*

With application to practical cases, namely, determination of center of gravity for ordnance and their parts, pressure upon supports, rafters, against walls, dikes and arches; stability, carrying power, strength as well as regulation and calculation of power of machines which are moved by animals. ($4\frac{1}{2}$ months.)

C. THE LECTURES IN THE FIRST SECTION OF THE THIRD CŒTUS COMPRISE,

1. Differential and integral calculation. (3 months.)
2. Higher geometry. ($2\frac{1}{2}$ months.)
3. Dynamics (mechanical,) and hydraulics, with application of the determination of the strength, direction, and distribution of the recoil upon the separate proportions of a piece of ordnance, of the science of projectiles, of the theory of carriages, of the rise of rockets. ($3\frac{1}{2}$ months.)

D. THE LECTURES IN THE SECOND DIVISION OF THE THIRD CŒTUS COMPRISE,

1. Repetition of the most important results of the instruction in the first cœtus in a series of exercises.
2. Repetition of the theory of statics and solution of numerous problems from real life. (3 months.)
3. Dynamics and hydraulics without higher analysis, with applications. (3 months.)

E. GENERAL APPROPRIATION OF TIME.

The number of lessons (hours) amounts, according to the prescribed plan for the first and second cœtus, to six hours, for each division of the third cœtus four hours, weekly; if the course be taken, after deducting the holidays and other interruptions, at thirty-five weeks, then there will be for the first and second cœtus, 210, and for each division of the third, 140 hours.

The number of hours to be devoted to each portion must, in the first instance, be determined by the teacher in his special lecture plan, as it in part depends upon his previous experience; at all events, all the above-named themes for the first cœtus must be treated in the stated time. Only in special cases, in the second and third cœtus, can the omission or transposition of one or the other, on reference to the higher authorities, be permitted.

It has been already remarked that the course of mathematics should impart to the students not only that amount of positive knowledge which he requires

for his immediate sphere of action and needs as incitement and guide to further study, but also should fill the important purpose of forming the mind of the students generally. This purpose will be the more certainly gained the more the teacher is enabled to render the scholar self-trusting, and in each separate study to lead to the development of a few select principles simple and easily understood, but comprising in natural and logical connection the whole theory, so that the scholar fancies they are his own discovery, and therefore prizes them as his own. The teacher must, therefore, gradually propose a series of connected inquiries, and those naturally first on which the usual systems are based, as questions to which the students have to submit answers deduced from the above-named principles, with constant application of simple common sense. By these means the students are not only continually gaining single results, made ready to their hand by use, but what is principally desired, they acquire thereby great mental activity.

As regards instruction in the separate cœtus, the following rules are to be observed:—

At the commencement in the first cœtus, the teacher should endeavor, by frequent questions to form a full and correct judgment of the previous knowledge of each student, that he may determine how he should proceed with his lecture, slower or quicker, and to what subjects generally for the entire class special notice and exercise should be devoted.

The most complete exercise of the elementary rules, forming, as it does, the indispensable basis for all future progress is in this cœtus the principal aim of the teacher.

In the second cœtus, in the application of the theory of co-ordinates to the commonest curves, no investigation of the specialties of the theory of curves is necessary, because this is reserved for later lectures, and it would here abridge the time required for subjects of nearer interest. The development of these theories must, therefore, be confined to the simplest elementary use. The study, too, of the analysis of finite numbers is to be continued only so far as the student requires for immediate application, without any intention of going deeper into the science. On the other hand, a suitably increased time is to be given to statics and hydrostatics, because the student ought to be acquainted with them in the most complete manner.

As the first division of the third cœtus consists of but few and only the best scholars, it may be required of them to work out independently at home separate questions given by the teacher, and submit them to him for examination. The progress of the student is more surely gained and advanced, the oftener he has opportunity of personally discovering mathematical truths, or by applying them to examples to come to a clearer comprehension and use of them.

In the second division the teacher will not always be able to avoid giving a repetition of the reasons of propositions. This is necessary when he perceives from the work or expressions of the students, that the majority have not perfectly comprehended the proposition. Still the teacher will here content himself with bringing forward the most important points in the chain of deduction. The explanatory problems are solved by the teacher himself, who then sets similar ones for working out by the students at home.

For practical static problems, the teacher can use with great benefit objects often occurring in common life, and yet regarded so little; the numerous appli-

cations of the lever, of the inclined plane, &c., by artillerists and engineers, for their works, carriages, draught, &c., furnish sufficient material for such problems; as for instance, determination of the depth of a boat of given length and breadth when after putting into it a piece of ordnance a given height out of water is required; determination of the power requisite to overcome the resistance of a log lying in the track of a vessel; determination of the pressure of a laden beam on two or more supports with reference to the flexibility of the beam; determination of the center of gravity in an excentric hollow shot, both theoretically with given radius and known centers, as well as more practically when the centers and the radius of its interior are unknown, as by dipping the hollow shot into quicksilver; determination of the counterpoise of a drawbridge and examination of the best position for the axle; investigation of the strength of metal and wood pipes which are to serve as water-pipes at given heights of pressure, &c.

At the same time the teacher ought not to leave unnoticed the advantages which theory can offer to practice when rightly applied, by which is in no way meant that the practical man should enter every time into a prolix and anxious calculation, but from the improvement his mind and capacities have received, he may apply readily what he has learnt to the purposes of common life.

Dynamics and hydraulics will be rather treated in a physical and historical point of view; here, too, the application of known professional results is the principal object.

As the limited time will not allow separate mathematical repetitions, the teacher should therefore be the more careful to make his lectures as much as possible applicatory. To insure progress the students must, besides the usual writing out the lecture, have frequent themes given to them for work at home, and of which their own execution should be secured by proper means.

It is perfectly necessary that a hand-book should form the basis of the instruction, from which the teacher should lecture, and the students make repetitions.

The hand-books are to be proposed by the teacher to the Board of Studies, and must not be changed without permission.

These books, as well as the logarithm tables, every student must have a copy of, as he can not do without them in the school, and may frequently require them in future life.

Models of solids, to illustrate the projection theory, are in the collection of the models of the school.

VII. PRACTICAL ARTILLERY EXERCISES.

The practical artillery exercises are intended, in the first place, to furnish the students with a sight of that portion of the material of the artillery which they have had no previous opportunity of knowing, and of which the knowledge is indispensable for a complete understanding of the theoretical lecture. The exercises should follow the lecture as immediately as possible, and occur therefore during the continuance of the theoretical course.

The students are besides to become acquainted with the methods of execution of the most important artillery duties, in an extent compatible with their position, and the time at their disposition. For this portion of the exercises, the months of July, August and September are to be preferred.

In the major part of these exercises, the engineer students take part, so as to gain a knowledge of such parts of the artillery service as seem to be of the greatest importance to them.

The artillery exercises separate into numerous subdivisions, of which the following may be particularly remarked:—

I. EXERCISES OF THE FIRST CŒTUS.

A. *Visits.*

The visits happen, as already noted, at the period of the theoretical instruction. The students are to be divided into as many sections as is necessary, that each may gain the desired information. There belong to this part—

a. Visiting the foundry and the boring machine. All the students of the first cœtus are to be taken by the artillery teacher of this cœtus, on two afternoons, to the foundry, and to the new boring machine.

They will see the general construction of the foundry and the boring machine, and, in case such work is going on, the molding, boring, and turning, and receive the explanations necessary.

b. Examination of ordnance, gun-carriages, and ammunition wagons.

Those in the arsenal, as well as the exercising pieces of the regiment of artillery of the guard, are to be used for this purpose, to exhibit the construction of ordnance both in the Prussian and foreign artilleries, and also those of an earlier date, from the specimens kept there. In the same way as has been remarked for the ordnance, the gun-carriages and equipages of the guard artillery regiment in store will offer opportunity for a more exact scrutiny of these carriages, limbers, and wagons. For these visits four afternoons are to be taken.

c. Visit to the workshops of the artillery:—

The students will, in two afternoons, gain there a knowledge of the following objects:

1. The mode of work in general.
2. Processes in the manufacture of the most important objects of artillery material, as axles, wheels, carriages, mountings, sponges, harness, ropes, &c.
3. The raw material (wood, iron, leather.)
4. Objects furnished to field, siege, and fortress artillery.

d. Visit to the small-arms factory and powder-mills in Spandau:—

The scholars of the first cœtus will be conducted into both manufactories, to obtain a general insight into the various works.

In order that the work of the manufactories may receive no interruption, the teacher of the first cœtus is to communicate beforehand with their respective superintendents, and take the students in suitable small parties, and before entering the powder manufactory to insist, most carefully, on all the proper precautions being observed.

These visits are to take place during the theoretical course on the same day as is fixed for the first cœtus to visit the fortress of Spandau to study its fortifications; and, therefore, an agreement should be made between the teacher of artillery and the teacher of general engineering.

e. Visit to the armory at the arsenal:—

The students are to be conducted on an afternoon to the armory of the arsenal, where the superintendent will explain to them the peculiarities of match

and wheel locks, with the most remarkable projects for loading at the breech, and with the form of small arms amongst other nations.

B. *Exercises.*

a. Examination of small arms:—

The students are to be taken by their teacher to the musket manufactory, where they will be shown the mode of proof of small arms in general, and with reference to the theoretical lecture then in progress.

Each student then receives a faulty musket, with direction to examine and note its defects. The teacher revises and corrects these notes.

b. The management of machines:

In the presence of the students the management of various machines, &c., as well as the repair of damaged carriages, will be undertaken. According to the means at disposal, such exercises will be selected as are most instructive, in exhibiting arrangement, strength, and care in their application.

The students will be permitted to lend a hand only in such cases as it is foreseen that their strength will be sufficient. For all other purposes where strength is necessary, workmen must be employed.

II. EXERCISES IN THE SECOND CŒTUS.

When the teacher judges proper, some of the previous visits are repeated on the afternoons disposable during the theoretical course.

A. *Marking out and Tracing Batteries.*

The students undertake these exercises under inspection of their teacher of artillery on two days in the last three months of the course.

The teacher instructs them then how to ascertain the prolongation of the enemy's lines, and the mode of determining the line of fire of the first embrasure of the different batteries, as well as the other points to be marked out, both with the use of the usual instruments, and with simple measurement by pacing, and laying down right angles by the eye.

A complete construction of a battery is not possible on account of the shortness of time, paucity of means, and strength of the students. The exercise, therefore, is confined to an explanation of the formation of the material and tool depôts; to marking out and tracing horizontal and sunk batteries on even, irregular, and sloping ground, and to the construction of the powder magazine.

B. *Practical Exemplification of the Rules for Placing Ordnance according to the Ground.*

These exercises are to be carried out on two afternoons by all the students, under the inspection of their artillery teacher.

They have only reference to the ground, and leave out of consideration all tactical considerations. This object may be fully attained even without guns, and the necessary instruction may be given without them, as it would not be easy to form all the batteries in the desired number.

The teacher chooses the ground, explains it by means of a plan to the students, and goes with them to the place. He divides them into various sections, and lets each select positions for from two to eight pieces, both for attack and defence with different kinds of ordnance, giving only generally the direction and distance at which the enemy is operating.

Each position is inspected by the teacher, and the views and reasons for it received and discussed as regards effect, mode of firing, and covering and free movement, and where it is necessary, improved; and at the same time the requisite precautions taken for the limbers and wagons.

C. *Drawings of Ordnance Carriages and Wagons.*

These exercises are to be undertaken by the artillerists of the second cœtus, under inspection of the teacher of artillery-drawing, on twelve afternoons in June.

The drawing of a piece of ordnance is to be clearly distinguished from the examination of it. For the first, taking the necessary measures is alone necessary, but not their comparison with given models.

The teacher will order these exercises, so that the students learn principally—

1. What scale they ought to take for a given object, so as to execute a drawing with the precision necessary for being afterwards worked from.

2. With what instruments and method of procedure they may most easily obtain their end.

3. How notices of improvements are to be taken and arranged.

4. How the rough draft is to be jotted down.

It must be here particularly remarked that our guns, carriages, &c., have no mathematically exact forms, and that therefore the number of measures to be taken must be often multiplied to have a true figure of the body.

A fair drawing from these measures in the above period is so much the less possible, as the number of objects is as much as possible multiplied. It is fully sufficient, however, for the purpose of this exercise, that the students learn to take complete and useful rough drafts.

On their entrance into the third cœtus, the complete drawings from these rough drafts take place.

In his selection of objects to be drawn, the teacher must, in having regard to variety, take care that the drawings by too great difficulty do not exceed the time and power of the students, nor by too great simplicity cease to be instructive.

Ordnance carriages, limbers, wagons, and the machines required in artillery, are the most suitable for choice, and are easiest obtainable in the arsenal.

The students must be divided into sub-sections, of at most three or four persons, and to each a separate task given.

The teacher is to be present at the drawings to see to their proper execution, and has delivered to him the notices and rough sketches to amend any errors that may be in them.

The relative section of the second edition of Burg's "*Drawing of Artillery Material*" is to be taken as the basis for these exercises. In addition to them, the students receive guidance and suitable instruction in drawing artillery objects off-hand by the eye, without the use of instruments. The first two days are to be chosen for this, and the students by this use of off-hand drawing receive at the same time a useful preparation for the drawings subsequently required to be taken by the aid of instruments.

D. *Exercises necessary in regard to Sieges—*

Are to be conducted by the teacher of artillery and special engineering jointly, and are given more in detail under *exercises in fortification.*

III. EXERCISES IN COMMON OF THE FIRST AND SECOND CŒTUS.

A. *Proof of Powder.*

This exercise is to be conducted by all the students of the first and second cœtus at the time of the gun-practice, and comprises—

1. Firing different sorts of powder from the proof mortar.
2. Firing different sorts of powder purposely brought into an abnormal state.
3. Instruction in weighing and measuring the powder.

B. *Artillery Practice.*

All the students of the second and third cœtus take part in the practice under the inspection of the two teachers of artillery, for which fourteen days in August and September are fixed. If possible, it is to be undertaken in the morning, and only when the practice-ground is otherwise occupied is it to be deferred till the afternoons.

The practice comprises—

1. The necessary preparation for firing; namely, laying down the platform, marking the range, fixing the targets, preparing the lists to note the shots.
2. Firing from different kinds of ordnance and with different projectiles.
3. Instruction of the students in the service of the guns; selection of the charge and direction under given circumstances, and their correction; effects of distance; noting and jotting down the shots and the time of flight; calculation of the length of fuse, of ranges and averages from the different data, and remarks on the effects sought.
4. Burning a portion of prepared laboratory materials for observation of its action and effect.

The following are to be objects of practice:—

a. Rounds of six, twelve, and twenty-four lbs. shot and shell out of the short 24-pounders, to note—

aa. The grazes, distances, and deviations at different elevations, and as regards ricochet fire.

bb. Probability of hitting upright targets at various distances.

cc. As regards dismounting.

dd. As regards firing against heads of saps.

b. Seven, ten and twenty-five lb. shells, carcases, and light balls, to note—

aa. The grazes, distances, and deviations at different elevations and charges, also as regards ricochet firing.

bb. The probability of hitting upright targets at various distances.

c. Shells, carcases, and light balls from mortars, to note—

aa. The probability of hitting upright targets at different distances.

bb. The calculation of the charge or elevation when one of these elements and the distance are given, or *vice versâ*.

cc. Calculation of lengths of fuse for given distances.

d. Throwing hand grenades, stones, 1-pound case shot, and 3-pound balls at various distances for comparison of the effects.

e. Firing from the hand and stock-mortars at differing distances.

f. Case shot from 6 or 12-pounders, also from short or long 24-pounders and 7 and 50-pound howitzers at different distances against planks, and both with case shot, and grape shot, for observing the effect:

aa. Of different charges.

bb. Of different weights of the entire case.

cc. Of the weight and size of balls used.

dd. There is also to be observed the scattering, the number of hits and wide balls, and determination of the best line.

g. Shrapnel shells from field-pieces against planking.

5. The number of the before-named rounds is not to be too great, partly not to increase expense, partly in regard to time, since the practice is intended for instruction, and therefore not to be hurried. Still for shot, shell, and grape shot, ten rounds is the *minimum* if a result is to be drawn; for the small mortar five rounds are sufficient.

Notwithstanding this limit, it will not be possible to take the practice all in one year. It seems, therefore, expedient to divide the whole into two portions, so that the most important practice happens indeed in each year, generally however, in one year the practice is to take place with field-pieces, in the following year with siege-pieces, so that the student who is present once in the first year and once in the second can complete the necessary course.

The teachers have, therefore, to determine, in the proposed plans for these exercises, the sort and number of rounds they judge necessary for the following year.

C. *Practice in the Laboratory.*

As the students of the artillery, by the present regulations of their education in the regiments, have not sufficient opportunity to learn the service of the laboratory perfectly, particular attention must be paid to this work in the school.

The students of the engineer corps also take part in it, in the second cœtus, not to become perfect proficients in the different operations, but so as to gain a general knowledge of ammunition, matches, and compositions, and the duties of the laboratory.

All the students of the first, and the artillery students of the second cœtus are therefore to be occupied by their teachers for twelve afternoons in the laboratory.

For the superintendence, so necessary in these works, and for variety of practice, the fireworkers employed as assistant teachers in the school, and others from the proof department of the artillery, and also five or six artillery officers of the third cœtus, are to be present at this practice, so that each of these students is present twice or thrice on the average.

The work embraces, first, the preparation of ammunition for the artillery practice, &c.

But as this would not suffice for the complete instruction of such a large number of students, it must receive an extension calculated for this purpose, and embrace not only the separate preparations, but also a large quantity of ammunition, which, as not required for the school, is therefore sent to the depôt.

The following work is to be preferred:—

Pounding of saltpetre, grinding meal powder, pounding sulphur and charcoal, boiling paste, making mastic, composition, quick-match, fuses, tubes, portfires, carcass composition, touchpaper, case and grape shot, loading shells for bursting, discharging empty shells in which a fuse only has been driven; carcasses, fire-balls, and light balls: infantry, cavalry, buck-shot, and percussion

cartridges; ball, canister, howitzer, and paper cartridges. Fanal, signal rockets, pitch compounds, powder bags, and stink-pots. The teacher is to make a careful distribution of the students, (allowing for such as have missed any days by illness,) to be satisfied that each artillerist has made every article in the laboratory, if possible, or at least has carefully witnessed its preparation.

IV. EXERCISES IN THE THIRD CŒTUS.

All the exercises of this cœtus take place during the period of the theoretical course.

A. *Visit to the Workshops.*

The student will have to learn the mode of proceeding, the construction, and the use of the machines employed. Examination and storing of the most important raw materials.

B. *Visit to the Iron Foundry.*

All the students of the third cœtus are to be divided into two sections, and each section to be conducted on an afternoon under the care of the teacher of artillery concerned to the Royal Iron Foundry.

They will see there the molding, casting, and cleaning of case shot, cannon balls, and shells.

They will also have explained to them the construction of reverberatory and cupola furnaces, of steam engines, and of turning lathes, and planing benches.

C. *Visit to the Foundry and Boring Machine.*

The students of the third cœtus are to be present at the actual manufacture of cannon, their molding, casting, and boring. But as the circumscribed room and other considerations will not allow all the students to be present at one time, different divisions are to be formed, to visit the foundry and boring house on different days. The teacher concerned, will, therefore, make the necessary inquiries as to the time when the above works are going on, and arrange the visits by communication with the director.

The casting and preparation of iron ordnance require particular attention. On this, too, the teacher has to obtain information, and proceed as above.

D. *Examination of Iron Ammunition.*

The artillery officers of the third cœtus take these exercises in hand on two afternoons, under care of the artillery teacher in the same cœtus.

The purport of it is not so much a thorough instruction in this manufacture, as a completion of the theoretical lectures on the mode of conducting the processes by means of personal inspection and handling of the instruments. The teacher will pay particular attention to the errors that may occur in the measurements, &c.

E. *Examination of Cannon.*

This exercise is to be undertaken by the artillery officers of the third cœtus, under the inspection of their artillery teacher, in six afternoons. The object of it is exactly the same as of the foregoing.

The exercise must commence with directions for proving the instruments, when the teacher will show the mode of their manipulation.

As the use of such instruments only can be reckoned on as the school, the depôt, and the artillery proof department possess, only three sections of the

students can work each day simultaneously; the section consisting, at the utmost, of six persons, if individual handling of them is presumed necessary.

The teacher must, therefore, divide the students into sub-sections, and make such arrangement that each student, if possible, personally work every part of the exercise, or at least have a perfect sight of it.

That portion of the students which can not be immediately occupied on each exercise day, put their tables of dimensions in the order and forms required by the regulations.

F. *Examination of the Gun-Carriages and Wagons.*

The exercise is to be conducted by the artillery officers of the third cœtus, exactly as the foregoing, in five afternoons.

G. *Practical Exposition of the Rules for the placing of Guns according to given Tactical Relations.*

These exercises are to be performed by the artillery students of the third cœtus, under the direction of their teacher of artillery, on four afternoons.

The teacher makes known the ground by means of a plan; he then directs reconnaissances to be made, and receives the reports.

He selects a tactical problem, the nature of which offers opportunity to remark both on the placing of guns of different calibres, and also the reserve artillery at the decisive moment of a battle, as well as the more minute details of placing single divisions and guns, and the limbers, riding horses, and wagons.

Before he solves himself the problem completely, he gathers the opinions of the students in respect to single portions, and if necessary sets them right.

The principles to be followed refer so specially to the ground, that the object of illustrating the instructions can be attained without guns. The teacher may therefore content himself with marking by flags the situation of single guns and batteries, by which the advantage is obtained of an easier use of the ground.

II. *Exercises at Spandau in reference to a Siege.*

These exercises are to be conducted by the teacher of artillery, in unison with analogous regulations of the teacher of engineering, and are more particularly mentioned in the practical exercises of fortification.

The limits of time and means render it impossible to gain for the above-named exercises that extent by which the full acquirement of the necessary mechanical readiness could be insured. It is sufficient if the student has made a perfect personal examination and performed as much manipulation as circumstances permit.

The separate practical exercises can only be made after the termination of the theoretical treatment of the subject. This rule is necessary, partly because this practice is only a continuance and completion of the lecture, partly because the shortness of time restricts the exercises considerably, and therefore the days devoted to them can not be applied to theoretical explanations, which will be more profitably given in the lectures.

Where the nature of the exercises permits, the officers and elder *portépée ensigns* will take the superintendence, that having formerly learnt the execution, they may now make themselves acquainted with the duties of ordering and inspection.

The number of students engaged at one time in an exercise ought not to be so large that a portion of it remain unoccupied or not under the complete inspection of the teacher. The disturbances that occur too easily in such cases, being most injurious, must be most carefully avoided. The teacher will make the division above stated, and take all necessary measures for obtaining the requisite control.

If, at any of the exercises, danger can arise to the students, the teacher is previously to instruct them specially in what is to be observed for the safety of the workmen; after that, the superintendence of the students must be conducted with increased care, and any departure from the given orders visited with redoubled severity.

The determination of the days for these exercises rests with the director, after consulting the teachers. Should unexpected hindrances prevent the carrying out an exercise, the teacher may determine concerning it, but must consult with the Direction as to the fetching it up on another disposable day.

The necessary workmen will be demanded by the Direction from the respective services, of which the teacher will give to the Direction due previous notice.

The guns necessary for practice are to be lent by the Artillery Regiment of the Guard and the Artillery Depôt; all the other instruments, equipments, &c., are borrowed from the Depôt. All materials are received by order of the war department or by purchase. It is therefore the business of the senior of the two Artillery teachers, in his yearly demand for the practice, to state the full requirement of tools and materials, that the Direction may take timely measures for their supply.

VIII. PRACTICAL EXERCISES IN FORTIFICATION.

Practical exercises in fortification stand in immediate relation to the lectures on fortification, sieges, and field engineering. They complete, as far as possible under given circumstances, the theoretical lectures by personal view; they also offer the students opportunity for solving fitly chosen problems, to apply what has been learnt, and to prepare by reflection for practical service.

The exercises are to be conducted in each cœtus by the teachers who lecture on Engineering. The presence of the Artillery teacher is elsewhere separately noted.

A. THE EXERCISES COMPRISE—

a. *For the First Cœtus.*

1. In unison with the teacher of Artillery and of General Engineering, the examination of the fortress of Spandau, to make clear to the students the combination of the details of a complete fortress from an actual example.

2. Examination of the models of fortresses and their details in the Arsenal, to make clear the principles of a siege.

3. Visiting the exercising-ground of the Engineer division of the guard in all its details.

4. Marking out, tracing, profiling, calculation of the cubic measurements, of the time for building, of the number of workmen, and of the garrison for given fortifications on ground near Berlin.

5. Being present at the exercises of the Engineer division of the guard in sapping, mining, building redoubts, laying bridges, and their instructions.

b. *For the Second Cœtus.*

1. Examining the models in the model-house, partly to illustrate the systems taught, partly to show the influence of ground on the situation, form, and contrivance of the works; and again to explain by the aid of the necessary notices of the sieges of these fortresses the choice of the fronts of attack, and other matters relating to sieges.

2. Problems on the ground for sieges, such as may happen, to a subaltern officer, as simple as possible, but to be solved clearly and exactly.

These exercises refer principally to the marking out of parallels, zig-zags, and saps, as well as marking out and tracing siege batteries. They are to be undertaken under the united direction of the teachers of Special Engineering and of Artillery on the exercise ground of the Guard Engineer division.

3. Problems on field fortification, not too comprehensively drawn out, but of which the solution should be the more complete. Here belong, *e. g.*, the fortifying of a house, a farmstead, a bridge, or other defile, covering of an advanced post, &c., &c.

c. *For the Third Cœtus.*

1. For the Artillerists:—Exercises in reconnaissances of fortresses. Fixing the points for laying down batteries of attack. Statements of the arming of detached works against *coups de main* and formal attacks. Sketches of instructions for subordinates in particular cases. Construction of ammunition and other depôts in and before a fortress. Under the guidance of the Artillery teacher of the third cœtus, with regard to the analogous regulations of the teacher of Exclusive Engineering.

2. For Engineers:—*a.* Reconnaissance of Spandau in reference to projects in permanent and field fortification, as well as military architecture and hydraulic works, under the guidance of the teacher of Exclusive Engineering, with the assistance of the teacher of Fortification-drawing.

b. In conjunction with the Artillerists, reconnaissance of Spandau for fixing a front of attack, securing its investment by field fortification adapted to the ground. Placing the depôts of material. Marking out the first parallel, with its communications, as well as the subsequent works of attack. Measures of the defenders, special discussion on arming the works on the spot. Under the guidance of the teacher of Exclusive Engineering, having regard to the analogous regulations of the Artillery teacher in the third cœtus.

B. FIXING AND APPORTIONING THE TIME.

a. *For the First Cœtus:—*

1. The visits prescribed in 1 and 2 for this cœtus are to be made in spring, whilst the theoretical course is going on, and for them are fixed,	2 days.
2. The further exercises under 3, 4, and 5, are to be taken in the summer months; to them are allotted, for the visit at 3,	1 "
To the exercises at 4,	5 "
To " at 5,	6 "
Total,	14 "

b. *For the Second Cœtus:—*

The exercises under 1, 2, 3 for this cœtus, are to be held in the Summer, and are thus regulated:—

For the visit at 1,	2	days.
To the exercises at 2,	2	"
To " at 3,	8	"
Total,	12	"

c. *For the Third Cœtus:—*

The exercises ordered for this class are to take place only in Spring, whilst the theoretical instruction is going on, and for it are fixed:—

1. For exercises by the Engineers alone,	2	days.
2. For those jointly by Engineers and Artillerists,	3	"
Total,	5	"

The days of the calendar for these exercises are to be proposed by the teachers when delivering in their annual sketch of exercises, and their propositions will be laid by the Direction before the authorities for their approval.

To engage the pupils to work they are to be divided for the visits and exercises into suitable sections. Each section receives its problem from the teacher, who also nominates the president of the section. This president distributes the sub-sections among the other students, and sees that the work to be written and drawn is finished in the required time, signed by the author, and is delivered by him to the teacher. Great care is to be taken that single students do not remain unoccupied; the disturbances thence only too likely to arise are always injurious to the instruction and the discipline. In giving out problems, their principal conditions only are to be designated by the teacher, and the development left entirely to the student, or with little aid from the teacher, in order that the student may gain early that confidence and independence necessary to the soldier in carrying out matters committed to his charge.

In the exercises the workmen demanded for marking out, are to be limited as much as possible, as the students must perform the greatest part of the work themselves. The number indispensably necessary will be demanded in time by the teacher from the Guard Engineer Division through the Direction.

The necessary material, if the Guard Engineer Division can not furnish it as a loan, may be purchased at the charge of the school.

THE WAR OR STAFF SCHOOL AT BERLIN.

BY GENERAL VON HOPENER.

I. OBJECT, PLAN AND STAFF OF THE INSTITUTION.

The War School (*Kriegs-Schule*) is intended to receive officers of all arms, who during three years of active service have given proof of ability and of particular capacity. They find there the means for acquiring the knowledge requisite for the higher ranks of the service, for the duties of officers of the staff, and for all other appointments which demand military and scientific studies of a higher and more general character than the common ones.

The course of study is for three years, and is divided amongst three classes. The courses begin on the 1st of October, and continue to the 1st of July. The number of officers who can be received is 120, neither room nor means of instruction sufficing for more. The three months of vacation in the summer are employed by the pupils in learning the service of those arms of the profession to which they do not belong.

The Special Direction of the War School consists,—

(*a*) Of the Military Direction.

(*b*) Of the Direction of Studies.

The Military Direction consists of a director, a field officer connected with the direction as inspector, and an adjutant, who directs the accounts of the Institution.

The military director is supreme, both over the military officers who are members of direction, and of the military officers who are studying in the school. The police, the discipline, and all the administration of the Institution are under his control. All the subordinate officers in the house are under his orders. The field officer attached to him is charged to look carefully to the discipline and to the due attendance at the lectures. The adjutant directs the correspondence and accounts of the establishment. The whole of the staff and the military directors are lodged in the school.

The Direction of Studies is in the hands of three field officers of literary and scientific attainments, and of two other persons, civil-

ians of Berlin, of high literary reputation. Its president is the senior officer, who is generally also the military director. It has also a secretary attached to it.

The Direction or Board of Studies is exclusively intrusted with the care of everything affecting the teaching of the Institution, and its members are bound to be frequently present at the lectures. It has also under its inspection all the means and objects required for teaching, such as the library, the collection of maps and models, the collections for physical science, and the laboratory.

The Director of Studies selects the professors of the Institution, recommends them to the superior authorities, and in case of their appointment gives them their instructions.

At the beginning of each course the direction fixes the plan of the lectures, and if any alterations in them are required, proposes them to the superior authorities for their sanction.

The Direction of Studies regulates the examinations which the officers who are candidates for admission into the school are to undergo. With this view it draws up a certain number of subjects and questions suited for the purpose, which it sends, in the spring of each year, to the chiefs of the staff of the different Corps d'Armée, in whose presence the candidates do their work. Those of the candidates whose work is satisfactory are entered at once in the school.

In order to take account of the progress of the students the board of studies makes them pass an examination in writing at the end of every three months; makes a revision of the judgment of the professors upon the papers, and conjointly with the military board of direction, gives certificates at the end of the triennial course to the officers who have gone through it completely. In these studies it is the part of the board of studies to give a judgment on the scientific merit, and that of the military board to judge the moral conduct of the officers.

The two boards make a report yearly on the progress and the conduct of the officers of the school. This report is submitted to the king by the minister of war. Particular mention is made of those officers who by extraordinary success have deserved his majesty's favor.

II. SUBJECTS AND AIDS OF INSTRUCTION.

Attendance on the different courses is partly obligatory, partly compulsory, with this restriction, however, that every student must attend twenty lectures a week, given before 12 o'clock, including the obligatory courses. These last are those of the purely military

sciences, and for the first class those of mathematics. As it is impossible for most of the pupils to give sufficient attention to all the courses to be examined in them at the end of each three months, they are allowed to select those of the courses which they may choose to follow. But this choice once made must be adhered to.

The instruction is divided into theoretical courses and practical exercises.

The theoretical courses comprehend all the subjects which come within the object of the Institution. They are the following :—

1. Mathematics, a course of three years, six lectures a week, half employed in statement of the theory, half in the practical application.
2. The Higher Geodesy, in the third class, three lectures a week.
3. Physical Geography, in the first class, two lectures a week.
4. General Geography, in the first class, four lectures a week.
5. Special Geography, particularly that of the probable theaters of War for Prussia, in the second class, four lectures a week.
6. Universal History, in the first and second class, four lectures a week in each.
7. General History of Literature, in the third class, four lectures a week.
8. Logic, in the second class, four lectures a week.
9. Physical Science, in the second class, four lectures a week.
10. Chemistry, in the third class, four lectures a week.
11. Physiology of the Horse, in the second class, two lectures a week.
12. Tactics, in the first and second classes, four lectures a week in each.
13. Artillery, in the first class, three lectures a week.
14. Fortification, a course of three years in the three classes. In the first class, Field Fortification; in the second, Permanent Fortification; in the third, the Conduct of Sieges; two lectures a week in each class.
15. Military Administration, in the first class, two lectures a week.
16. Military History, in the third class, seven lectures a week.
17. Duties of the Staff, in the third class, three lectures a week.
18. Military Law, in the third class, one lecture a week.

All these lectures are given in the morning, between eight and one o'clock.

19. The French Language, a course of three years in different classes; into each of which the pupils enter according to the knowledge they possess of the language; six lectures a week for each class.
20. The Russian Language, four lectures a week.

The above two courses are in the afternoon.

The practical work is done after the end of the courses of the second and third classes. They consist in making the officers draw plans for military objects, make sketches of ground.

These exercises are completed by a journey of fifteen days under the conduct of an officer of the staff, in order to teach the service of an officer of the staff in the country.

The instruments of teaching consist of—

1. A library for the use of professors and students, and a collection of maps and plans, all under the charge of a librarian living within the school.

2. A collection of models for the courses of artillery and fortification, under the care of a commissary of the school.

3. A cabinet of physical science, under the direction of a professor lodged in the house.

4. A laboratory and chemical apparatus, under the direction of a professor of chemistry.

There are no manuals specially used for the instruction.

For the courses of geography and of the history of war, the direction furnishes the pupils with the plans and maps required, as far as the means of the Institution allow it, or it procures them at moderate prices, to be repaid by instalments.

PROFESSORS AND STUDENTS.

The officers acting as professors in the school are officers of mature age, and high education, chosen from the garrison of Berlin. The teacher of the duties of the staff, must always belong to this corps. They are appointed to their work in the school for an indefinite time, without prejudice to their other duties.

The civil professors are generally chosen from those of the Royal University at Berlin.

With regard to discipline, all the professors are subject to the board of military direction; with regard to teaching, to the board of direction of studies.

Every professor is bound upon entering on his functions to lay before the board of direction of studies a programme stating the bearing, the successive subjects, and the arrangement of his course. This programme must be approved by the direction.

The payment of professors is fixed according to the number of their weekly lectures. It is less for the professors of Language, as they require less time to prepare their lectures.

The students of the school are under the immediate authority of the military direction; but they are ordered to look upon the professors, whilst engaged in their duties, as their superiors, so that offences against them are subject to military law.

Permission to follow the courses of the school involves for every officer the obligation to serve two years in the army for every year passed in the school.

Although the complete course is for three years, officers do not always continue it for more than one year. At the end of the year those only are allowed to return who have shown themselves deserving of this favor. Students lose the right of continuing their studies who neglect their lectures, or show indifference and a want of interest in their work, who come often too late, avoid the duties imposed upon them, or endeavor to escape their examinations.

PRUSSIAN STAFF IN 1869.*

The Prussian Staff (*Generalstab*) which has been completely reorganized since the war of 1866, subserves the double purpose of providing staff officers for the duties of the active army, and of collecting and arranging the statistical, geographical, and historical information necessary for the operations of war; further, it is the school in which young officers temporarily detached from their regiments, after a course of instruction at the Military Academy, have their qualifications tested before admittance to this branch of the army, and the principal office of the trigonometrical survey of the Eastern Provinces.

The head-quarters of this organization are at Berlin, where a large building is appropriated to the various offices and departments, in which the chief of the staff, General von Moltke, resides. It has two establishments:—

1. The peace establishment, divided into—
   A. Chief *état*, subdivided into
      (*a.*) The staff of the commands.
      (*b.*) The general staff, or *grosser Generalstab.*
   B. The accessory *état, neben Etat.*
2. The war establishment.

The staff of the commands is so complete during peace as to require a very unimportant augmentation, and that chiefly in the lower grades, on the outbreak of war; the framework not only exists, but the officers comprising it are already acquainted with the generals under whom they serve, and with the officers and troops with whom they have to communicate.

At the head-quarters of each corps there are: a chief of the staff—sometimes a Major-General, more frequently a Colonel, exceptionally a Lieutenant-Colonel—a field officer, and a captain; at that of each division a field officer; there is also a chief of the staff with the General Inspection of the artillery. The subordinate duties are performed by the aides-de-camp, of whom there are two at the head-quarters of each corps, and one with each division and brigade; but these officers are not included in the establishments of the general staff, and wear the uniform of their respective regiments; are in no sense of the word aides-de-camp as existing in the English army; they bear the designation of *Adjutant*, and may more properly be compared to our Deputy Assistants and Brigade Majors: indeed the solitary Adjutant is the only assistant to the Major-General in the performance of the brigade duties. In the time of war the staff is further supplemented by *Ordonanz Offiziere* attached as aids to the general officers in command.

The *Grosser Generalstab* includes the officers of the staff who are not employed with the commands, and is stationed in Berlin under the personal direction of the chief of the staff. The *Neben* or *accessory Etat* includes the officers employed in the strictly scientific work allotted to this department.

The combined staff at head-quarters is subdivided as follows:

a. The three Sections;
b. The section for military history;
c. Trigonometrical section;
d. Topographical section;
e. Geographical-statistical section;
f. The map-room.

The three sections have the object of collecting and arranging information respecting the home and foreign armies. The home subjects to be treated are

* By Col. Beauchamp Walker, C. B. 1869.

the means and warlike institutions of the State, its fortresses, magazines, ports, inland communications, the organization, recruiting, mobilization, armament, equipment, and drill of the army. The warlike systems of foreign nations, the strength and organization of their armies, regulations, and drill, the distribution of the troops, state of preparation for active service, and their systems of reinforcement and reserves, are the further subjects of inquiry. For these purposes the work is divided as follows, according to the division into—

1*st Section.*—Austria, Russia, Sweden and Norway, Denmark, Turkish Empire, Greece, Asia.

2*d Section.*—Prussia and North Germany, South Germany, Italy, Switzerland.

3*d Section.*—France, Great Britain, Belgium, the Netherlands, Spain, Portugal, America.

The number of officers actually belonging to the two categories of principal and accessory establishments of the staff is 115, of whom 94 belong to the first, and 21 to the second named branch. In the first there are 17 chiefs of the staff—viz., 13 with the army corps, one with the General Inspection of the artillery, and three at the head of the three sections—47 field officers, and 29 captains. In the accessory establishment there are four chiefs, five field officers, and 12 captains.

The office establishment, inclusive of the Engineer geographers—who are non-commissioned officers of the Artillery or Engineers serving permanently in the trigonometrical section in place of the officers who were till recently employed temporarily in this office, and of whom there are at present 10—consists of 18 permanent officials, not including a head messenger, two chancery servants, two house servants, and a porter.

The supernumeraries comprise 40 officers attached for a year, 20 for duty with the staff generally, the remainder for surveying; 34 surveyors who are only employed during about five months in each year, and 41 draughtsmen.

The pay of the permanent staff amounts to 206,150 thalers, or 30,922*l.* 10*s.*, the material expenses being 62,250 thalers, or 9,339*l.* 10*s.* Of this latter sum about two-thirds is required for office and surveying expenses; 17,000 thalers, or 2,550*l.*, are allowed for the annual journeys of instruction undertaken by the staff, and 3,000 thalers, or 450*l.*, for allowances to officers traveling for scientific or professional purposes.

The actual sum disbursed for office and surveying purposes is 47,450 thalers, or 7,417*l.* 10*s.*, of which 7,000 thalers, or 1,050*l.*, are recovered by the sale of maps and works published by the staff, 2,000 thalers, or 300*l.*, being derived from the profits of the bi-weekly military paper, "*Militair Wochen Blatt.*"

Besides the duties already mentioned, the staff at head-quarters undertakes:

1. The training of officers for staff purposes. To this end young officers who have passed the prescribed three years at the Military Academy, "*Kriegs Akademie,*" are attached for a year to the different sections, where they are required to draw up reports on strategical and tactical questions, critical reports on the military events of past eras, descriptions of the ground embraced in military operations, and of the military organization of foreign countries. These essays, when of special value, are laid before the chief of the staff.

2. The preparation of printed reports on foreign armies, which are distributed to the staff officers employed elsewhere.

3. The contribution of papers on professional subjects to the "*Militair Wochen Blatt,*" or military paper.

This publication, which appears twice a week, was formerly edited in the office of the staff, but has lately been in the hands of a responsible editor, a colonel on half-pay, who stands, however, in intimate connection with the office. The contribution required from the staff is twenty sheets of printed matter annually from the various departments, a much larger amount being furnished, from which the chief selects what he considers suitable for publication.

4. Military tours of instruction, for which a sum of 2,550*l.* is annually granted.

All the officers who can be spared from the duties of the office take part in these tours, as also a few staff officers called in from the commands, and a selection from the commanders of regiments.

They are also made on a smaller scale by the staff of the Corps, augmented by regimental officers attached for instruction, under the superintendence of the respective chiefs of the staff.

For the tour superintended by General Von Moltke, the theatre of operations and certain conditions likely to influence them are indicated, a supposed strength is given to two opposing armies, their depots and means of reinforcement are clearly laid down, and the influence likely to be exerted by the movements of other armies or bodies of troops on their flanks are taken into calculation. According to these data the senior officers present make their plans of manœuvre, employing their juniors in the preparation of all the subordinate arrangements, the movements of the troops, the selection of positions for attack or defense, the arrangements for supply, and for retaining a communication with the base. All these measures are carried out on the spot, and daily reports are made to the superintending officer, which, when necessary, are accompanied by such rough sketches as are usual during the progress of a campaign.

From these materials he is enabled to form an idea in what degree the spirit of the operations has been grasped by the directing officers, and in how far their juniors are instructed in the details of duties which they may hereafter be called on to perform.

5. A large share in the military education of the army generally, by taking part in the lectures given in the various educational establishments, and by acting as members of the commissions of examination and of studies.

6. Officers of the head-quarter staff are also detached to attend the annual corps manœuvres, those taking place in foreign countries, or the active campaigns of friendly allied nations.

Of the three sections into which the head-quarter staff is divided, the railway department forms part of the second of these sections, the chief of which selects an officer to preside over and superintend the working of it, and gather materials on inland and foreign railway communication. Certain officers are attached permanently, similarly, in fact, to those belonging to the sections of the accessory establishment, who have not only to make themselves theoretically masters of their subject, but by traveling on the various lines acquire practical acquaintance with the working of railway transport in all its phases. With a view to diffusing this knowledge as largely as possible, all officers of the staff have since 1867 been required to attend a six weeks' course of study with this branch.

The section of military history has charge of the war archives of the Prussian army and of the library of the general staff, for additions to which latter a sum of 1,100 thalers, or 165*l.*, annually, is voted.

The staff of the section is occupied not only with subjects of recent and immediate interest, but with the study and arrangement of materials belonging and relating to the wars of earlier date, of which there is a valuable collection, consisting of reports, day-books, plans, and other documents, many of them legacies of the prominent actors in the scenes to which they relate. The library is well supplied with the most important works in all languages on military history, tactics, geography, and military science.

The trigonometrical and topographical sections stand in intimate connection with each other. Since 1865 the former is charged with the survey of the Eastern Provinces, a work which it is hoped will be concluded in ten years, under the direction of the chief of the staff.

Under the present organization there are always forty young officers attached to the head-quarter staff, but only for one year, their absence from regimental duty having proved detrimental, while the current work is naturally better executed when carried out by permanent *employés*, thus avoiding the interruption caused by constant reliefs.

The geographical-statistical is a new section, the necessity for which arose from the overcrowding of other branches, particularly of the map-room. So much material had accumulated in the other branches that it was found necessary to establish a section in which the scattered information could be condensed in the form of statistics. To this end the former geographical subsection was altered into its present form with an enlarged sphere of work, and the charge of the collection of maps was transferred to it from the map-room, which had become so much overcrowded with old materials as to have neither room nor time for the ordinary business of taking charge of the current surveys and of the maps and charts intended for distribution to the army.

With a view to facilitating the collection of the best geographical and statistical materials all the sections are placed *en rapport* with the new section, to which they are required to forward all special material coming under notice, and all books or pamphlets which contain geographical or statistical information. This section stands also in constant communication with the civil statistical bureau.

The duties of the "*Plankammer*" (map-room) are now restricted to the care of the topographical instruments of the original surveys of the topographical section, of new maps prepared for distribution, and of the financial business of the general staff. All the scientific duties of the map-room have passed over to the geographical statistical section.

There is no regulation on the admission of officers to the staff, nor is there any direct preliminary examination. They are selected from:—

1. Those who have completed the prescribed course at the Military Academy.
2. Those who notify their desire to enter the staff.
3. Those who are recommended by their superiors as officers likely to become useful staff officers.

The year of probation at head-quarters, already mentioned, affords the opportunity of forming an opinion as to the capabilities of these officers, who at its conclusion return to their regiments, where they are usually employed as adjutants, or, on the occurrence of vacancies, with the brigades, divisions, or corps.

PRUSSIAN MILITARY EDUCATION IN 1869–70.

CHANGES SINCE 1856.

THE following remarks are gathered from the "Report of the Military Education Commission presented to both Houses of Parliament," in 1870, in continuation of the Report submitted in 1856, on the Systems of Military Education in France, and Prussia.

1. The chief alterations that have taken place in the system of military education in Prussia since 1856, are as follows:—

(*a.*) All the educational establishments have been very much enlarged, owing to the increase in the army which has taken place since 1866.

(*b.*) The educational requirements for a commission remain in principle the same as they were—the double examination for the rank of officer, and the exaction from every candidate for a commission of proof of both general and professional knowledge being still the peculiar feature of Prussian military education. There has been, however, a constant tendency to raise the standard of the preliminary examination in subjects of general knowledge, and to insist more strongly upon a sound liberal education as a condition of obtaining a commission. The number of *Abiturienten*, or men who have passed through the complete course at a public school, entering the army annually is now four times as great as it was in 1856, and there is the strongest wish still further to increase their number.

(*c.*) The Cadet Schools in their general character are unaltered; the introduction of the peculiar class of the Ober-prima in the Upper Cadet School at Berlin is the most important modification made in their organization. The proportion of officers supplied by the Cadet Schools continues much the same as it was in 1856. The feeling in the army, however, against preparatory military schools appears to be increasing; a strong opinion is entertained as to the narrowing effects upon the mind of exclusive class education; and a preference is very generally exhibited for officers who have had the ordinary education of civil schools. At the War Schools (*Diossi, on Schools in* 1856), the Artillery and Engineer School, and the War Academy (*Staff School in* 1856), a decided opinion was expressed as to the intellectual superiority of the *Abiturienten* over those who have been educated in the Cadet Corps.

(*d.*) The arrangements for the professional instruction of officers of corps have been very much altered. These officers now have their education up to the time of obtaining their commissions in common with candidates for the line; their *special* instruction does not commence at the Artillery and Engineer School until they have been in the service three or four years. For the Artillery, the course at this school has been reduced to one year, and made strictly practical in character.

(*e.*) The course of instruction at the War Academy, or Senior Department, has been considerably modified; though still comprising many subjects of an entirely unprofessional character, their number has been reduced; the attention of the students is more concentrated upon military studies than formerly, and a larger amount of time is devoted to practical work. In short, the object has been to render the instruction less purely theoretical than it formerly was.

(*f.*) The most important change, however, which has been made is in regard to the War Schools—the Schools at which officers of all arms receive their

professional instruction. Since 1856 they have been entirely re-organized, and placed under the direct control of the Central Educational Department; a much higher class of teachers are employed; the character of the instruction has been greatly improved; and attendance at one of these schools is, with rare exceptions, made compulsory upon every one before obtaining a commission. These schools hold a most important position in the Prussian system of military education, and the greatest pains are bestowed on making them answer the purpose for which they are intended—that of giving a thoroughly practical instruction in military subjects to candidates for commissions. The improvements made in the War Schools show the greatly increased importance attached of late years in Prussia to the professional instruction of officers.

2. However different the French and Prussian systems may be in some respects, they both agree in this—that no attempt is made to give a special military education at an early age, that a general education is made the ground-work of the professional training, and that at least up to the age of 17 or 18 the future officer receives the same kind of education as the civilian, and in the great majority of cases receives it at the ordinary schools of the country. In Austria, also, the same principle seems now to have been adopted. The cadet schools in Prussia are no exception to the rule, for the instruction at them, except in the two upper classes at Berlin, is the same as at civil schools. The principle of deferring military education to a comparatively late age is, indeed, in Prussia carried even to a greater extent than in France, for all professional instruction is postponed until after the service has been entered, and regimental duty been performed for nearly a year. The few who enter the army from the Ober-prima and Selecta of the Cadet Corps (not amounting to 70 each year) are the only individuals who receive any military instruction before joining the service, and in their case this special instruction does not commence until the age of 17. So strongly is this principle insisted upon, that even for the artillery and engineers there is no preparatory military education, and the special instruction of the officers of these arms is not given until after they have been some years in the service. The idea in Prussia is that a young man can derive no advantage from studying the *theory* of the military profession until he has learnt the *practice* of it. "What use can it be," it was said, "to talk to a lad of the principles of tactics, when he does not even know the movements of a battalion, and perhaps has never seen one on parade?"

3. After, however, entering the service *all* the officers of the Prussian army receive a careful professional instruction—that given at the War Schools. The course is of an essentially practical character, comprising only strictly military subjects, and excluding such studies as mathematics and even languages.

4. The officers of the staff do not necessarily receive any special training previous to their appointment; but in Prussia this is of less importance, as from the professional education which every officer has had, those appointed to the staff, even if they have not passed through the Senior Department, must at least be acquainted with field sketching and military regulations, and know something of fortifications and artillery. Moreover, after appointment, means are taken in the "staff expeditions" which occur annually, to instruct them in their practical duties, and (as is the case also in France with the officers of the Staff Corps) to insure their keeping up the knowledge of field sketching and reconnaissance which they had previously acquired.

5. The connection which exists in Prussia between the military system and the general education of the country is remarkable. *Portefée-fahnrich*, exami-

nations are not only based on the course of instruction at civil schools, but have been also used as a means of raising the character of the education given at these schools. On the one hand, the advantages offered to *Abiturienten* and to those who have been at a university, indicate a wish to encourage men of liberal education to enter the army as officers; on the other hand, by making exemption from the ordinary period of compulsory service in the ranks dependent (among other conditions) on educational attainments, the military system has been employed as an engine for stimulating education among the middle classes.

6. The general management of military education is vested in a single officer, the Inspector-General. He is assisted by two Boards or Councils, the Board of Studies in matters connected with the general system of instruction, and the Supreme Examination Board in regard to the examinations and qualifications for commissions. The system of education has been still further centralized since 1856, especially in the case of the War Schools; and much of the progress that has been made is ascribed to the unity now given to the whole system of instruction. At the same time each of the educational institutions has its own Board of Studies, similar to the *conseils d'instruction*, at the French schools, who are charged with the general control of the course of study and with the duty of making suggestions for its improvement. Several of the professors, both civil and military, are always members of this Board; so that the benefit of their practical experience is secured, and the control of the instruction is never left entirely in the hands of one man, nor even exclusively of military men. The introduction of the civilian element into these Boards is deserving of notice; not merely the professors of the schools, but eminent men connected with the University of Berlin are employed upon them, and have a voice in determining the system of military education.

7. In discipline the heads of the various schools are almost entirely supreme. At the War Schools the young men are subject to military law, being already in the army; at the Cadet Schools this is not the case, but the discipline is strictly military in character. At both establishments the regulations are extremely stringent, and the slightest irregularity entails punishment. But the importance attached to the exercise of moral influence over the pupils, the personal interest taken in them, and the kindly relations existing between them and the officers, make the system of discipline much less rigidly military than it is at the French schools. Both at the War Schools and the Cadet House, specific punishments are attached to idleness.

8. In the appointment of the heads of the various schools and of the subordinate officers employed at them, great attention seems to be paid to selecting individuals fitted for the posts both by educational experience and by personal qualities. There appears to be rather a general opinion that the instructors at most of the schools are underpaid, and that this, combined with the preference frequently given to active military life, prevents the posts being much sought after by the ablest officers. On the other hand, however, selection for such appointments is always regarded as a distinction; and in the Prussian army mere honorary distiuctions, altogether irrespective of material advantages, are held in much higher estimation than is probably the case in any other service.

9. The most marked point of contrast between the French and Prussian systems of military education consists in the thoroughly competitive character

of the former. In Prussia the principle of competition, though to a certain extent recognized, is little applied in practice, and never perhaps fully and strictly carried out. For promotion to the highest class (the Selecta) of the Berlin Cadet house there is considerable competition among the pupils, and admission to the War Academy is obtained by competitive examination open to all the officers of the army; but even in these two cases personal and other considerations come more or less into play, and the rewards can not be said to be thrown open to pure competition. All the other military examinations are simply qualifying, and there is no attempt to afford the stimulus of publishing a list of the candidates arranged in order of merit. In fact the term "competitive examination" scarcely seems to be understood in Prussia. The pecuniary assistance afforded by the State for the education of boys in the Cadet Schools is dependent solely on the circumstances and services of the father, not on the abilities of the candidate himself.

10. The objections expressed to the further introduction of a competitive system appear to be universally entertained in the Prussian army. The object in Prussia seems to be, not to attempt to establish an accurate *comparison* of the educational attainments of a number of individuals, but to form a *general estimate* of the abilities, character, and military capacity of each. The army generally are not considered to be losers by the rejection of the competitive principle; the system of inspections and of reports from inspecting officers is so elaborate, and so many checks are provided, that the character and abilities of individual officers are well known; and appointments, certainly as a general rule, are said to be made on the ground of real merit.

11. There appears to be less strictness in enforcing the regulations connected with military education in Prussia than in France. The regulations themselves are very stringent, but exceptions are constantly sanctioned—for instance, in the length of time which a pupil is permitted to remain in the same class of the Cadet Schools, in the number of failures allowed in the various examinations, &c.

12. The very great care bestowed upon the method of instruction at all the Prussian military schools, is extremely remarkable. Individual instructors are not left to follow out their own ideas of teaching, but careful regulations are issued for their guidance by the Inspector-General of Education, to which all are required strictly to conform. The system of small classes in striking contrast to the French plan of lectures to large numbers, is a remarkable instance of the anxiety to devote attention to individual students, and to adapt the instruction to varieties of ability. But the most remarkable feature of the system of teaching is the care bestowed upon the higher objects of education, upon forming and disciplining the mind and encouraging habits of reflection. The regulations for the instructors at the various schools over and over again assert that the great object to be kept in view is, not merely to impart a certain amount of positive knowledge, but to develope the intellectual faculties and to cultivate powers of thought and reasoning. The teachers are warned to avoid minute details and barren facts, which merely burden the memory and are soon forgotten, and to direct attention to broad principles, which will lay the foundation for further individual study in after life. With the same object in view, the examination questions are calculated, not merely to serve as an exercise of the memory, but to test an intelligent acquaintance with a subject, and the power of turning knowledge to a useful purpose.

PART III.

MILITARY SYSTEM AND SCHOOLS IN AUSTRIA.

XV. MILITARY SYSTEM AND SCHOOLS IN AUSTRIA.

I. OUTLINE OF MILITARY SYSTEM.

The Austrian Army is recruited by conscription, the period of service being for eight years, with two years in addition for the reserve; but such soldiers as wish it may generally obtain leave after six years' service. Those who serve eight years are understood to have a claim for employment on railways and in the custom-houses. Substitutes are allowed, but they are provided solely by the State, and the means used for supplying them is made an element towards securing good Non-Commissioned Officers for the Austrian Army, in the following manner.

The sum paid over by private individuals for avoiding service in the Army is £150 (1,500 florins,) and the Government, in providing a substitute, pays him the *interest* of this sum during his period of service, and the *capital* when it is completed. A good substitute is permitted to serve twice, and he may thus receive £300 (3,000 florins) when he quits the army. Generally speaking, the substitutes provided by the Government are good Non-Commissioned Officers, who by these means are induced to continue a length of time in the service.

The Officers are obtained during a state of peace, either from the Military Academies, or by direct entry as Cadets, after passing a slight examination, into the regiments of infantry and cavalry, in which capacity they perform the ordinary duties of soldiers, and no particular period of service is required in this grade. The entry as Cadets is by nomination, part by the Colonels, proprietors of Regiments; part consisting of those having claims on the Regiments; and part of those recommended from the ranks.

Those who join the Army from the Military Academies consist principally of the sons of military men, whose education is mainly provided for by the State, and of others who are placed there by means of funds provided by provinces, districts, municipalities, or private individuals.

Any Austrian subject has a *claim* for admittance, on payment of the annual sum prescribed by the regulations.

There is no fixed proportion existing between the Infantry and Cavalry officers supplied from the Military Academies, and those entering regiments directly as cadets, but it is understood that the former do not amount to more than one-twentieth or one-thirtieth of the latter.

The Artillery and Engineers are now entirely supplied with officers from the Military Academies.

There is no difference in the pay of officers of the same rank in the various arms in Austria.

Officers when not required are placed on half-pay, which is rather less than the half of their actual pay whilst serving. When an officer dies, his widow is not entitled to a pension, but the state provides for the education of the children; and to prevent distress, an officer is not permitted to marry unless he has a certain income, independent of his pay, for the maintenance of his wife.

The promotion in the Infantry and Cavalry is regimental, and usually by seniority; but there is no doubt that promotion by selection also takes place, though not in the regiment itself, the officer selected being promoted into another regiment. The promotion in the Artillery and Engineers is also by seniority, and by corps, and, until the Hungarian war, was exceedingly slow.

Although not actually sanctioned by the authorities, cases have occurred in the Austrian service where officers have purchased steps from others serving in *different* regiments to themselves in the following manner:—if any officer is about to retire from the service, the promotion in the regiment being by seniority, the officer whose turn it would be to obtain the promotion would frequently sell his right to a junior officer serving in another regiment, who would thus be promoted into the vacancy. We were informed that this system had formerly led to frequent duels between the officer obtaining the promotion, and those officers in the regiment whose prospects were directly injured, by the senior having sold his promotion, and thus stopped their advancement.

II. OUTLINE OF SYSTEM OF MILITARY EDUCATION.

Military education in Austria has been entirely remodeled since the Hungarian war, and is now conducted in a very regular and systematic manner under the sole control and supervision of the Fourth Section of the Supreme War Department, entitled "Military Schools."

The establishment consists besides of—

2 Majors of Infantry.
1 Captain of Artillery.

2 Captains of Infantry.
2 Lieutenants of Infantry.
2 Employés belonging to the Administration.
6 Clerks.
6 Messengers.

To show the great importance of the Fourth Section, it will only be necessary to state that the disbursements of the government for Military Education in Austria for the current year are estimated at £281,440, (2,814,400 florins,) without taking into consideration the sums contributed for foundations by provinces, districts, and private individuals, or of those received for the education of paying students. This sum of 2,814,400 florins is apportioned in the following manner:—

	Florins.*	Number of Students.
Vienna Staff School,	43,000	30 Officers.
ACADEMIES—		
Wiener Neustadt, for Infantry and Cavalry,	256,000	400 Students.
Znaim, Engineers,	157,000	200
Olmutz, Artillery,	122,000	200
Trieste, Marine,	73,000	100
4 Cadet Houses, at 87,000f.,	348,000	800
SCHOOL COMPANIES—		
6 Infantry, at 33,000f.,	198,000	720
1 Cavalry, " 39,000f.,	39,000	60
2 Frontier, " 35,000f.,	70,000	240
SCIENTIFIC SCHOOL COMPANIES—		
5 Artillery, at 35,000f.,	175,000	600
1 Engineer, " 36,000f.,	36,000	120
1 Pioneer, " 36,000f.,	36,000	120
1 Flotilla, " 22,000f.,	22,000	60
1 Marine, " 40,000f.,	40,000	150
1 NON-COMMISSIONED OFFICERS' OR TEACHERS' SCHOOL, WIENER NEUSTADT.	17,000	60
12 UPPER HOUSES OF EDUCATION, at 49,500f.	594,000	2,400
12 UNDER HOUSES, " 25,700f.,	308,400	1,200
	2,534,400	7,430
Bureau of the Fourth Section,	280,000	
Total,	2,814,400 =	£281,440

So that the annual cost to the state for the education of an officer student, cadet, non-commissioned officer, and boy in these various schools is as follows:—

	£	s.	d.
Student Officer at the Staff School,	143	6	0
Student at the Engineer Academy,	78	10	0
" " Artillery Academy,	61	0	0
" " Infantry and Cavalry Academy,	64	0	0

* A florin is equal to two shillings of English money.

	£	s.	d.
Student at the Marine Academy,	48	6	0
Cadets at the four Cadet Houses,	43	10	0
SCHOOL COMPANIES—			
An Infantry School Company Student,	27	10	0
A Cavalry " " "	65	0	0
A Frontier " " "	29	4	0
An Artillery " " "	29	4	0
An Engineer " " "	30	0	0
A Pioneer " " "	30	0	0
A Flotilla " " "	36	12	0
A Marine " " "	26	12	0
A Non-Commissioned Officer at the Teachers' School,	28	6	0
A Boy at the Upper Houses of Education,	29	14	0
" Lower " "	25	14	0

And thus, as the course of instruction is continued for four years in the Cadet Houses, four years in the Academies, and two years in the Staff School, the cost of training the Officers in the Austrian Army is—

	£
For an Officer of Artillery, about	420
" " Engineers,	490
" " Infantry or Cavalry,	430
" " Marine,	370
" " the Staff,	710

From the Bureau of this Section at Vienna all orders for the management, maintenance, discipline, studies, and regulation of the various Schools and Academies are issued; and all details relating to the progress of the several students and the results of their examinations are periodically sent and regularly examined.

THE IMPERIAL INSTITUTIONS FOR MILITARY EDUCATION.*

The Imperial institutions for Military Education, are divided into Three Classes. They are—

A. Such Institutions as are immediately intended for the education of pupils as Non-commissioned Officers; namely,

(1.) The Lower Military Houses of Education.
(2.) The Upper Military Houses of Education.
(3.) The School Companies.

B. Institutions in which it is intended to educate pupils as Officers; namely,

(1.) The Cadet Institutions.
(2.) The Military Academies.

* The following account is translated from "*Die Kaiserlich-Königlichen Militär-Bildungs-Anstalten, mit besonderer Rücksicht auf die Vorschriften für den Eintritt in dieselben, Zusammengestellt aus den allerhöchst sanctionirten Reglements der Militär-Bildungs-Anstalten. Wien*, 1854." (*The Imperial Military Institutions for Education*, with special reference to the conditions required for admission, compiled from the regulations sanctioned by His Majesty. Vienna, 1854.)

C. Such Institutions as partly give a special kind of instruction, and partly complete and carry out the previous education of Officers. These are—

(1.) The Institution for Military Teachers.
(2.) The Higher Course for the Artillery and Engineers.
(3.) The War School.

In the institutions of the first and second class, education as well as instruction is given, but those of the third class are limited to instruction; accordingly, all that is said in the following pages with regard to the admission of pupils, and with regard to beneficial foundations, has no reference to institutions of the third class.

Although each of the first-named classes forms a complete whole in itself, yet they stand in close mutual relation to each other, inasmuch as the most distinguished pupils of the Lower Houses of Education pass into the Cadet Institutions; and in the same way the most distinguished scholars of the Scientific* School Companies, viz., those of the Artillery, Engineers, Pioneers, Flotilla, and Marine Schools, may be transferred as attendant pupils† to the Academies; by this means they may obtain a right to a position in the Army as Officers.

So, on the other hand, insufficient progress may be a reason for scholars being removed from the Cadet Institutions and the Academies into the Upper Houses of Education and the School Companies.

By these regulations a road is opened for the advancement of any talent that may gradually develop itself; and at the same time the pupils of the Institutions for Higher Military Education are submitted to that process of elimination which is requisite for the success of these Institutions.

The pupils in the Institutions for Military Education are either foundation pupils,‡ or paying pupils; the first are divided into the

* *Techniche* (technical) is the original word. Compare its use in another matter; there are in the Artillery two services, the ordinary Campaigning Artillery and the *Technical* Artillery.

† *Frequentanten*, who frequent, attend, or visit the school.

‡ *Stifftinge*, foundationers, and *Zahlende*, paying pupils, the first divided into, (1.) *Militär-Ararial* foundationers, who are, as a rule, sons of Soldiers and Officers, and are maintained at the expense of the Military Treasury, the *Arar*, or *Ærarium*; (2.) Provincial foundationers, who are maintained by the interest of lands or money granted in favor of young men belonging to some particular province, Bohemia, Gallicia, the Tyrol, Upper or Lower Austria, either by the Central Government (the State,) or by the Estates or Parliament (*Stände*) of the province; (3.) Private foundationers, under which name are included not only those maintained by moneys left by private individuals, but those also whose payments come from grants made by municipal and local corporations.

military or treasury foundation pupils, and the provincial and private foundation pupils.

The military or treasury places belong to the army; the claim for these depends upon the nature of the institution and the position of the parents. As a general rule, it may be laid down that children of officers are expected to remain up to eleven years of age under the care of their parents, whereas those of common soldiers may in the eighth year of their age be taken under the protection of the State.

The provincial foundations are bestowed upon the sons of the nobility, or of distinguished *employés* of the state belonging to the crown lands of the province. Private foundations are those established by private individuals or corporations, and the appointment to these depends upon the conditions laid down by the founder. The capital or property of these foundations is generally administered by the Supreme War Department.*

Every Austrian subject may claim admission as a paying pupil, if the other conditions of admission are fulfilled in his case.

In the Lower Houses of Education there are only military or treasury places.

In the Upper Houses of Education there are 1,800 military places; the remaining 600 are filled up by pupils upon provincial or private foundations, and by paying pupils.

In the School Companies the number of the foundation places and paying places is not fixed.

In the Cadet Institutions and the Academies there are 900 full and 200 half military places, and 520 places for pupils on provincial and private foundations, and for paying pupils.†

A sum to cover the expenses is fixed in the case of the pupils on the provincial and private foundations, as also for the paying pupils, amounting in the Houses of Education and in the School Companies to 150 florins (15*l.*) per annum; in the Cadet Houses to 400 florins (40*l.*) per annum; in the Academies 600 florins (60*l.*) for each of the three first years, and 800 florins (80*l.*) for the last year. These payments will be subject to modifications, at considerable intervals of time, according to the price of articles of consumption, and will be drawn in the case of the pupils on the provincial foundations

* The *Ober-Militär Commando*, or *Commandership-in-chief*, the Fourth Section of which has the charge of Military Education. *Commando* is the German word corresponding to Commander, as *Ministry* does to *Minister*, and may signify one or more persons, a single Officer, or a Board of Commissioners.

† Making a total of 1,620, to which may be added about 80, reserved for *Frequentanten* from the School Companies.

from the funds of the respective provinces, and in the case of the pupils of the private foundations, from the moneys belonging to the private foundations.

The capital for the provincial and private foundations must be duly secured and sufficient in amount to cover the fixed payments for the number of places determined upon. Supposing the sum contributed to be insufficient, the requisite sums must be obtained by deferring any further nominations.* The proper sums in discharge of these contributions must be paid in advance, half-yearly, on the 1st of October and the 1st of April. Those which belong to the provincial foundations, and such private ones as are administered by trustees, must be paid into the nearest Military Chest.† In the case of those pupils who pay for themselves, the money must be sent precisely on the above-mentioned days to the Commandant, or Director of the School, without reference to the day on which the pupil may have entered the school. On the other hand, in cases where a pupil either is removed from or otherwise quits the institution before the natural time, restitution will be made of the corresponding proportion of the sum paid in advance.

For admission into a Military Educational Institution, the boy must first of all be of the age specified for the institution in question, and must further possess the proper bodily growth and strength corresponding to that age, and the prescribed amount of knowledge. Every boy who is to be offered as a candidate for a military place must first be registered, and this in the course of the same year for which his admission is desired. This registration must be made by the parents or guardians through the Commanding Officers of the Army,‡ or Army-Corps, or Military Government§ within whose district they are domiciled, or in case of their living in foreign parts, through the Austrian Legation of the country.

Applications thus made must state what is the institution, admission into which is desired, and must be accompanied by the following certificates:—1. Baptismal certificate. 2. Certificate of vaccination. 3. Certificate of bodily health, by a Military Surgeon. 4.

* The interest, that is, will be allowed to accumulate, until a sufficient sum is provided to pay for the maintenance of a pupil.

† Such as exist in most large towns.

‡ There are four *Armies;* the First in the west, with its head-quarters at Vienna; the Second in Italy, with its head-quarters at Verona; and two others in the eastern provinces. Each of these is divided into a certain number of Army-Corps. The particulars may be seen in Schematismus or Military Calendar, and briefly in the Almanach de Gotha.

§ In those parts of the Empire, namely, in the so-called Military Frontiers, the old Turkish border, where the government is simply military.

The school certificate for the last half-yearly examination: And 5. On the reverse the following declaration:—

"I hereby pledge myself to surrender up my son (*or* ward) to the Imperial Military Service, in case of his being admitted into a Military Educational Institution; and I declare that I will under no pretext require his return."

The object of this declaration is, on the one hand, to secure permanent elements for the Military Educational Institutions, and to create in the minds of the relations of the candidates the seriousness of purpose so essential in the choice of a profession. The declaration will also serve to retain the pupils to a course, which they have usefully commenced, and to protect them from the consequences of hasty decisions on the part of their friends. On the other hand, if it appears manifest that a pupil has not the requisite inclination or qualification for the military service, his removal from the institution ensues with or without the request of his friends, as will be more fully explained further on.

The applications will be examined by the Commanding Officers of the Army, or the Army Corps, or Military Government, and after their revision the candidates will be registered and the petitioners duly informed.

Any changes which occur in the case of the registered candidate, or in his family circumstances, between the time of registration and of actual admission, are to be made known to the authorities before whom the application was brought.

The registers are to be submitted to the Supreme War Department in the middle of June, so that applications can be received by the Commanding Officers of the Army, or Army Corps, or Military Government, at the utmost only up to the end of May.

Appointments to the military places in the Houses of Education and the School Companies are made by the Supreme War Department; His Majesty the Emperor reserves for himself those in the Cadet Institutions and the Academies.

Vacancies in the provincial foundation places are advertised, and applications called for, by the Governors or by the Standing Committees of the Estates of the respective provinces.*

All proposals made in this manner are forwarded to the Minister

* The Governor or Lord Lieutenant (the *Statthalter*) is the ordinary representative of the Emperor in the various provinces composing the Empire. In his hands resides the usual administration of the government. The provinces have also their ancient Estates or Parliaments, Standing Committees of which might, under certain circumstances, sit at times when the Estates were not assembled.

of the Interior, and submitted by him for the sanction of His Majesty.

Appointments to the private foundations are made by the person specified by the founder; decisions of this kind are submitted on or before the 15th of June, to the Supreme War Department for their approval of the candidates and distribution of them into the various institutions.

If a candidate in whose case the prescribed conditions of admission are not fulfilled is nominated to a private foundation, and his nomination consequently not approved, a new nomination must be made.

Pupils who pay are appointed by the Supreme War Department.

The sanction of the appointments and the distribution of the candidates appointed in the various institutions, in the case of the military and the paying pupils, will be made known to them by the Commanding Officers of the Army, or Army Corps, or Military Government; in the case of the provincial foundations by the Minister of the Interior; and in the case of the private foundations by the trustees.

Candidates living in a foreign country will be informed by the Legation in that country.

Upon the appointment made to an entirely gratuitous place in a military educational institution, all payments of allowances for the education of children cease.*

The conveyance of military foundation pupils to the school to which they are appointed will, if not provided for by the friends of the pupils, be made at the expense of the Military Treasury by the ordinary means of locomotion.

Trustworthy Non-commissioned Officers from the nearest detachment of troops should be selected by the military authorities for the conveyance and charge of the pupils; four or five being, according to the circumstances, committed to the care of a single superintendent.

The conveyance of all other pupils must be provided for by their friends.

Admission into the Military Educational Institutions takes place only at the commencement of the school year. Candidates admitted must present themselves in their respective institutions between the 15th and the 30th of September.

* Small allowances, *e. g.* of 8*l.* for three years, are very generally made to the widows of officers, and occasionally to officers themselves, to assist them in securing a decent education for their children.

The Commanding Officers of the Army, or Army Corps, or Military Government have to take care that every candidate admitted to a military place shall, before leaving to join the institution, be a second time examined by an Army Surgeon, and shall only be allowed to proceed to the institution in case of his bodily qualifications being found perfectly sufficient.

Finally, the candidate upon presenting himself must be re-examined by the chief Medical Officer of the institution, and if he is hereby found to be unqualified for military education, will not be received.*

Any Military Surgeon or Medical Officer who incurs the guilt of neglect of his duty in this particular will be held responsible.

Every candidate upon presenting himself will moreover undergo the prescribed examination in his previous studies, and if his previous education appears insufficient, his appointment will be cancelled.†

Pupils admitted after a private education into a Military Institution are provided by this institution with new linen and clothes. All clothes they bring with them are without exception to be returned to their friends, and an acknowledgment of the return given.

No pupil in any of the Military Institutions is allowed to possess any linen or clothes except what is provided; and the friends and relations are not to be called upon for any sort whatever of additional contribution. An amount of pocket-money, varying with the character of the institution, may be transmitted to the pupils through the hands of the authorities of the school; but this is entirely at the pleasure of the friends and relations; all necessaries being provided by the institution.

The pocket-money can only be paid to the pupil through the Commanding Officer of the Institution or of the Company.

The amount allowed must depend on the conduct of the pupil, but must not, even in the Academies, exceed three florins (six shillings) a month.

The course of instruction given in the Military Educational Institutions is fixed by special tables drawn up for each institution. Special text-books, to be followed in the courses, are also appointed.

* Thus, it will be seen, all candidates appointed to the military places in the schools are examined three times over by a medical officer. Where the State does not pay, in the case of provincial or private foundations, or of paying pupils, the same amount of precaution is not thought necessary.

† The difficulties of traveling appear to be considered in Austria too great to allow of any examination (competitive or otherwise) before the candidates provisionally admitted actually arrive at the school to which they are appointed; if ill qualified, they are dismissed with the chance of a second trial.

The tables drawn up to regulate the course of instruction are subject to such modifications as may be called for by the requirements of science and by improvements in the methods of teaching.

The scholars will also receive in the course of the year, more particularly in summer, and after the close of the examination, practical instruction suitable to the arm of the service for which they are destined.

Every September the pupils pass into the next succeeding yearly course.

In the same month the scholars quit the institutions, and are either placed in the army or transferred to other institutions. The conditions under which this is done are given in detail in the account of each institution.

The expenses of the conveyance of the pupils from one institution to another are borne by the Treasury.

Pupils who make no progress in scientific studies will be required to enlist in the army* if old enough, and if not, will be removed to an inferior Military Educational Institution; or if they are already in one of the Houses of Education or School Companies, will be employed in learning some trade which will be of use in the army,† and when they have reached the proper age, will be enlisted.

Pupils whose want of bodily qualification unfits them for the army will be sent back to their parents or guardians. Those holding military places in the Academies, if their parents are entirely unable to provide for them, will receive a yearly pension of 150 florins (15*l.*) until they can be placed in some employment under the State at a salary at least equivalent to this sum.

Pupils out of the Military Houses of Education or School Companies, who are removed for want of bodily qualification, and whose parents are entirely unable to provide for them, will, according to their capacities, be placed either in the Accounts Department‡ or some similar Military Department, in the Geographical Institution, or as drummers or clerks in one of the higher Military Schools, or will be taught some trade for employment in the Outfit Department,§ or will be made teachers. If, however, the pupil's bodily disqualifica-

* Will be *assentirt*, will take the oath. They are considered old enough for this at sixteen.

† Even clothes and shoes being made by soldiers; a considerable number of soldiers were found thus employed, for example, at the Artillery Academy at Olmütz, under the superintendence of a master workman, bearing a non-commissioned grade, that of a *prima-planist*, for whom, see a Note further on.

‡ *Militär Rechnungs Branche.*

§ *Montur Commission*, charged with the duty of providing arms, clothing, &c., for the army. There are several establishments in various parts of the Empire. One of the largest is at Stockerau, near Vienna.

tion be of a nature to incapacitate him for any of the above-mentioned employments, he will be removed at the expense of the Treasury into some Civil or Military Hospital.*

If in moral respects a pupil is found to be a mischievous member of the institution, he may at any time in the course of any year be removed.

Pupils who pay, in case of their removal being found, for whatever reason, necessary, will be sent home to their friends, the consent of the friends being required before they can be either engaged as soldiers or removed to one of the lower institutions. The expenses already incurred will be deducted from the payment made in advance, and the balance repaid to the parents or guardians.

A pupil who for whatever reason has once been removed from a Military School can never be afterwards admitted into any one of them, and in case of his either then or afterwards enlisting in the army, he can not, under any pretext whatever, obtain the rank of Officer before the pupils of the year to which he belonged. This rule, in the case of pupils who have been transferred from a higher to a lower institution, even when they pass out of this latter in the regular course, must be observed in reference to the pupils of the year to which they belonged in the institution from which they were removed.†

A. SCHOOLS FOR NON-COMMISSIONED OFFICERS.

1. *The Lower Military Houses of Education.*

The twelve Lower Military Houses of Education contain, as has been said, only military places.‡ These appertain, in the first instance, to the legitimate sons of all soldiers bearing arms,§ whether born in marriage of the first, or in marriage of the second degree.‖

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* Into a *Siechen-haus*, a hospital for incurable cases; or an *Invaliden-haus*, for *Invalides*.

† A pupil who was removed from the Academy at Wiener Neustadt might, for example, enter the army as a simple Cadet, under the patronage of the Colonel of a regiment, and might, but for this rule, receive rapid promotion, and become the senior in rank of his comrades of the same year at the School. In like manner, a pupil removed from a Cadet Institution and transferred into a School Company, might, upon leaving that, under certain circumstances, outstrip his late comrades at the Cadet Institution.

‡ That is, all the pupils are of military or quasi-military birth, and the expense is borne by the State. Both these and the Upper Military Houses are to be reduced, it is said, to ten.

§ The whole body (*Mannschaft*) of soldiers bearing arms (*Feuergewehrstand.*)

‖ Marriage of the first degree is that entered into with full permission. In this the wives live in the barracks, receive a certain amount of rations, their children are recognized, and in case of the father's death are admitted into the Orphan Schools. Soldiers, are, however, occasionally allowed to marry, on condition of surrendering every claim to the above-mentioned privileges. This constitutes marriage of the second degree.

Subordinately to these, a lawful claim exists in the following cases:—

1. Sons of soldiers serving in the Trabant Body Guard, the Court Watch, the Outfit Commission, and other military bodies.*
2. Sons of fathers belonging to the Reserve,† without prejudice, however, to sons of soldiers in actual service.
3. Sons of invalided soldiers,‡ not only in cases where the father has already married at the date of his reception as invalided, but also in those where marriage has been subsequently permitted.
4. Sons of those who have either as substitutes or otherwise served double time, and are now in the employment in connection with the Court or Government, even in cases where marriage has been contracted after quitting the service.
5. Sons of men belonging to the military service, not included in the above-mentioned cases, namely, the sons of Prima-planists,§ Employés, and Officers.

In any large number of candidates special regard should be had to the sons of fathers who have been killed or invalided on the field; after these, to those who are orphans on both sides; then to the sons of substitutes and other soldiers in actual services; and last follow in order the sons of fathers either belonging to the Reserve or received as Invalides, or otherwise connected with the Military Service.

As the sons of Officers serving with the sword‖ have a large number of places reserved for their benefit in the Cadet Institutions and the Academies, their admission into Military Houses of Education, more especially into the Lower House of Education, is only allowable when no prejudice is caused to the above-mentioned claimants, and as a general rule can only take place when they are orphans, or under special circumstances.

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* The *Trabanten-Leibgarde* and the *Hofburgwache* are Court troops. For the *Monturs Commission*, see a previous Note.

† Soldiers enlist for eight years, and after this to the end of the tenth year are on the Reserve.

‡ That is, belonging to the Hospitals or Hotels des Invalides, the *Invaliden-häuser*, of which there are several.

§ Prima-planists, a name derived from *prima plana*, the first leaf of the list, is given to soldiers employed in various special duties, especially perhaps those not of a strictly military kind. The master tailors, master shoemakers, master farriers, are all *prima-planisten*. The surgeon's assistant ranks as such. The grade is superior to that of sergeant, but those who hold it are excluded from promotion to a commission.

‖ This is a frequent phrase (*mit dem Degen dienende*) for active service.

The age of admission is the completion of the seventh year. Children under this age who are orphans on both sides, or whose fathers being widowers, have to serve in the field, will be received into the Orphan House at Vienna, and be transferred on completing their seventh year to the Lower Houses of Education. Children who have passed the prescribed age for admission into the first class of the Lower Houses of Education can only be admitted, in case of their possessing the requisite amount of knowledge, into the classes corresponding to their age, and in case of there being places vacant in these classes; any addition to the prescribed numbers in the respective years is not allowable.

The number of pupils in each of the Lower Houses of Education is fixed at 100. These 100 pupils are divided into four years, each year being as nearly as possible of the same numerical strength.

The command is held by a Subaltern Officer, to whom are attached for the religious education, the medical care, the discipline, and the instruction—

1 House Chaplain,
1 Army Surgeon,
4 Sergeants and Instructors,
4 Honorary Sergeants* as Assistant Instructors,
1 Sergeant, as House Adjutant; and
6 Corporals, for the discipline.

Additional assistance may be procured for managing the house and attending on the pupils.

To conduct the instruction (which will be almost entirely addressed immediately to the senses of the children) class-teachers will be provided for each yearly course; and these, with the house chaplain and the medical officer, aided by assistant teachers, will give the pupils instruction in the following subjects:—

1. Religious Knowledge. 2. German. 3. Natural History. 4. Geography. 5. Arithmetic, both ordinary and mental. 6. Writing. 7. Common Drawing. 8. First Notions of the Rules of Drill. 9. Gymnastic Exercises and Swimming.

2. *Upper Military Houses of Education.*

These, twelve in number, form a continuation to the Lower Houses of Education, the pupils from which are admitted here at the close of their eleventh year.

At this age foundation pupils of every kind, as also paying pupils, may be admitted immediately from their parents' homes, only, however, into the first year's course, and after passing an examination in

* *Feldwebel*, Sergeant; *qua Feldwebel*, Honorary Sergeant, with the title and distinction in the uniform, but without the pay.

the subjects taught in the Lower Houses of Education, to the same extent up to which they are taught in the second class of the ordinary elementary school.

The claim to a military place in an Upper House of Education, is similar to that for a military place in a Lower House of Education.

The number of pupils is fixed at 200 in each Upper House of Education, divided in like manner into four yearly courses.

The command is intrusted to a Captain, who is aided, for purposes of instruction and superintendence, by—

2 Subaltern Officers.
1 House Chaplain.
1 Army Surgeon.
1 Surgeon's Assistant.
4 Sergeants as Teachers.
2 Honorary Sergeants as Assistant Teachers.
1 Sergeant as House Adjutant.
8 Corporals, for discipline.

Additional assistance may be procured for managing the house and for attendance, upon the same scale as in the Lower Houses.

The instruction, as in all the Military Schools to be noticed hence-forward, will be given by teachers specially assigned to each subject, and will include here the following subjects:—

1. Religious Knowledge. 2. German, with written compositions. 3. One of the other Languages of the Empire. 4. Natural History. 5. Geography. 6. History. 7. Arithmetic. 8. Military Rules and Regulations. 9. Rules of Drill, and first notions of the Rules of Military Exercise. 10. Writing. 11. Common Drawing. 12. Gymnastic Exercises, Single-stick,* Swimming.

After completing their fourth year course, the pupils are transferred, according to their qualifications and their own wishes, into the School Company.

Entrance into the Marine School Company takes place at the end of the second year's course.

3. *The School Companies.*

The School Companies have the object of furnishing the different arms of the service with Non-commissioned Officers well educated, both practically and theoretically, and likely in the course of time to prove useful Commissioned Officers† in charge of the troops.

They are in all twenty in number:—

6 for the Infantry.
3 " Cavalry.

* *Stock-fechten*, or staff-fencing; a sort of military single-stick, the staff used resembling a musket and bayonet in one piece, all of wood.

† *Truppen-Officiere.*

2 for the Frontier Troops.
5 " Artillery.
1 " Engineers.
1 " Pioneers.
1 " Flotilla.*
1 " the Marine Service.†

Under the general term of School Companies the School Squadrons (for the Cavalry) are included. The term Scientific‡ School Companies applies only to those of the Artillery, Engineers, Pioneers, Flotilla, and Marine.

The scholars in the School Companies are either pupils or attendants.§ The pupils are taken, as already described, from the Upper Houses of Education, after the close of their fourth year's course, (or, in the case of the Marine School Company, after that of the second,) or they come direct from places of private education.

The conditions for gratuitous admission from private educational institutions into the School Companies are similar to those for admission into the Houses of Education, with the difference, that in the School Companies the sons of officials in the civil service, who have served long and meritoriously, and are ill-provided for, may also claim military places.

The candidates must be not under fifteen and not above eighteen years of age; in the Marine School Company not under thirteen and not above fourteen.

The Attendant pupils (*frequentanten*) come from the soldiers of the Standing Army.‖ They exist only in the School Companies of the Artillery, Engineers, Pioneers, and Flotilla; to be admissible, they must, as a rule, have passed with credit through the Non-commissioned Officer Schools of the Artillery or Engineer regiments, or of the Pioneer Corps or Flotilla Corps; they must have been not more than two years in the service; and not at the utmost be above the rank of an Upper Cannoneer, an Exempt, or an Upper Pioneer.¶

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* For service on the Lower Danube, the Po, and the Italian Lakes and Lagoons.

† Both for service in the Fleet and in the Coast Defenses.

‡ *Technische*, Technical or Artificer Companies.

§ *Zöglinge* and *Frequentanten*.

‖ The *Mannschaft-stand* is a term used to mean the whole body of Private Soldiers and Non-commissioned Officers.

¶ The Non-commissioned Officers in the Austrian service rank as follows:—
In the Infantry, Corporal, and Sergeant (*Feldwebel*:)
In the Cavalry, Corporal, and *Wachtmeister*:
In the Artillery, Corporal, and *Feuerwerker*:
But there are distinctions in addition. A private soldier who is exempted from certain duties, *e. g.* from standing sentry, bears the name of *Gefreite*, or Exempt, in the Infantry and in the Engineers; the corresponding rank to which in the Artillery is an Upper Cannoneer (*Ober-Canonier*,) and in the Pioneers, an Upper Pioneer (*Ober-Pionier*.) These are in no case Non-commissioned Officers, though in the way to become so. There are also Vice-Corporals

The admission of Attendants (*frequentanten*) can only be allowed without prejudice to the claims of candidates from the Upper Military Houses of Education and from places of private education.

Pupils who come direct from private education must, if they propose to enter one of the Scientific School Companies, be at least 4 feet 10 inches;* if one of the other School Companies, at least 4 feet 8 inches high. And these and the Attendant pupils alike must at their entrance into the School Companies pass an examination in the subjects of instruction taught in the Upper Houses of Education.

A perfect knowledge of German is accordingly an indispensable condition for reception into the School Companies, and can only in the single case of the Marine School Company be under certain circumstances overlooked.

At his entrance into the School Company every pupil takes the military oath, and is from this day bound to eight years' service in the Standing Army, and two years' service in the Reserve.

Each School Company is commanded by a Captain; each School Squadron by a Captain of Cavalry.

They have attached to them for purposes of instruction and discipline,—

In each	Infantry School Company,	3	Subaltern Officers.
"	School Squadron,	3	"
"	Frontier School Company,	6	"
"	Artillery "	6	"
In the	Engineer "	6	"
"	Pioneer "	6	"
"	Flotilla "	4	"
"	Naval "	4	"

Each institution is provided also with four Sergeants as teachers, together with a requisite number of additional persons required for management, discipline, and service.

Religious superintendence and instruction is intrusted to a local Ecclesiastic, and the medical duties to an Army Surgeon.

Scholars in the School Companies are to receive a practical as well as a theoretical training. This is to be regulated according to the branch of the service for which they are detained.

Each of the Infantry School Companies consists of 120 pupils, divided into two years, the subjects of instruction being— ,

1. Religious Knowledge. 2. One of the National Languages. 3. Geography and History of the Austrian State. 4. Arithmetic. 5. Elements of Geometry. 6. Military Correspondence and Management of the Internal

(Lance Corporals,) with the badge but without the pay of Sergeants, and *qua Feldwebels* or Honorary Sergeants, with the badge but without the pay of Sergeants.

* The Austrian foot or shoe (*schuh*) of 12 inches (*zoll*) is a little longer than the English: 80 Austrian make 83 English.

Affairs of a Company.* 7. Pioneer Service.† 8. Knowledge of the Arms of the Infantry. 9. Rules and Regulations. 10. Rules of Drill, Exercise, and Manœuvring. 11. Calligraphy. 12. Military Drawing. 13. Gymnastics, Fencing, and Swimming.

After the close of the course the pupils who have done remarkably well enter the Infantry as Corporals, the pupils who have done well as Exempts, with the corporal's badge; those who have done moderately, as Exempts; and those who have done either remarkably well, or well, will be, without further examination, named as Cadets‡ as soon as they pay down the sum required for outfit, or prove their legitimate claim to exemption from this outlay, they themselves being consenting parties.

The arrangements of the School Squadrons, with a number of 60 pupils in each, are analogous to those of the School Companies, special attention only being given to instruction in riding and practical exercise in the Cavalry service; for which purpose each Squadron is provided with 71 horses.

The first of the School Squadrons forms a Regiment of Dragoons, the second one of Lancers, and the third one of Hussars.

The subjects taught are as follows:—

1. Religious Knowledge. 2. One of the National Languages. 3. Arithmetic. 4. Elements of Geometry. 5. Geography and History of Austria. 6. Military Correspondence, and Management of the Internal Affairs of a Squadron. 7. Knowledge of Cavalry Arms. 8. Rules and Regulations. 9. Rules of Cavalry Drill, Exercise, and Manœuvring. 10. Knowledge of Horses and Grooming, of Bridling, Saddling, and Shoeing. 11. Calligraphy. 12. Military Drawing. 13. Riding. 14. Gymnastics, Fencing, and Swimming.

On leaving, the pupils enter the Cavalry in the grades corresponding to those mentioned above for the Infantry.

The Frontier School Companies, each of 120 pupils, give three yearly courses.

In all essential points, these institutions are organized on the same plan with the Infantry School Companies. As, however, Officers and Non-commissioned Officers on the Military Frontiers are also intrusted with the general administration, and accordingly require of necessity a knowledge of political administration, of jurisprudence, and agriculture, the range of the plan of study in the Frontier School Companies is more extensive.

The following subjects are taught:—

1. Religious Knowledge. 2. The Wallachian or Illyrian Language. 3. Aus-

* *Manipulation*. See the account of the visits to the School Companies.

† This includes pontooning.

‡ Cadets in a regiment, *i. e.* candidates for a commission, like those appointed on the nomination of the colonels.

trian Geography and History. 4. Arithmetic and Algebra. 5. Geometry, Plane Trigonometry, and Practical Mensuration. 6. Military Correspondence and Management of the Internal Affairs of a Company. 7. Arms and Munitions. 8. Pioneer Service, Road and Bridge Making. 9. Elements of Civil Architecture. 10. Agriculture. 11. Frontier Law and Administration. 12. Rules and Regulations. 13. Rules of Drill, Exercise, and Manœuvring. 14. Calligraphy. 15. Military Drawing. 16. Gymnastics, Fencing, Swimming.

The pupils of the Frontier School Companies, at the close of their third year, enter the Frontier Troops, under the conditions already stated in the case of the Infantry School Companies.

The Artillery School Companies have a course of three years, and consist each of 120 scholars (pupils and attendant pupils.)

The subjects of study are—

1. Religious Knowledge. 2. The Bohemian Language.* 3. Austrian Geography and History. 4. Arithmetic and Algebra. 5. Geometry, Plane Trigonometry, and Practical Mensuration. 6. Popular Mechanics, First Elements of Natural Philosophy and Chemistry. 7. Military Correspondence and Management of the Internal Affairs of a Battery or Company; Computation of Estimates. 8. Artillery. 9. Field Fortification. 10. Elements of Permanent Fortification; Attack and Defense of Fortresses. 11. Rules and Regulations. 12. Rules of Drill and Exercise. 13. Calligraphy. 14. Military Drawing. 15. Elements of Descriptive Geometry. 16. Grooming, Stable Duty, Harnessing. 17. Gymnastics, Fencing, Swimming.

After the close of the complete course, pupils who have done remarkably well enter the Artillery as Corporals, those who do well as Bombardiers, the others as Upper Cannoneers.

The most distinguished scholars, however, pass at the close of their second year into the Artillery Academy free of cost, as Attendant Pupils (*frequentanten*,) with the rank of Lance-Corporals, to receive there the education which will fit them for the rank of officers.

The Engineer School Company contains 120 scholars, distributed in three yearly courses. The subjects taught are—

1. Religious Knowledge. 2. Austrian History and Geography. 3. Arithmetic and Algebra. 4. Geometry, Plane Trigonometry, Practical Mensuration. 5. Military Correspondence and Management of the Internal Affairs of a Company. 6. Pioneer Service. 7. Sapping and Mining. 8. Elements of Permanent Fortification. 9. Civil Architecture. 10. Arms and Munitions. 11. Rules and Regulations. 12. Rules of Drill, Exercise, and Manœuvring. 13. Calligraphy. 14. Military Drawing. 15. Architectural Drawing. 16. Gymnastics, Fencing, Swimming.

The scholars enter the Corps of Engineers in the same way as has been described in the case of the other School Companies; the most distinguished passing as Attendant Pupils with the rank of Lance-Corporals, free of cost, into the Academy of Engineers.

* Because of the large number of Bohemians in the Artillery.

The Pioneer School Company also contains 120 scholars, similarly divided into three yearly courses.

The instruction given is similar to that of the Engineer School Company, special attention being paid to pioneering duties.

1. Religious Knowledge. 2. The Bohemian Language. 3. Austrian History and Geography. 4. Arithmetic and Algebra. 5. Geometry, Plane Trigonometry, and Practical Mensuration. 6. Popular Mechanics. 7. Military Correspondence and Management of the Internal Affairs of a Company. 8. Land Pioneering. 9. Water Pioneering.* 10. Arms and Munitions. 11. Rules and Regulations. 12. Rules of Drill, Exercise, and Manœuvring. 13. Calligraphy. 14. Elements of Descriptive Geometry. 15. Gymnastics, Fencing, Swimming.

After the close of the third year, the scholars enter the Corps of Pioneers, under the various conditions already described. Scholars who specially distinguish themselves will at the close of the second year be received, free of cost, as Attendant Pupils (*frequentanten*) in the Academy of Engineers; and after completing the four years' course there, be distributed as Officers in the Corps of Pioneers.

The number of scholars in the Flotilla School Company is 60; and the course of instruction three years in length. The subjects are—

1. Religious Knowledge. 2. Italian. 3. Austrian History and Geography. 4. Arithmetic and Algebra. 5. Geometry, Plane Trigonometry, Practical Mensuration. 6. Popular Mechanics. 7. Military Correspondence, and Management of the Internal Affairs of a Company. 8, 9, 10. Flotilla Navigation, Artillery, and Pioneering. 11. Rules and Regulations. 12. Rules of Drill, Exercise, and Manœuvring. 13. Calligraphy. 14. Military Drawing. 15. Elements of Descriptive Geometry. 16. Gymnastics, Fencing, Swimming, and Boating.

The most distinguished scholars are sent, free of charge, at the end of the second year, to the Artillery Academy, and after completing the four years there, enter the Flotilla Corps as Officers. The others leave at the end of three years under conditions similar to those already described.

The Marine School Company contains 150 pupils, and its course of instruction lasts four years.

The subjects are—

1. Religious Knowledge. 2. German. 3. Italian. 4. Illyrian. 5. Natural History. 6. Geography and History. 7. Arithmetic. 8. Algebra. 9. Geometry and Plane Trigonometry. 10. Popular Mechanics. 11. Military Correspondence and Management of the Affairs of a Company. 12. Artillery, Arms, and Munitions. 13. Rules and Regulations, by Land and Sea. 14. Rules of Drill, Exercise, and Manœuvring. 15. Calligraphy. 16. Common Drawing and Machine Drawing. 17. Military Drawing. 18. Gymnastics, Fencing, Swimming.

The pupils will also be thoroughly exercised in boat manœuvring,

* Pontooning being included in the duties of the Pioneers.

in the use of sails, and of cannons, and after the end of each year's examination, will pass some weeks on board a sailing vessel for practice.

Pupils who either through want of capacity or of diligence fall behind in the theoretical instruction, will at the end of the second year be sent on board ship as ship's boys (*Schiffs-junge.*)

The other scholars go through the courses of the third and fourth year, and then pass, on the same plan as in the Infantry School Companies, into the Marine Infantry, or as Marine Artillerymen or as Engineering pupils* of the first class, into the Navy, or into the Arsenal Works Company, to devote themselves to Naval Architecture.

The best scholars enter after four years instruction as Attendant Pupils in the Artillery Academy, and after completing their time there are admitted as Second Lieutenants of the second class into the Marine Artillery.

B. SCHOOLS FOR OFFICERS.

1. *The Cadet Institutions.*

The object of these is to prepare pupils for the instruction in military science given in the Academies.

They are four in number, with 200 pupils in each.

They contain military or treasury places, either wholly or half gratuitous; places on provincial and private foundations; and finally places for paying pupils.

The exact number of places open to pupils on provincial and private foundations, and to paying pupils, can not be determined, as in this respect the Cadet Schools form a single whole with the Academies, and the amount can only be fixed as a total for these institutions taken together. There are altogether 1,100 of these military places, which may be distributed in varying proportions amongst the Cadet Schools and the Academies; the number in any one of them can not be stated as a rule.

The military foundations are reserved for the sons of Officers serving or having served with the sword; the entirely gratuitous places for the sons of Officers in want, and the half gratuitous places for those of Officers provided with means of their own, or serving in higher positions.

Officers employed in the Outfit Department, Remounting† De-

* The Marine Infantry do not serve like our Marines on board ship, but only on the coast. The Marine Artillery and the Engineering pupils (*Maschinen-lehrlinge*) serve on board.

† For the Outfit Department (*Monture Commission,*) see a previous Note. The business

partment, the Department of Military Law and Jurisdiction* are thus excluded, unless they have previously served with the sword. But for the sons of these Officers, of the Military Judges, the Military Surgeons, and other Officials, having attained the eleventh or any higher allowance class,† there will be reserved eight entirely and eight half gratuitous places in the Cadet Schools and the Academies.

Appointments to the military and provincial foundations are granted by His Majesty, the former on the recommendation of the Supreme War Department, the latter on that of the Minister of the Interior. Among the former are included, as already stated, the most distinguished pupils of the Lower Houses of Education, for whose transfer to the Cadet Schools the rules are laid down, the recommendation being annually submitted for His Majesty's approval.

Special regard will be given to candidates whose fathers have been killed or invalided in the field; after these, to those who are orphans on both sides; to the sons of Officers of special merit, of Officers with large families, and the like.

Appointments upon provincial and private foundations, or as paying pupils, will be made in the manner already stated in the general account of the Educational Institutions.

The age of admission is the eleventh year completed, and twelfth year not exceeded, and the candidate will be expected to know the subject of instruction prescribed for the third class of the common (*normal*) schools.

A knowledge of German, however, will not be considered indispensable. Pupils who are not Germans will receive in the first half year of the first course special instruction in German.

The instruction continues during four yearly courses. The command is held by a Field Officer, assisted by—

1 Subaltern Officer as Adjutant.
2 Captains.
10 Subaltern Officers.
2 Ecclesiastical Professors.
1 Accountant.

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of the Remounting Department or Remounting Establishments (*Remontirungs Anstalten*) is to supply the cavalry with horses. There are several of these great establishments for buying and breeding horses; the largest of all is in Gallicia.

* *Auditoriat.*—There is an *Auditor* or Military Judge in each regiment. He has passed through his course as a law student, and declared for this branch. In every province there is a central department. These law officials rise through all the grades from Lieutenant up to General.

† One of the marks of superior rank is the amount granted for *allowances*, for which there is a carefully graduated scale.

1 Army Surgeon.
1 Surgeon's Assistant.
12 Sergeants for Inspection.
4 Orderlies, together with the requisite number of mechanics and servants.

The subjects of instruction are—

1. Religious Knowledge. 2. German Language and Art of Speaking. 3. French. 4. Natural History. 5. Geography. 6. History. 7. Arithmetic. 8. Algebra. 9. Geometry and Plane Trigonometry. 10. Rules of Drill and Exercise. 11. Calligraphy. 12. Common Drawing. 13. Gymnastics, Single-stick, Swimming.

Those pupils who satisfactorily complete their four years' course are transferred, according to their capacities, and as far as possible, to their own wishes, into one of the Military Academies. Entrance into the Marine Academy takes place at the close of the second year.

Pupils who do ill, will, at the close of any one of the three first years, be removed into the course of the following year at one of the Upper Houses of Education; or, at the close of the fourth year, into one of the Infantry School Companies.

This removal, in the case of paying pupils, will be dependent on the consent of the parents; failing which, they will be sent back home.

2. *The Military Academies.*

The object in these is to educate Officers in the higher military subjects for the different arms of the service.

There are four Academies; the Neustadt Academy, the Artillery Academy, the Engineers' Academy, and the Marine Academy.

The scholars in each are divided into four yearly courses of nearly equal numbers. In the Neustadt Academy each year is sub-divided into two parallel classes, the instruction being the same in both.

The pupils in the Military Academies are of the different kinds described in the account of the Cadet Houses, and the appointments similarly made; the Academies and the Cadet Houses in these respects forming a single body.

Candidates for admission into the Neustadt Academy, the Artillery Academy, or the Engineers' Academy, must be nearly, if not quite, fifteen, and not above sixteen years old. For admission into the Marine Academy, they must be nearly, if not quite, thirteen, not above fourteen years old.

The Academies receive their pupils in the first instance from the Cadet Schools, after the satisfactory completion of the fourth (or, in the case of the Marine Academy, the second) year, and then, as

already stated under the head of the School Companies, from the Artillery School Companies, and from the Engineer, Pioneer, Flotilla, and Marine School Companies, after the highly satisfactory completion of the second (or, in the Marine School, of the fourth) year.

Pupils from these School Companies, before entering the Academies, will take the Military Oath, receive the rank of Lance-Corporals, and be admitted free of charge as Attendant Pupils into the Academies, to receive their education for the rank of Officer. Scholars from the general body of soldiers, who are attending the School Companies, are to be treated, in respect of their transfer to the Academies, in the same way as the other pupils.*

Entrance into the Academies is confined to the commencement of the first year.† Pupils admitted from places of private instruction are examined in the subjects taught in the Cadet Schools; those who wish to enter the Neustadt, the Artillery or Engineers' Academy, in the following subjects, to the extent here described:—

1. German:—The Art of Speaking; Prosody; the Rules of Speaking; the various Rhetorical Styles.
2. Natural History:—General knowledge of the Three Kingdoms.
3. French:—General grammatical rules; Translation from German into French.
4. Geography.
5. History:—Ancient and of the Middle Ages.
5. Geometry and Rectilinear Trigonometry, with the Application of Algebra, and the Solution of Geometrical Problems.
7. Common Drawing.

Candidates for the Marine Academy will be required to know,—

1. The German Grammar, including Syntax.
2. Zoölogy.
3. French:—The Auxiliary Verbs; the Four Conjugations; Reading.
4. General Geography.
5. Ancient History.
6. Arithmetic and Algebra as far (inclusively) as Equations of the First Degree, with two unknown Quantities.
7. Common Drawing.

Candidates from both institutions must also possess the degree of religious knowledge corresponding to their age, and must write a good current hand.

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* In the School Companies there are two different sets of Scholars, those who have come from the Houses of Education or from private schools, and those who *attend* after two years' service in the Army. These are *frequentanten* in the School Companies, but all alike, who come from the School Companies, are *frequentanten* in the Academies.

† It appears, however, that a transfer of pupils, for example, from the Engineers' Academy to Wiener Neustadt, in consequence of incapacity for Mathematics, is allowed at a later standing. After passing a year at Znaim, a young man may enter the second year's course at Neustadt.

Pupils who are found negligent in the course of their academical studies, will at the close of the first, second, or third year be transferred to the classes corresponding to their age in the School Companies, or will be enlisted in the Army as Cadets if they possess the requisite bodily qualifications, in the manner already described.*

The Neustadt Academy.

Wiener Neustadt having been the seat of this Academy for more than a century, the ancient name thence derived will be retained in its usual acceptation, though the Academies for the Artillery and the Engineers will also be placed in the same locality. The institution counts 400 pupils, designed primarily for the Infantry of the Line and of the Frontier, and secondly, for the Chasseurs and the Cavalry.

The Director of the Academy is a Colonel or General, attached to whom, for purposes of instruction, discipline, and general management, there are three field and thirty-four other Officers; for religious care and instruction, four Ecclesiastics; for medical attention, one Regimental Surgeon, one Army Surgeon, and one Surgeon's Assistant; for the accounts, one Accountant, and four Accountant's Assistants. The large number of pupils maintained in the institution requires, moreover, a proportionately large staff for superintendence, a numerous body of attendants, servants, and the like; so that the whole number to be added to that of the pupils does not fall short of 309 persons; 64 horses are allowed for the riding lessons.

The plan of study is based on that of the Cadet Schools, and embraces the following subjects:—

1. Religious Knowledge. 2. French. 3. Italian. 4. Bohemian. 5. Hungarian. 6. Logic and Psychology. 7. Geography.. 8. History. 9. Analytical Geometry and Higher Analytical Mathematics. 10. Mechanics, Spherical Trigonometry, Mathematical Geography, Triangulation. 11. Natural Philosophy, Elements of Chemistry. 12. Practical Mensuration, taking Maps at Sight. 13. Descriptive Geometry. 14. Military Composition. 15. Positive International Law,† Austrian Civil Law (*Privat Recht.*) 16. Military Penal Law and Procedure. 17. Pioneer Service, with Field Fortification. 18. Permanent Fortification. 19. Civil Architecture. 20. Arms and Munitions. 21. Study of Ground and Positions, and Military Drawing. 22. Rules and Regulations, and Military Administration. 23. Rules of Infantry Drill and Exercise. 24. Rules of Cavalry Drill and Exercise. 25. Manœuvring. 26. Riding. 27. Gymnastics. 28. Fencing. 29. Dancing. 30. Swimming.

Pupils who show a talent for general drawing will be practiced in it.

* The wishes of the parents are, of course, consulted in the case of paying pupils, but it is said that their consent is very generally given.

† The Law of Nations as it exists *de facto* without consideration of its principles.

After the completion of the fourth year's course, the pupils will be recommended by the Supreme War Department to His Majesty for nomination as Second Lieutenants of the second class.

In their distribution into the various regiments, &c., of the army, the choice of the pupils will, as far as possible, be considered.

The pupils upon leaving will be, without exception, fully equipped at the expense of the State. Only in the case of the pupils who wish to enter the Cavalry, the parents (or guardians) will be called upon to give security for the payment of 1,000 florins (100*l.*) towards the expenses of the first equipment, and for a monthly allowance of 25 florins (2*l.* 10*s.*)

3. *The Artillery and Engineers' Academy.*

The arrangements of these two Academies are in many respects similar, as required by the character of the two kindred sciences for which they are founded.

The number of scholars is fixed at 160 pupils, and 40 attendant pupils (*Frequentanten*) in each.

The command in each is intrusted to a General or a Colonel.

For the smaller number of scholars, fewer instructors, superintendents, and attendants are needed; the complete amount in each Academy is fixed at 200 men, in addition to the scholars. Each has thirty-two horses allowed to it.

The plan of instruction is in many respects identical in each.

The subjects taught in both are—

1. Religious Knowledge. 2. French. 3. Italian.* 4. Logic and Psychology. 5. Geography. 6. History. 7. Analytical Geometry and Higher Analytical Mathematics. 8. Descriptive Geometry. 9. Mechanics and the Elements of the Study of Machinery. 10. Mathematical Geography. 11. Natural Philosophy and Chemistry. 12. Practical Mensuration, taking Plans at Sight. 13. Military Composition. 14. International Law; Austrian Civil Law. 15. Military Penal Law and Penal Procedure. 16. Military Drawing; Study of Ground and Positions. 17. Rules and Regulations, and Military Administration. 18. Riding. 19. Gymnastics. 20. Fencing. 21. Dancing. 22. Swimming.

Common drawing will be treated, as it is at the Neustadt Academy, as an optional subject.

In the Artillery Academy the following additional subjects will be taught;—

1. Bohemian.† 2. Field Fortification and Permanent Fortification. 3. Tactics of the Three Arms. 4. Artillery. 5. Sieges, Construction of Batteries; Artillery. 6. Rockets. 7. Rules of Drill and Exercise in the Artillery and

* This is at present, in point of fact, omitted for want of time.

† The Artillery is recruited very largely from Bohemia and Moravia. A knowledge of the Bohemian language (which is pretty nearly the same as Moravian) is therefore essential for an Officer in the command of Artillerymen.

Infantry. 8. Instruction in shoeing horses, in judging of their Age, in judging of them at Sight, in Bridling, Saddling, and Grooming.

In the Academy of the Engineers the additional subjects are—

1. Arms and Munitions and Artillery. 2. Art of Fortification. 3, 4. Civil Architecture, Plain and Ornamental. 5. Pioneer Service. 6. Rules of Drill, Exercise, and Manœuvring.

The pupils of the two Academies enter in the same way as those at Neustadt, after the satisfactory completion of four years' instruction, with the rank of Second Lieutenant of the Second Class, the respective services of the Artillery, and of the Engineers or Pioneers. Pupils for whom no vacancies can be found enter the Infantry.

4. *The Marine Academy.*

This, like the other Academies, is in the charge of a Field Officer, or a General.

The pupils are 100 in number; the Teachers, other Officers, and attendants, 88.

One essential distinction here (explained by the necessity of habituating the pupils to the sea) is the admission at an age earlier by two years, and the proportionally earlier termination of the course.

The plan of instruction combines a continuation of the studies prescribed in the Cadet Schools, with the commencement of those specially required for the marine service, viz.:—

1. Religious Knowledge. 2. German. 3. Italian. 4. French. 5. English. 6. Geography. 7. History. 8. Algebra. 9. Geometry and Plane Trigonometry. 10. Analytical Geometry and Higher Analytical Mathematics. 11. Spherical Trigonometry and Nautical Astronomy. 12. Mechanics and Natural Philosophy. 13. Descriptive Geometry. 14. Navigation. 15. Military Composition. 16. International Law, Austrian Civil Law, Sea Law. 17. Military Penal Law, and Penal Procedure. 18. Artillery. 19. Fortification, Attack and Defense of Coast Fortifications. 20. Naval Tactics and Naval History. 21. Knowledge of Rigging, &c. (*Takelungslehre.*) 22. Naval Manœuvres. 23. Naval Architecture. 24. Signals. 25. Rules and Regulations. 26. Rules of Drill and Exercise. 27. Calligraphy. 28. Military Drawing. 29. Common Drawing. 30. Swimming. 31. Gymnastics. 32. Fencing. 33. Dancing.

In addition to the practical instruction given in the course of the school year, the pupils of the three first years will in the months of August and September be sent in sailing vessels on a voyage for practice.

The pupils at the end of four years enter as Cadets into the Navy, the Flotilla Corps, or the Corps of Naval Architecture.

After completing a practical course of two years, they will receive their promotion as Second Lieutenants of the second class.*

C. SPECIAL SCHOOLS.

1. *The Military Teachers' School.*

The object here is a double one; first, to bring up good and serviceable teachers in the subjects of study prescribed for the Military Houses of Education; secondly to provide at the same time instructors in gymnastics and fencing for all the military schools and for the troops. The institution accordingly consists of two departments, each of thirty Attendant Pupils, receiving instruction in these two different branches.

Non-commissioned Officers are admitted after a service of at least two years. Candidates for admission into the Teachers' department must, in addition, possess the required amount of knowledge in the subjects taught in the Military Houses of Education; and, as a rule, must know, besides German, one other of the Austrian national languages. Proficiency in every one of the subjects will not be considered essential. Candidates for admission to the Gymnastic and Fencing Department will be required to show a certain amount of readiness in the use of arms and in gymnastic exercises, and an evident capacity for acquiring greater skill.

Registration for admission is to be obtained in the usual course of the service from the Supreme War Department.

The Attendant Pupils receive, in addition to their ordinary pay, bread and the extra allowance; and for their better subsistence also an allowance corresponding to that granted for provision during a march.

The command is held by a Field Officer or Captain; six Subaltern Officers and four Sergeants act as teachers, the latter as assistants in the instruction in fencing and gymnastics, and as swimming master. The instructor in the art and methods of teaching may be a civilian.

The subjects of instruction in the Teachers' Department are—

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* Literally, "as *Frigate-Ensign*, or Second Lieutenant of the second class," the former being in rank the same as the latter. The order of rank is,—

Captain	of a Man-of-War	equal to a	Colonel in the Army.
"	of a Frigate	"	Lieutenant Colonel ditto.
"	of a Corvette	"	Major ditto.
Lieutenant	of a Man-of-War	"	First Captain ditto.
"	of a Frigate	"	Second Captain ditto.
Ensign	in a Man-of-War	"	First Lieutenant ditto.
"	in a Frigate	"	Second Lieutenant ditto.

In the Corps of Naval Architecture the ordinary military titles are used.

1. The Art and Methods of Teaching. 2. German. 3. Another Austrian Language. 4. Arithmetic and Geometry. 5. Geography. 6. Military Composition, and the Management of the Internal Affairs of a Company. 7. Calligraphy. 8. Common and Military Drawing. 9. Gymnastics, Fencing, and Swimming.

In the Gymnastic Department,—

1. Staff, Rapier, Sword, and Bayonet Fencing. 2. Gymnastics and Swimming. 3. Knowledge of Fire-arms.

In both Departments a certain number of hours weekly will be devoted to Military Exercise.

Instruction in all the subjects will be given with special reference to the methods to be pursued in teaching them in the various Military Schools.

The course in each Department lasts one year. Under certain circumstances particular pupils in the Teachers' Department may remain for the further completion of their studies a second year in the institution.

In the Teachers' Department, pupils who show no aptitude or liking for some particular subject, may be exempted from attending the lessons given in it, so as to allow them to give more thorough attention to other branches.

After passing the examination, the pupils are either sent immediately to undertake duty in the Military Schools, or return to their service in the troops, and pass, as occasion requires, into the Military Schools. Corporals who distinguish themselves by remarkably good progress will be promoted to the rank of Sergeant.

2. *The United Higher Course for the Artillery and Engineers,*

Has for its object the more advanced instruction of young Officers in a scientific and technical point of view, for service in the Artillery and Engineers.

Twenty Officers, of more than usual capacity, between twenty-one and twenty-six years of age, will be admitted from each of the two arms. They must be unmarried, and must have served with distinction during a period of not less than two years.

Officers in whose cases these conditions are satisfied, and who desire to be admitted to the course, apply for registration for admission to the examination, in the ordinary form, to the War Department.

Officers who, in the month of October, are summoned to attend, may charge their traveling expenses to the Treasury, and undergo an examination before the Professors attached to the Course, in the following subjects:—

1. Analytical Geometry and Higher Analytical Mathematics. 2. Mechanics and the Elements of the Study of Machinery. 3. Natural Philosophy and Chemistry. 4. Military Composition. 5. French. 6. Military Drawing, tested by the production of a Drawing of their own doing.

Candidates for the Artillery will be, moreover, examined in the Tactics of the three Arms, and in Artillery; and those from the Engineers, in the Art of Fortification and in Civil Architecture, both Plain and Ornamental.

The text-books used in the Academies of the Artillery and Engineers will serve as a measure for the range of attainment required. Pupils who passed with distinction through these Academies will thus be specially fitted for admission into the Higher Course after they have proved, during their time of service, their diligence in bringing the knowledge they have acquired into actual application.

On the close of this preliminary examination, the results will be submitted to the Supreme War Department, and the recommendations for admission laid before His Majesty.

A superior Field Officer, either of the Artillery or the Engineers, will be intrusted with the charge of the united course. The lectures will be given by the Professors of the Academy of the Artillery and Engineers. From the nature of the duties, partly common and partly distinct, which devolve upon the two corps, it follows that the course of the studies (which will be carried on during two years) will in like manner be partly common and partly separate.

The subjects of common instruction will be—

1. Mechanics in application to Machinery, combined with Machine Drawing. 2. Natural Philosophy and Chemistry, combined with practice in manipulation, in making experiments, and in analyzing. 3. Theory of Artillery, in reference to the constructions that occur in Artillery. 4. Higher Tactics. 5. Principles of Strategy, illustrated by the representation of campaigns, with special attention to the use of Artillery, as well in Attack and Defense of fortified places, as in the field.

Separate instruction will be given to Artillery Officers in—

1. Service in Workshops, Depôts, and Arsenals. 2. Knowledge of Foreign Artillery, of the requisites (*ausrüstungen*) for Field service and Sieges, and for furnishing fortified places.

To Engineer Officers, in—

1. Ornamental Architecture, combined with Architectural Drawing. 2. The Art of Fortification, special attention being given to working out projects.

The pupils receive in addition practical guidance and supervision in all subjects of a scientific nature connected with the Art of War.

The pupils of the second year undergo an examination in October. Upon the results of the examination the War Department decides on their promotion for the rank of Second to that of First Lieutenants.

3. *The War or Staff School.*

The object of the War School is to give Officers of all arms an education for higher duties, especially for those of the Staff and of the Upper Adjutant Department.*

Any Subaltern Officer of the active army, without distinction of arms, may claim admission into the War School, provided he is above twenty-one and under twenty-six years old, is unmarried, and has served as Officer uninterruptedly and with distinction two years at least with the troops, and, provided, finally, he has passed the prescribed preliminary examination.

For admission to the examination, registration, to be obtained in the usual form from the War Department, is requisite.

The examination is conducted between October 10th and 20th, in the War School buildings; the registered candidates will be summoned to Vienna at the beginning of October; traveling expenses will be paid by the Treasury. The subjects are—

1. Algebra and Geometry, including Plane and Spherical Trigonometry. 2. Geography. 3. History. 4. Arms and Munitions. 5. Field and Permanent Fortification. 6. Pioneer Service. 7. Rules of Drill and Exercise (in detail, for the arm in which the candidate has served, and generally for the other arms.) 8. Manœuvring. 9. Military drawing, tested by the production of a drawing of the candidate's own doing. 10. Military Composition, tested by working out an exercise in the presence of the Commission. 11. French. And finally, 12, the candidate must be able to speak one of the national languages of the Austrian Empire, Slavonic, Hungarian, or Italian, and must write a good current and legible hand.

The amount of knowledge required in these subjects will be regulated by the range of the text-books prescribed for use in the Academy at Neustadt. Regard, however, will not so much be given to the minutiæ of knowledge possessed by the candidate, but rather to the evidence of his having a correct judgment and quick apprehension, and the power of expressing himself both orally and in writing.

Upon the results of the examination, formally drawn up by the authorities of the school, recommendations for admission will be submitted to the sanction of His Majesty.

The number of attendants in the War School is fixed at thirty, and the length of course is two years.

* The Higher *Adjutantur* or the Aide-de-Camp Department.

The attending pupils receive, in addition to their ordinary pay, a monthly allowance of twenty florins, rations, and allowance for two horses; when employed in taking surveys and reconnoitring, they have an extra allowance of thirty florins monthly.

The War School is commanded by a General or Superior Field Officer.

Five Field Officers or Captains, taken as a rule from the Staff, give lectures on the prescribed scientific subjects. One Field Officer or Captain of Cavalry takes the duty of riding-master; and one civil Professor that of instruction in the French language and literature. Necessary officers, attendants, and servants take the duty of adjutants, of the internal management, of the service, and of attending to the thirty horses.

The first year's subjects of instruction are—

1. Military Drawing and the study of Ground and Positions. 2. Higher Tactics. 3. Staff and Superior Adjutant Duty. 4. French Language and Literature. 5. Riding.

Those of the second year,—

1. Military Drawing, Ground and Positions. 2. Military Geography. 3. Principles of Strategy, illustrated by representations of some of the most instructive campaigns. 4. French Language and Literature. 5. Riding.

The course begins on the 1st of November, and lasts to the end of September.

The Attendants at the War School must be practiced in those arms in which they have not served. They are for this purpose distributed into the various bodies of troops forming the garrison of Vienna, go through the exercises and manœuvres of these troops—in the first year with one, and in the second with the other arm. At the termination of these periods of practice, they will be called upon to undertake the command of a Battery, of a Squadron of Cavalry, and of a Division of Infantry.

In the month of May, the attendant pupils of the first year will go out upon a course of practical surveying; those of the second year will be similarly employed in reconnoitring, choosing sites for encampment, discovering, judging of, and describing proper points for taking up positions, forming *têtes-de-pont*, entrenched camps, and the like, and in performing other duties falling within the service of the Staff.

At the beginning of October, the pupils of the second year will undergo an examination, which will be conducted both orally and by papers.

Upon the results of this the Supreme War Department will determine upon their promotion to the rank of First Lieutenants (if they are not already of that rank,) and this without any reference to their previous position, their position henceforth being simply determined by their merit.

The same grounds determine the cases of those who are admitted to the Staff, or who return to their respective arms.

Those who, after a satisfactory completion of the course, return to service with the troops, will, after three years' meritorious service, be specially recommended for extraordinary promotion.

Control of the Institutions.

The Upper and Lower Houses of Education, the Infantry School Companies, the Cavalry School Squadrons, and the Frontier School Companies, are under the orders of the Commanders of the Army, the Army Corps, or the military government in whose district they are situated. The Artillery and Engineer School Companies are under the orders of the General Artillery and Engineer Departments; the Pioneer and Flotilla School Companies, under those of the Quartermaster-General's Department; the Marine School Company, under those of the Admiralty. Which functionaries, however, receive from the Supreme War Department all directions relating to organization and instruction.

The Cadet Schools, the Academies, the Military Teachers' School, the Upper Artillery and Engineer Course, and the War School, are immediately under the orders of the Supreme War Department.

The general organization of all the military schools and places of instruction is once for all established by the regulations sanctioned by His Majesty. These regulations contain all that concerns the physical, moral, and intellectual training of the pupils, and all have the one object of rearing them up as worthy members of the Austrian army, and faithful supporters of the throne and of the honor of their country.

III. REMARKS ON THE AUSTRIAN MILITARY EDUCATION.

The English Commissioners in their General "*Report on the Education and Training of Officers for the Scientific Corps*" hold the following language:—

The magnitude of the Military Education of Austria entitles it to rank among the chief Institutions of the Empire. It has been remodeled since the wars of 1848, 1849. It is now centralized, and wholly directed by one of the four Co-ordinate Sections of the War

Office, which is independent of the others, and reports directly to the Emperor. This Educational or "Fourth" Section has the control of between 300,000*l.* and 400,000*l.* yearly. It provides for the free or nearly free education of more than 5,000 pupils. The extent and completeness of the system will be best understood by a reference to the clear and valuable official account of the schools.*

The military schools are divided by this document into (1) those which educate pupils for *Non-commissioned Officers*, (2) those which educate for *Officers*, (3) and those *Senior Schools* which complete the education and extend the instruction of both classes. The method of training Non-commissioned Officers is a peculiar and remarkable part of the system.

1. No less than 5,730 pupils are in process of being educated for Non-commissioned Officers. They are received into a Military School at seven years old, and at that early age are devoted to the army, with a kind of solemnity, by their fathers, somewhat similar to the practice at Woolwich Academy:—"I hereby pledge myself to surrender up my son to the Imperial Military Service, in case of his being admitted into a Military Educational Institution, and I will under no pretext require his return." This promise, as the official document states, may no doubt be recalled if the youth finds that he has mistaken his vocation; but it must exercise great influence (and such is its avowed object) in retaining him in it.

After passing successively through two Junior Institutions,—the Lower Houses of Education, where he continues till eleven years old, and the Upper Houses, where he remains till fifteen,—the boy receives his finishing course in one of what are termed the School Companies, the highest class of schools for training boys to become Non-commissioned Officers in all arms of the service. These are twenty in number, and scattered over the whole Empire, containing generally 120 pupils each, though in one case only sixty; and with a course of either two or three years, according to the nature of the service. The extent and the requirements of the Empire give a striking variety to their character. Thus, in the frontier School Companies, "the range of the studies is more extensive, because the Non-commissioned Officers on the Military Frontiers are intrusted with the general administration, and require of necessity a knowledge of Political Administration, of Jurisprudence, and Agriculture;" and thus also the Non-commissioned Officers for the responsible Flotilla Service of the mouths of the great rivers, the lagoons of the Po, the head of the Adriatic, and the lakes, are carefully

* See *Ante*, p 412—441

educated and frequently promoted. Following the course of a pupil through these Upper Houses and School Companies, we were much struck by the sensible and vigorous character of the education, and the motives supplied for exertion. In the Upper Houses the boys compete for entrance to the School Companies which they prefer, and the more scientific companies are a special object of ambition, because it is more usual in these for young men to be raised by their talents to the Academies, and thus made Officers, "free of all cost:" according to the regulations, however, this is possible in all. It may be stated that from six to ten pupils from each of the more scientific School Companies,—the Artillery, Engineer, Pioneer, Flotilla, and Marine Companies,—are yearly transferred to the Academies, to complete their education there for the Officer's Commission.

A system of this kind, supplying at once a good education and large opportunities of advancement, must necessarily operate as a great encouragement to young men educating for Non-commissioned Officers; and allowing for the social differences of the two countries, it resembles in spirit the French system, which throws open the gates of the Polytechnic and St. Cyr, and with them a proportion of the Commissions in the Army, to all.

This, however, is not all. The sums devoted to the education of Non-commissioned Officers, as well as Officers, are immense, and may be regarded as a spontaneous contribution of the National Feeling, no less than a State provision. A system both of public and private foundations (*Stiftungen*) prevails—part derived from the Emperor, part from the provinces, part from private gifts and legacies—by which 3,190 pupils are supported in the Houses of Education and the School Companies, and 1,320 in the Cadet Schools and Academies. The very large majority of these exhibitions supply a *complete*, about 200 a *partial*, maintenance. And it is curious to observe the aid to education which is so common in our own Universities, devoted in Austria to what may be termed the great National Institution—the Army,—and retaining all the limitations to the descendants of Founders or Natives of provinces which marked our own foundations. Some of these exhibitions have been founded by foreign soldiers for their own countrymen. Thus there are two bearing the name of the O'Gara and the O'Brady, to be held by any Irishmen of good family, one of which is in the gift of the Roman Catholic Archbishop of Dublin. We should add that this system is still a living and popular one. Within three years the city of Brünn has founded such an exhibition "for sons of Austrian subjects in Moravia, and by preference in Brünn, in

commemoration of His Majesty's escape from assassination in 1853." We ourselves heard a distinguished Officer express an intention of founding one of these Exhibitions. The comparison with the open *Bourses* of the Polytechnic is remarkable; but the Austrian appointments to free places seem to be given, like the Prussian, solely as rewards for the service of the parent.

2. The education of young men for Officers is conducted upon the same principles which regulate that for Non-commissioned Officers. The age of admission to a Cadet School is about eleven. The pupils are pledged to the service with the same formalities which we have noticed in the Lower Houses of Education. Between fifteen and sixteen they enter one of the Academies for the Line, the Artillery, the Engineers, or the Marine, and after four years they pass to their respective services.

Thus, unlike the French system, that which is followed in Austria commits the pupil to the Army, and to a Military Education, from an early age, resembling herein the plan of the *Accademia Militare* of Turin. But an attempt seems to be made to combine general with special teaching. Thus, although even in the two first years (from fifteen to seventeen,) at Wiener Neustadt, there is some introduction of successful practical military teaching, the chief weight is thrown upon mathematics, history, geography, drawing, and French; special military teaching has a greater, though far from an exclusive place, in the two last years. The studies are high, and (as far as we could judge) pursued carefully, and with excellent discipline.

The description we have given of the system pursued in the Schools for Non-commissioned Officers will have shown that there is a constant appeal to emulation. The same is found at Wiener Neustadt. There is a careful system of assigning credits during the whole school period, which itself argues competition. The chief immediate reward, indeed, is the choice of a regiment on leaving the school; but the prospect of entering the Staff School stands in no distant perspective, and this is filled with so many pupils from Wiener Neustadt, that it must be looked upon as the sure reward of a successful Neustädter. There are other inducements of a different character. The discipline being strict, pupils are constantly removed from Wiener Neustadt and the other Academies to the schools for Non-commissioned Officers, and though sometimes allowed to enter the army as Officers, it must always be as juniors to their contemporaries at Wiener Neustadt. We heard instances of great strictness in this matter.

The new course for the Special Arms in Austria is not yet com-

pletely in operation. It is at present carried on separately in the Academy of Olmütz for the Artillery, and that of Znaim, in Moravia, for the Engineers. There are 200 pupils in each Academy, and the courses of instruction, which are more special or technical than at Wiener Neustadt, last four years, from the age of fifteen to nineteen. The yearly examinations, the manner in which the marks of the monthly examinations tell on the final one, and the careful classification of the pupils in the order of merit, reminded us of the system of the Polytechnic more than any other school we have seen. And an inspection of the very high credits obtained by the first thirty pupils will prove the diligence with which the studies are pursued. We should add that several pupils of marked talents come from the scientific School Companies. A further fact bears witness to the vigor of the discipline. We have alluded to the dismissal of unpromising subjects from the Austrian Military Schools. In the course of three years, since the changes of 1850, it appears that nearly 100 pupils were removed from Znaim, as not coming up to the standard required for the Engineers by the new regulations.

3. The courses of instruction in the three Academies for Infantry and Cavalry, Artillery, and for Engineers, last for the same time, and run (as it were) parallel to each other. Each is, or is to be, completed by a senior department. The United Course for the Artillery and Engineers is not indeed yet combined in the magnificent buildings begun at Wiener Neustadt; but it is already organized in a provisional state at Znaim for the Engineers, and the plan of instruction drawn up is a solid one. The arrangements for the general Staff School require more remark.

In our report upon Austrian schools we have specially noticed this School as remarkable for its thorough and open competitive character from first to last, and its very sensible plan of study. Admission to it is by competition, open to Officers of all arms: the pupils are not unduly overburdened with work; perhaps, there is even room for one or two more subjects of importance; but what is done seems to be done thoroughly; the Officers are carefully ranked, on leaving the School, according as the abilities they have displayed, may be considered a criterion of their fitness for employment on the General Staff; and *in this order* they enter the Staff Corps. The consequence is that every Officer knows distinctly, from the time that he first competes for admission until his final examination on leaving, that the order in which he will enter the Staff depends entirely on his own exertions and success at the school. It seemed

to us that this open competition produced a spirit of confidence and energy in the students, as great, if not greater, than any we met with elsewhere.

The whole of the above system of education is directed by the Fourth Section of the War Department. In all the schools we found traces of its activity; and the energy and system which prevail in the Military Teaching of Austria appear in great measure to result from its being directed by this single head.

IV. THE STAFF OR WAR SCHOOL AT VIENNA.

[From Report of English Commissioners in 1856.]

The Staff School (Kriegs-Schule,) in Vienna, was established in 1851, and grew out of the experience of the Hungarian war, although a Staff-Corps had existed for more than a century in the Austrian army, and for many years past all the appointments in it have been made upon an examination, which was, in fact, one of competition. The process was formerly as follows:—

An officer desirous of becoming a candidate for a staff appointment, sent in his name to the colonel of his regiment, whose recommendation he was obliged to obtain as a preliminary step. If supplied with this, he began his course of staff study, and was sent for this purpose to some large garrison town as an *attaché* to the staff. Whilst here he went through, for two years, the course of drawing, writing military memoirs, mapping the country, &c., and for two years more served on active staff duty with different bodies of troops. At the end of these four years a number of the officers thus employed in a particular country were brought together, and examined by the chief of the staff in the country, assisted by a board of officers appointed for the purpose. No actual list was drawn out of the order in which the candidates acquitted themselves, but it was understood that the best were chosen and put upon the general staff. The work upon this was exceedingly laborious; few except officers of real ability were candidates for it, and patronage in it was looked upon with great dislike. On the other hand, studies and reading were not made the first requisite; a ready intelligence and quick eye to make an officer a *Colonnen-führer*,—leader of a column on a march,—were always most valued.

Before describing this school, it may be as well to mention shortly the staff-corps and the corps connected with it.

1. The General Staff of the Austrian Army consists of:—

Twelve Colonels.
Twelve Lieutenant-Colonels.
Twenty-four Majors.
Eighty Captains.

The *attachés*, to the number of eighty,—*i. e.*, those who are expecting appointments, may be subalterns, but they obtain the rank of captain on joining.

The chief of the staff-corps is Field-Marshal Hess.

2. There has been created very lately a separate corps of adjutants or aids-de-camp, who are charged with the administrative duties, such as inspecting the bearing, equipment, carrying on the discipline, &c., of the troops. This consists of—

Eleven Generals.
Eighteen Lieutenant-Colonels.
Eighteen Majors.
Fifty-eight First Captains.
Ten Second Captains.
Ten First Lieutenants.

There is no examination for entrance into this corps. Appointments are made by the generals, and we were told that there was some scope for "protection."

3. There is also a smaller corps for the purpose of surveying, called the Corps of Geographical Engineers, connected with the staff, inasmuch as some of the staff officers draw the maps on a large scale, which it is the business of this corps to reduce. It is usually occupied on the Great Surveys of the Empire; at present it is employed on the Survey of the Principalities.

It consists of—

One Colonel, called the Director.
Two Lieutenant-Colonels.
Two Majors.
Sixteen Captains.
Sixteen Lieutenants.
Four Sous-Lieutenants.

The staff school consists of thirty pupils taken from all arms of the service, fifteen being received each year, and the course of study lasting two years. It is under the direction of a general and a lieutenant-colonel; and, with few exceptions, such as might occur in the time of war, no appointments on the general staff are to be given to any officers who have not passed through the staff school.

In order to enter the school for the staff corps, an officer must have served at least two years with his regiment, and be unmarried, and above twenty-one and under twenty-six years of age. He may then forward to the chief of the staff, through his colonel, his claim to be admitted as a candidate at the entrance examination. Further inquiry is made, and a good many of the names sent in are struck off the list. Such, we were told, was the case last year when the names sent in were very numerous, but out of these only forty-five were allowed to compete, and out of these again only fifteen (the regular yearly number) were selected. The competition for entrance into the school is indeed said to have been very active ever

since it was opened. Most of the students are *Neustadters;* the seven professors were all, with the exception of the professor of the French language, military men, and chiefly officers of artillery, formed in the long studies of the old Bombardier School.

The subjects in which the candidates for admission are examined are—

1. Algebra and Geometry, Plane and Spherical Trigonometry.
2. Geography.
3. History.
4. Arms and Munitions.
5. Field and Permanent Fortification.
6. Pioneering.
7. Rules of Drill and Exercises.
8. Manœuvring.
9. Military Drawing.
10. Military Composition.
11. French.
12. To be able to speak one of the Austrian national languages, and to write a good current and legible hand.

The most striking features in the system of this school, both at the entrance and throughout the course, are that it is distinctly competitive, that it admits very young officers, and that while the work is considerable, the subjects for study are not numerous. In these three points it differs considerably from the Prussian Staff School, in which the students are generally older, and the principle of competition is not so fully carried out. In the Austrian school, the students are placed on entering in the order which their entrance examination has just fixed. They are examined once a month during their stay. On leaving the school, their respective places are again determined, and they have a claim for appointments in the staff corps in the exact order in which they were placed on leaving the school.

Their relative places on leaving the school are assigned to them, as we were assured, very carefully, and, after much consultation in every case among the professors; but this is not done by marks, nor by any minute system of testing intellectual qualifications, but an estimate is formed upon the whole work of the two years, both on the studies in the school and the practice in the field,—of the student's comparative fitness, *as an officer, for the work of the staff.* "We try to estimate the whole man," was the expression used to us, "whether he will make a good *Colonnen-führer*" (a good man to direct a regiment on a march,) as was said elsewhere. This general estimate was preferred to that of marks, on the ground that the latter might give too much weight to the more appreciable, *i. e.*, simply intellectual qualities.

The students do not at present live within the establishment, but

are to do so when the new ones, building, are ready. They begin their lectures at half-past seven and end at one or three o'clock on alternate days, going to the riding-school in the afternoon on the days when their morning's work ends at one. Thirty horses are kept for their use.

The subjects of instruction during the first year consist of—

1. Military Drawing and the Study of Ground and Positions.
2. Higher Tactics.
3. Staff Duties.
4. French Language and Literature.
5. Riding.

And those of the second year are as follows:—

1. Military Drawing, and the Study of Ground and Positions.
2. Military Geography.
3. Principles of Strategy, illustrated by representations of some of the most instructive campaigns.
4. French Language and Literature.
5. Riding.

The students are occupied at the school about eight hours daily, and their chief work is military drawing and topography. We went into the room where the students of both years were working together at drawings and plans under an artillery officer, said to be one of the best draughtsmen in the army. Some of the plans were modeled in soap, the *hachures* being marked very elaborately, so that the models and drawings might closely correspond. We also attended a lecture of the second class in military geography. A student traced out on the blackboard the line of the Western Alps, and was examined very closely on the smaller passes, the rivers, and the bases of operations for armies on both sides. The answers were very minute, and given with the greatest readiness; and we understood the question to be taken at random, and not to be a prepared one.*

* It may be desirable to give some specimens, taken from the official account of the school, of the questions put at the examinations for admission,

I. *Viva voce.*

1. Mathematics:—
   Give an explanation of geometrical series, and a proof of the general formula.
   How is the circumference and area of a circle determined? How are the trigonometrical functions of the different quadrants of the circle indicated?
2. Geography:—
   What is meant by the *backbone* of Europe? What states does it pass through?
   The source of the Elbe; its principal feeders?
3. History:—
   Describe generally the wars of Charles V.
   The political consequences of the Battle of Leipzig.
4. Arms and Munitions:—
   What is the material of sword blades? how are they made and proved?
   How are gun carriages made for field and siege guns?
   What kinds of hollow shot are used in the Austrian artillery, and on what do their effects depend?

The student officers attending the school are called upon to serve in those arms to which they do not belong. For this purpose they join the troops of the garrison of Vienna during June, July, August, and September, and if they belong to the infantry they go through all the exercises of the cavalry in one year, and of the artillery in another. If they belong to the cavalry, they go in the same manner through the exercises of infantry and artillery. After going through this practice, they have to take command of a battery, of a squadron of cavalry, and of a division of infantry.

The month of May is devoted in the first year to an expedition for practice in surveying the country, and in the second, for making reconnaissances, &c.

October is a vacation in the first year. In the second it is taken up with the final examination before leaving.

The officers acting as professors receive 600 florins, about 60*l.* annually, besides their pay.

Immediately after the final examination, if there are any vacancies in the staff corps, the pupils receive appointments in order of merit, and are at the same time made captains. In proof of their receiving appointments on the earliest opportunity, we were told by Colonel Scudier that the last ten vacancies in the staff corps were filled up out of the twelve students who had just left the school.

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5. Field and Permanent Fortification:—
   - How is a trench made?
   - How is a parapet built?
   - What does a front of fortification consist of? what is the disposition of the several lines? what parts protect the principal rampart? what is the form of the flanks? and how is the main ditch made?
   - What is meant by detached works? where are they placed?
   - What are the best arrangements for the successful defense of a fortress?
6. Pioneer Service:—
   - How are two beams of the same dimensions fastened together in the same direction?
   - How are suspension bridges put up?
7. Rules for Drill and Exercise:—
   - (*a.*) Infantry.
     - Wheeling during a march.
     - Forming of close battalion column.
   - (*b.*) Cavalry.
     - Marching in files and fours.
     - Forming line from the flank to the front and rear.
   - (*c.*) Artillery.
     - Intervals and distances in a battery.

II. Paper Work.

In Mathematics:—

1. Prove that in every triangle the square of the one side is equal to the sum of the squares of the two other sides, less twice the product of these two, multiplied by the cosine of the angle they inclose.
2. If the hypothenuse is 33, and one angle 25° 48′ 12″, find the other angle and the perpendicular, &c.

One of these was only a second lieutenant, and in order to make him a captain, (the rank required for the staff corps,) the Emperor promoted him to be a first lieutenant immediately, and to be a captain within three days afterwards. This double promotion was on the ground of great merit.

If an officer finds no vacancy in the staff corps ready for him, he must return to his regiment and wait as an attaché. But if a second lieutenant, he is entitled immediately to a step of rank, and if a lieutenant, after three years' service he is made a captain, although he may not even then be attached to the staff corps.

There are to be eighty of these attachés to the staff. Their number at present amounts to only thirteen.

With regard to special aids-de-camp, generals are allowed to choose their own, without examination, but with this limitation, the officer chosen must not be a relation.*

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* The following shows the nature of the Report presented by the examiners upon an Officer examined for admission. It is called the *Prüfungs-Act*, and is sent into the Supreme War Department, that is, to the Fourth Section.

Form No. I. gives the name, age, rank, and length of service of the Candidate (Lieut. R. H.)

Form No. II. :—*a* Oral Examination.

1. Mathematics,	Very good.
2. Geography,	Very good.
3. History,	Very good, knowledge thorough, statements logical.
4. Arms and Munitions,	Excellent; acquainted with the very details.
5. Field and Permanent Fortification,	Both satisfactory.
6. Pioneer Service,	Very good.
7. Drill and Exercise Rules—	
Infantry,	Very good.
Cavalry,	Not thorough.
Artillery,	Good.
8. Manœuvring,	Excellent.
9. French,	Translates without difficulty from French into German, and German into French. Not much practice in speaking.
10. National languages,	Speaks good Bohemian.

b. Paper Work—

1. Mathematics,	&c. &c.

c. Accomplishments—

Writing.

Military Drawing.

Remarks.—Lieutenant R. H. is a pupil of the Neustadt Academy, of much natural talent, and quick apprehension. His way of expressing himself is quick and logical, and shows a clear head. He has a fair military bearing, and prepossessing appearance. He gives every hope of proving a useful Officer of the Staff, and deserves admission into the War School.

Form No. III. gives the questions actually put, as in the note on the preceding page.

(Signed) . . . . . .

MILITARY EDUCATION AND SCHOOLS IN 1869.

PRINCIPLES OF MILITARY EDUCATION.

The disastrous results to the integrity of the empire and the reputation of the army, of the military operations of Austria in 1858, against the combined forces of France and Sardinia, and of the still more humiliating defeat in the brief but momentous campaign of 1866 against Prussia, forced the military authorities of the Austro-Hungarian Empire to a thorough investigation of her military system and the education of the officers of her armies. It was not difficult to account for ultimate defeat in the larger armies and better prepared in all the resources by which large armies are equipped, fed, and moved. But military critics were not slow in discovering that better preparation should have been made, the field should have been taken earlier, and the forces combined and moved with great certainty and skill.

In a Report by the Minister of War on the necessity of reorganizing the educational system of the Imperial army, and in the plan for such reorganization the author, Baron Kahn, starts with a principle which the great Empress Maria Theresa announced when she laid in 1748 the foundation of the earliest war school in Austria (Wiener Neustadt), and which Frederick the Great avowedly imitated in his War Academy in Berlin in 1764,—"In this school shall be formed *men* only, and of them, *soldiers*." The choice of the profession of arms must be postponed till a good general education, reaching the moral as well as the intellectual and physical qualities of the future officer, has been imparted. The separation of the military pupils from their families at an early age must be avoided, and hence the number of cadet boarding schools for young aspirants are diminished. The intellectual preparation required, the sharpening and hardening the mental faculties, must not be gained by an exclusive mathematical course, in special schools, but in the general training of the public schools, the Real Schools or Gymnasia, of the country. A more practical knowledge of the common studies,—of geography and national history and the whole science of public economy and the martial resources of the empire, must be gained before the special military instruction begins. Admission to the higher military schools must be given only to aspirants of mature age, of high moral qualities, and of thorough intellectual activity—ascertained by careful examination and tested by at least one year's service in connection with a regiment.

PLAN OF REORGANIZATION.

The military schools are divided into two classes, viz.:—

(1.) Those which give a boy a general education, but prepare him at the same time for the military profession.

(2.) Those which educate boys only in military matters.

In the first class may be included (*a*) all those lower class institutions in which military orphans and sons of poor non-commissioned officers and commissioned officers are educated; (*b*) the middle (cadet) schools which prepare students for the military academies; (*c*) the military academies, viz., *Wiener Neustadt*, and the engineer and artillery academies. As pure military schools, may be mentioned the schools for non-commissioned officers in the infantry, engineer, artillery, and pioneer corps; the cadet and division schools in the infantry; the higher artillery and engineer courses.

(*a.*) The lower schools for the education of military orphans of a tender age have the same system as the common schools of the like class (*Normal* or *Volks Schulen*), where the moral qualities are to be chiefly inculcated on Christian principles; it is therefore necessary that children should not be taken from family influences earlier than can be helped. It will therefore only be necessary to take into these schools such children as are orphans, or sons of penniless parents, or at all events those whose families can not be induced to educate them at home even by pecuniary assistance. One school would be enough for such boys, in which the moral education would be the first object, as the necessary education required to prepare the scholars for the higher schools and regimental cadet schools may be obtained by their attending the public schools.

(*b.*) As regards the middle cadet schools, they should be abolished, as they do not agree at all with the above-mentioned principles. Boys are torn from home at much too tender an age, and are not brought up in the path of morality. Should a reform only of these schools be intended, this would be so expensive that the improvement gained would be dearly paid for.

As the army is not only to be composed of drilled soldiers, but also of generally well educated men, in order to improve their intellectual position and the spirit of the army, and to prevent the undue growth of drill and mere formalities, it is of great necessity that the military schools should be brought into harmonious concert with the civil schools. The deficiencies of the latter are less than those of the former, and it may be expected that they will soon be removed. In accordance with these considerations (and there are yet many more), it is much to be recommended that these two institutions should be abolished, not only as being right in principle, but also in agreement with the laws of national economy.

By the laying down of the system of education to be taught at the common middle schools, as a condition of being allowed to enter a military academy, in connection with the influences of the moral development of the family circle, up to the fifteenth year of a boy's life, it is to be hoped that the general above-named principles will be attained; and when the poor officers are allowed the means to educate their boys aspiring for the military academies by granting them pecuniary allowances, it may be hoped that they will not only be contented, and will care for the moral education of their children, but that the State also will find in the system the best means of attaining its object.

As regards the higher schools, especially military ones, the following may be observed:—

There are two establishments at present:

(*a.*) The Military Academy and Wiener Neustadt for general education.

(*b.*) The Engineer Academy, as a special school for the engineers, and for the instruction of officers in general.

The latter of the two is not efficient enough, for not more than eight or ten persons at most are instructed as engineers in it, the rest being detailed for the infantry, cavalry, &c. As by the establishment and organization of division schools a sufficient supply of officers aspirant is provided, and as the officers detailed from the above-named academies to the line are not more efficient than the scholars of the division schools (especially when the extra cost of the academy education is considered), the Engineer Academy must be looked upon as much too expensive. I agree, therefore, with those who recommend its abolition. On the other hand, the Neustadt Academy, which offers to its students a more general, and therefore a better founded education, and where highly instructed officers can be educated in larger numbers, may be allowed to remain, both in consideration of its efficiency and in honor of its serene foundress, the great Empress Maria Theresa, but on condition of its being reorganized in accordance with the principles laid down by that noble lady in the following words:—"That in this school shall be formed *men* only, and of them *soldiers*."

The said academy must, however, seek to attain to a higher degree of perfection than of late. The classics must be more cultivated, as also national economy and a general civilized education. It should be organized for a course of six years, and it should receive students, sons of officers or military officials, who have successfully passed two or three Latin or technical schools.

The following subjects should be taught, besides the military and mathematical sciences:—

(1.) The Latin language, sufficient to understand the Roman classics.

(2.) All human sciences; particular attention should be paid to style, as it has been observed that since Latin has not been taught in the Wiener Neustadt Academy, there has been a great falling off in this respect. Rhetoric is to be taught in a practical manner, as the knowledge of how to speak is of importance in our constitutional era.

(3.) Philosophy, two years; in the first year, psychology; in the second year, logic to its full extent, moral philosophy, metaphysics, and the history of philosophy.

(4.) Statecraft, state and international law, and the fundamental law of the Austrian monarchy.

(5.) The rudiments of economy and national economy.

As special schools for the army the following should be retained:—

(*a.*) A special engineer and artillery school.

(*b.*) A special school for the pioneer corps, where the special knowledge necessary for that arm, as well as other military matters, are taught. The scholars should be between the ages of 16 and 19 years.

The students of the institutions intended for the education of the engineers and artillery will be enrolled in their respective corps quartered in Vienna. They will there have to pass a proper course of high mathematics, natural philosophy, and architecture at the Polytechnic; after they have succeeded in this, they will be either detailed for two years' active duty with their corps, or they may be at once ordered to pass through a higher combined course for

artillery and engineers. If this will suffice for the due supply of technically instructed officers, the artillery and engineer academies may be abolished.

As regards the present school for the General Staff, it may be recommended that a general college for the whole army should be formed from it, wherein not only the higher military sciences should be taught, but also statecraft and national economy. It would be right to examine a candidate before he entered the college in the rudiments of natural philosophy and chemistry.

The student may obtain the time necessary for the cultivation of these two sciences by reducing the time till now assigned to sketching and surveying; the more so, as the student will have already attained a great perfection in this branch of his education by former study of it in the public and preparatory schools.

SYSTEM AS REORGANIZED IN 1869.

(A.)—ESTABLISHMENTS FOR THE EDUCATION OF YOUTH.

1. *Military Orphan Asylum.*

Military orphans and other deserving candidates for the army are supported in this establishment. They are educated at the public schools.

The number of pupils is 150. They pass thence into the other institutions, according to their talents and final destination.

2. *Military Technical Schools.*

At present four in number. It is proposed to reduce them to two. The course is of three years. Number of pupils, 150 in each school. They are educated for the Technical Academy, and to provide good non-commissioned officers for the Artillery and Engineers. They enter at 14 and leave at 16 years of age, at the end of their third year's course of study. Those enter the Technical Academy who have most distinguished themselves; the others are sent either for a two years' course to the Division Schools, or else to the Artillery Officers' Aspirant Schools.

3. *The Military College.*

The course is for two years. This is chiefly intended as a preparatory school for the Military Academy at Wiener Neustadt.

4. *The Military Academies.*

These institutions are intended to provide the army with officers properly qualified for the various branches of the army.

(1.) *The Wiener Neustadt Academy.*—The course is of four years. Number of scholars 100 per annum, or a total of 400. The academy is intended for the education of candidates for the Infantry Regiments of the Line and Military Frontier, the Jagers, and the Cavalry.

(2.) *The Technical Academy* (established in Vienna) for the education of the best pupils of the technical schools for the artillery, engineer, and pioneer services. The course is of four years; 65 scholars in each year, or 260 total. Each year's course of study is divided into two sections, one for artillery pupils, one for engineer pupils.

It is proposed that these officers should be attached to their respective corps in Vienna during their course of study, and should attend lectures at the Polytechnic at Vienna. When this course is over, they are to be attached for two years' service with their corps, or sent direct to go through the higher artillery or engineer course.

(B.)—SCHOOLS ATTACHED TO REGIMENTS OR DIVISIONS.

1. *Regimental, Troop, and Cadet Schools.*

Besides the troop schools in each regiment or independent battalion, there is one of the cadet schools for the education of all those, from the rank of sergeant downwards, who aspire to the rank of cadet, or who desire to acquire the preparatory knowledge necessary to be admitted into the schools for officers aspirant.

The number of pupils depends on the number of individuals qualified. The course is of two years.

2. *Regimental Schools for Officers aspirant.*

(*a.*) For the *Artillery*—The course is of two years; 50 scholars annually.

(*b.*) For the *Engineers*—A two years' course for each. *Pioneers*—Number of pupils according to demand.

3. *Divisional Schools for Officers aspirant.*

There is a school of this sort in each of the 23 infantry and cavalry divisions, and for the country gendarmerie.

The course is of two years. Number of pupils not fixed (at present nearly 1,200), in addition to which is the special instruction for their respective arms; when they have successfully passed an examination at the end of the course, they become officers aspirant.

(C.)—ESTABLISHMENTS FOR MORE ADVANCED PROFESSIONAL INSTRUCTION.

1. *The Higher Courses for the Artillery, and* (2) *Engineers.*

These are intended for the formation of highly scientific officers for the more important duties and higher command of these arms, and for the army in general. The course is of two years. The number of officer students is not fixed, but must depend on the number of highly qualified candidates of the above arms. They must have served for two years with their corps with distinction.

3. *War School* (Staff College).

This institution is intended for the formation of officers for the general staff. The course is of two years. The number of students is 80.

An officer must have served at least three years with his corps with distinction before he can be admitted, and officers who have served longer will, as a rule, be preferred.

(4.) *Course for Military Frontier Instruction.*

This is an academy for those who are already serving in the army. The course is of two years, and the number of pupils is regulated by the demand. The studies are as follows:—

State organization and frontier administration.
Civil and military law and legal procedure.
Agriculture, law of commerce, and exchange.
Revenue law and institutions.
Croatian language.

5. *Central Cavalry School at Vienna.*

The object of this establishment is to prepare distinguished regimental officers for the higher commands in cavalry, and to instruct them in the theory and practice of that arm, and the *haute école* of riding.

There are 41 students of the rank of captain (1st and 2d class), or one from each cavalry regiment. The course is of one year. The studies are as follows:—

Theoretical and practical riding, training of unbroken horses, service and drill regulations of cavalry, veterinary art, leaping, fencing, pistol-shooting, rudiments of strategy and history of war, tactics, field service, occupation of ground, surveying, army organization, knowledge of arms, pioneer and engineer service, practical drill, and field service and reconnaissances.

6. *Josephinum Academy for Medicine and Surgery,*

For the formation of students for the higher grades of the medical and surgical departments, from the rank of first lieutenant-surgeon.

This establishment ranks with the upper school of surgery at Vienna. The number of students from the army is fixed at 242. When there is accommodation there are, besides this, paying students.

7. *Military Veterinary Institution,*

Consisting of two sections:—(1.) Veterinary. (2.) Farriery.

Students who have passed the necessary examinations are entitled to their diploma and rights in the same way as students of the civil veterinary school in Hungary.

The students of the veterinary section are field surgeons and farriers.

The students of the farriery section are non-commissioned officers and soldiers and civilians. The number of soldier students depends upon the requirements of the army.

8. *Course for the Intendance.*

This establishment, *when organized*, is intended to qualify captains or first-lieutenants on the active establishment of infantry or cavalry, captain auditors, and properly qualified clerks, for the administration of the Intendance of the army now in progress of formation.

COURSES OF STUDY IN THE MILITARY SCHOOLS.

(I.) COURSE OF SCIENCES TO BE TAUGHT AND LECTURED ON AT THE REGIMENTAL CADET SCHOOLS.

Subjects.	*Course of Lectures during*—1*st Year.*	2*d Year.*
German Language and Style,	1	1
The Regimental Dialect,	1	1
Caligraphy,	1	1
Military Style,	1	1
Arithmetic,	1	0
Algebra,	0	1
Practical Surveying,	1	1
Mapping and Tracing,	1	1
Geography,	1	1
History,	1	1
Drill and Manœuvre Regulations,	1	1
Service Regulations,	1	1
Field Service,	1	1
Pioneer Service,	1	1
Construction of Arms,	1	1
Hand Drawing,	1	1
Fencing,	1	1
Gymnastics, &c.,	1	1
Target Practice,	1	1

(II.) COURSE OF INSTRUCTION AT THE SCHOOLS FOR OFFICERS ASPIRANT.

A.—*Ordinary Course.*	*1st Year.*	*2d Year.*
Military Style,	1	1
Military Essays,	1	0
Geometry and Trigonometry,	1	1
Higher Trigonometry and Conic Sections,	0	1
Mechanics, Natural History, and Chemistry,	0	1
Geometrical Drawing,	1	1
Practical Surveying,	1	0
Military Mapping,	0	1
Sketching and Tracing,	1	1
Geography,	1	1
Mathematical Geography,	0	1
History,	1	1
Military Administration,	1	1
Drill and Manœuvre Regulations,	1	1
Service Regulations,	1	0
Army Organization,	1	1
Tactics,	1	1
Field Fortifications,	1	0
Permanent do.,	0	1
Construction of Arms,	1	0
Hand Drawing,	1	0
Fencing,	1	1
Athletic Games,	1	1
Target Practice,	1	1
Riding, if possible,	0	1

B.—*Course for the Pioneer Regiment.*

High Mathematics.	History.	Pioneer Service.
Higher Trigonometry.	Construction of Arms.	Surveying.
Practical do.	Fortification.	Tracing.
Analytical Geometry.	Architecture.	Athletic Games.
Mathematical Geography.	Mechanics.	Fencing.
Natural History and Chemistry.	Drill, ... }	Swimming.
Military Economy and Finance.	Service, ... } Regulations.	Tactics.
Geography.	Manœuvre, }	

(III.) COURSE OF INSTRUCTION AT THE PREPARATORY SCHOOL FOR THE WIENER NEUSTADT ACADEMY.

Subjects.	*Hours per Week—1st Year.*	*2d Year.*
Religious Instruction,	1½	1½
Latin,	7	7
Greek,	3	3
French,	4	4
German and Literature,	3	3
History and Geography,	5	5
Mathematics,	5	5
Natural History,	0	3
* Short-hand Writing,	3	0
* Caligraphy,	2	2
* Drawing,	2	2
* Athletic Games,	2	2
Dancing,	2	2
Swimming,	0	0
Total hours per week,	39½	39½

Subjects marked thus * are voluntary for scholars of classical schools, but are compulsory at the military schools.

(IV.) COURSE AT THE PREPARATORY SCHOOLS FOR THE TECHNICAL ACADEMY.

Subjects.	*Hours per Week*—1*st Year.*	2*d Year.*	3*d Year.*
Religious Instruction,	2	1	1
German,	4	3	3
French,	4	3	3
History and Geography,	4	4	4
Mathematics,	7	5	5
Analytical Geometry and Drawing,	3	4	3
Natural History,	2	2	2
Natural Philosophy,	0	3	5
Practical Chemistry,	3	3	0
Hand and Mathematical Drawing,	2	4	4
Caligraphy,	1	0	0
Military Style and Finance,	2	2	2
Artillery and Pioneer practice,	4	4	3
Service Regulations,	1	1	1
Drill and Manœuvre Regulations,	2	2	3
Management of Horses,	0	0	2
Athletic Games and Fencing,	3	3	3
Total hours per week,	44	44	44

(V.) COURSE OF INSTRUCTION AT THE MILITARY ACADEMY AT WIENER NEUSTADT.

* *Subjects.*—(*Hours per Week.*) *Years*—	1*st*,	2*d*,	3*d*,	4*th*.
Religious Instruction,	1½	1½	0	0
Latin,	4	4	0	0
Greek,	3	2	0	0
French,	4	4	3	3
German and Literature,	3	3	3	0
History and Geography,	4	0	0	0
Physical Geography,	4	0	0	0
Preparatory Philosophy,	1½	0	0	0
Philosophy,	0	4	0	0
Higher Mathematics,	5	6	0	0
Astronomy,	0	0	4	0
Analytical Geometry,	0	0	4	0
Practical ditto and Surveying,	0	3	0	0
Nat. Philos. and Fundamental Laws of Chemistry,	4	0	0	0
Theoretical Mechanics,	0	0	4	0
Review of Law and Statesmanship,	0	0	2	0
Cons'l Law of Austria, and its Adm'ive Org'tion,	0	0	5	0
European State and International Law,	0	0	0	3
Austrian Military Law (Criminal),	0	0	0	2
Military Finance,	0	0	2	3
Construction of Arms,	0	0	2	3
Pioneer Service,	0	0	3	0
Fortification,	0	0	0	4
History of War,	0	0	0	2
Drill Regulations,	2	0	0	0
Service do,	0	1½	1½	0
Manœuvre do,	0	0	1½	1½
Cavalry do,	0	0	0	1½
Tactics,	0	0	0	6
Surveying, Tracing, and Mapping,	4	4	4	0
Riding,	0	0	0	6
Fencing,	2	2	2	2
Athletic Games and Dancing, each 2 hours,	4	4	0	0
Total hours per week,	42	41	41	41

* To these should be added the Bohemian and Hungarian language for the 3d and 4th years.

(VI.) COURSE OF INSTRUCTION AT THE TECHNICAL MILITARY ACADEMY AT VIENNA.

Subjects.—(*Courses*—United Preparatory, Engineer, Artillery.)

Number of hours per week—Years—	Preparatory. 1.	2.	Engineer. 3.	4.	Artillery. 5.	6.
Zoölogy and Botany,	3	0	0	0	0	0
Mineralogy,	1	0	0	0	0	0
Geology,	0	0	2	0	0	0
French,	3	3	3	2	3	2
Higher Math. 1, 2, 3, Higher Geodosy 4th yr.	8	5	2	4	2	4
Analytical Geometry,	4	0	0	0	0	0
Sketching,	4	0	0	0	0	0
Practical Geometry,	0	4	0	0	0	0
Chemistry of Minerals,	3	0	0	0	0	0
Chemical Manufacture,	0	0	0	0	0	4
General and Technical Natural Philosophy,	2	3	0	0	0	0
Mechanical Technics,	0	0	2	0	2	0
Technical and Analytical Mechanics,	0	5	2	0	2	0
Construction of Machinery and Drawing,	0	0	4	0	0	0
Description of Machinery,	0	0	0	0	2	2
Mountain Roads,	0	4	0	0	0	0
Planning and Sketching,	0	0	5	6	0	0
Road and Water Communication, &c.,	0	0	5	0	0	0
General Architecture,	0	0	0	0	3	0
Machine Making,	0	0	0	0	3	5
Building,	0	0	0	0	4	4
Ornamental Drawing,	0	0	0	4	0	0
Review of the Law,	0	0	0	2	0	2
Military Criminal Law,	0	0	0	1	0	1
Construction of Arms (Engineer),	0	2	0	0	0	0
Do. of Batteries (Artillery),	3	6	0	0	0	0
Pioneer service,	0	1	0	0	0	0
Fortification,	0	0	4	6	3	3
Sappers' and Miners' Duties,	0	0	0	2	0	0
Military Finance,	0	0	2	2	3	3
Drill Regulations,	2	0	0	0	0	0
Service ditto,	1½	1½	0	0	0	0
Manœuvre ditto,	0	0	0	2	3	0
Cavalry ditto,	0	0	0	0	0	2
Tactics,	0	0	2	2	2	2
Surveying and Tracing,	0	6	3	0	3	0
Riding,	0	0	3	3	6	6
Fencing,	2	2	2	2	2	2
Dancing,	2	2	0	0	0	0
Total hours per week,	40½	41	43	43	51	50

(VII.) UPPER COURSE OF STUDY FOR ARTILLERY.

Subjects.	*Course*—*1st Year.*	*2d Year.*
French,	1	1
Practical Mechanics,	1	0
Construction of Machinery,	1	0
Fortification and Field Armaments,	0	1
Science of Higher Artillery,	1	0
Military Geography and Statistics,	1	0
Higher Tactics and Strategy,	0	0
National Economy and Finance,	1	0
Organization of the Constitution, and Administration,	0	1
State and International Law,	0	1
German Literature,	1	0
Active Duties of the General Staff,	0	1

(VIII.) UPPER COURSE OF STUDY FOR THE ENGINEERS.

Subjects.	*Course—1st Year.*	*2d Year.*
English,	1	1
Chemistry and Practical Technics,	1	1
The Mechanism of Building,	1	0
Fortification,	1	1
Architecture,	1	1
Ornamental Architecture,	1	1
Military History,	0	1
Science of Artillery,	0	1
Strategy,	1	0
National Economy and Finance,	1	0
Organization of the Constitution, and Administration,	0	1
State and International Law,	0	1
German Literature,	1	0

(IX.) UPPER COURSE OF STUDY FOR THE WAR SCHOOL.

Subjects.	*Course—1st Year.*	*2d Year.*
German Literature,	1	1
French,	1	1
Administrative Duties of the Staff,	1	1
Active Duties of the General Staff,	0	1
Tracing and Surveying,	1	1
Military Geography,	1	0
Higher Tactics,	1	0
Strategy,	0	1
Engineer Service,	0	1
Artillery Service,	0	1
Rudiments of State and International Law,	0	1
Rudiments of Nati'l Economy and Administrative Law,	0	1
Riding,	1	1

AUSTRIAN STAFF.

By recent ordinance the Special Staff Corps has been abolished. All the officers are borne on the army rosters according to their ranks, in particular branches of the service. No one will be allowed to enter the Staff School until he has served three or four years with the troops, and then captains and first lieutenants will be preferred to men of less service or rank. Having passed through the school course they will again join their regiments, and will then be appointed to the staff, as may be required. The period during which they are to remain on the staff will depend on their merits, their promotion, and the exigencies of the service; but as a principle they would generally rejoin their troop on promotion. There can be no doubt in the minds of those who have practically studied the question, that the system is sound. A special Staff Corps is never large enough to supply the demands of an army in the field for long, especially if the war is long and very active. The duties of a staff officer with an army actively engaged in the field, are so numerous and arduous that an *enormous number* are used up in the course of a campaign; and when you have only the Staff Corps to draw from, the supply of practical officers is not equal to the demand. The French experienced this in the Crimean War. By educating a number of young officers endowed by nature with the qualifications indispensable to form an *efficient* staff officer *on active service*, and by throwing them back into their regiments, they leaven the mass, and form a fund of selected and instructed officers from which can be drawn as occasion may require.—*Col. Crealock to Military Ed. Com.*

CAVALRY BRIGADE SCHOOLS FOR OFFICERS.

The following memorandum gives an account of an order lately issued, regulating Officers' Brigade Schools in the Austrian cavalry.

The object of the Cavalry Brigade schools will be to secure a supply of efficient riding masters throughout the service capable of giving general instruction.

The Central Cavalry School will continue to be a higher military and scientific establishment, with (in addition to the theoretical education of the pupils) a course of instruction which insures a uniform system of equitation and of breaking horses. A certain number of its best pupils may be transferred, after a year's attendance, to the *Kriegs-Schule*, with a view to their preparation for the staff.

Cavalry Officers' Brigade Schools educate officers of that arm, theoretically as well as practically, in all their duties. After the termination of the autumn manœuvres one will be formed in each brigade. The annual course lasts six months, and should begin on the 1st of October.

It is the duty of the Brigadier to superintend the school, but it is also that of commanding officers of regiments to inform themselves of the progress of their officers, and consequently to visit it often.

Before the 15th of August the Brigadier proposes to the Minister of War the station at which the school should be established, also the names of the instructors and pupils. It rests with him to make all arrangements for setting it in operation; and as his supervision must be continual, he should (whenever practicable) place it at the head-quarters of his brigade. Above all, a covered riding school must be fitted up; then a drill ground, a manège with artificial fences, and a school and fencing-room. Whenever possible the men and horses must be in barracks.

The best qualified officer in the brigade, of the rank of lieutenant-colonel or major, is to be selected for Commandant, and each school is to have two captains as instructors. One of them must have gone through the Central Cavalry School, and must have been reported as specially qualified to give instruction; the second must be considered one of the best horsemen in the brigade.

At the disposal of these officers there is the following staff:—one veterinary surgeon for instruction in the anatomy, diseases, and shoeing of horses; one sergeant in charge of the men and horses; one sergeant for quartermaster's duties and accounts; one farrier; three corporals; one trumpeter; twelve men per regiment of the brigade; and the riders of the horses attached to the school.

If there is an auditor (*Judge Advocate*) available, he attends regularly to explain the Articles of War and give lectures on military law. Should there be none, this duty devolves upon one of the captain instructors.

Six officers from the rank of first lieutenant downwards are sent yearly from each regiment. Each of them brings with him, besides his own horses, the one allowed him by Government. Every regiment sends six remount horses that have passed the first stage of breaking, and six that have just joined.

The principal subjects of theoretical instruction are—1st, Regulations of the army; 2d, Tactics, particularly as referring to the handling of cavalry; 3d, Field movements, and especially outpost duty, which are to be illustrated by examples from the history of war; the pupils will also draw and describe a tract of country, and give written reports upon field operations; 4th, description of the anatomy and diseases of horses, with their management and feeding

both in the stable and the field; shoeing theoretical and practical, in all its details; 5th, thorough practice in the use of cavalry weapons, a general acquaintance with the arms of the artillery and infantry of the principal military nations, and an accurate knowledge of those employed in the Imperial army; 6th, a general knowledge of field fortification and of the works to be executed by the Pioneer Corps in combination with cavalry; 7th, the study of tracts of country, extending to the observation of roads, streams, coverts, and undulations; the correct reading and understanding of maps.

The practical branch of education at these schools has for its main object the maintenance throughout the army of the best fundamental system of equitation, and the adoption of any improvements in the cavalry service in general which may appear advisable. To this is added practice in getting over long distances through every description of country, and in judging when and where halts should be made with most advantage to single horsemen, or to detachments of troops. These marches are to be combined with patrolling, reconnaissances, and posting piquets, and are to be practiced once a week.

After every such march the pupils will send in a brief report and rough sketch, either next morning or within forty-eight hours, as may be ordered. They are to practice making this sketch on horseback as well as on foot. They must perfect themselves in gymnastics, and in fencing and singlestick, both on foot and horseback.

The regulations issued to the Minister of War as to distribution of hours and reports will be strictly followed, and no deviation will be permitted except under particular circumstances. Sundays and holidays are observed. No leave of absence, except in cases of urgent necessity, can be granted to either instructors or pupils during the course.

At the end of the season of instruction (*i. e.* at the end of March) the Cavalry Officers' Brigade School will be broken up; and all persons attached to it, and their horses, will return to their regiments.

EXPENDITURES ON MILITARY EDUCATION.

The appropriation for Military Education in Austria for 1870, was as follows:—

For non-commissioned officers and men, 504,000 florins (40,320*l*).

For officers, 978,000 florins (78,284*l*).

PART IV.

MILITARY SYSTEM AND SCHOOLS IN BAVARIA AND OTHER STATES.

MILITARY SYSTEM AND SCHOOLS OF BAVARIA.

I. MILITARY SYSTEM.

Bavaria, with a population in 1867 of 4,824,421, on an area of 29,347 English square miles, maintained in 1869–70, an armed force of 56,760 men on a peace footing, and of 92,500 when placed on a war footing.

The armed force consists of the permanent army, the army of reserve, and the landwehr, or militia. The strength of the permanent army at the end of 1869 was as follows:—

16 Regiments of the line, each of 3 battalions,	28,304	men.
10 Battalions of Yager infantry,	5,870	"
20 Regiments of cavalry, each of 5 squadrons,	7,290	"
52 Batteries of artillery, with train,	6,361	"
10 Companies of engineers, with train,	1,212	"
4 Companies of sanitary troops,	624	"
6 Detachments of victualing troops,	288	"
Total strength of permanent army,	49,449	

The army of reserve numbered over 30,000 men, and is to be made more efficient. The landwehr is only organized in the large towns. The army is recruited by conscription. All men, from the age of 21 are liable to serve, but the sons of the nobility (*hohe adel*) are exempt, and they with the sons of superior employés in the service of the state have the privilege of entering the military school of cadets. Those who are drawn for the army are held liable to active service for eleven years, but are kept under arms, when on the peace footing, only three years, passing three years more in the Reserve when called out for actual training, and held for service for the remaining five years in the landwehr. No substitutes are allowed.

By the treaties of 1870, in time of war, the supreme command of the army of Bavaria passes to the Emperor of Germany, and in the further development of the Imperial policy, the military system of Bavaria as well as of the other German States, will be merged in that of Prussia. The following account of the system of Military Education, as it was in 1869, is taken from the Report of the Military Education Commission for 1870.

II. MILITARY EDUCATION.

There are four establishments for Military Education in Bavaria—1. The Cadet Corps. 2. The War School. 3. The Artillery and Engineer School. 4. The War Academy.

I. THE CADET CORPS.

The Cadet Corps was by a royal decree of May 14th, 1864, placed on the same footing with regard to instruction and final examination as the Real Gymnasium, and by a further decree of April 2d, 1868, the signification and value which are attached to an *Absolutorium*, or certificate of final examination, of a Real Gymnasium, were equally made to apply to an *Absolutorium* of the Cadet Corps.

There are three classes.

For admission into the first class, candidates must be acquainted with the following subjects:

Religious Instruction.—(*a.*) For Catholics: First chapter on Belief (*von den Glauben*) with preceding introduction, from page 33 to page 96.

The larger Catholic Catechism for all Bavarian bishoprics.

(*b.*) For Protestants: The heads of the Christian doctrine, with the ecclesiastical explanation of the same, as well as the most important passages of the Bible contained in the catechism.

German.—Grammar: formation of sentences; change in the form of sentences; copying from dictation small stories, narratives, and letters; facility in orthography and correct punctuation.

Latin.—Elementary rules: easy translations from Latin into German, and from German into Latin.

French.—Tolerably correct reading.

Mathematics.—Vulgar fractions; decimals; rule of three; interest; exercises in mental calculations.

Geography.—Europe generally, and Germany in particular, with especial regard to mountain chains and river districts.

Caligraphy.—German and English characters.

Second Class.

For admission into the second class candidates must be acquainted with the following subjects:

Religious Instruction.—(*a.*) For Catholics: A knowledge of the second chapter on the Commandments (*von den Geboten*), pages 100 to 159 inclusive.

The larger catechism for all Bavarian bishoprics.

(*b.*) For Protestants: All the knowledge obtained from the so-called preparatory instruction for confirmation (*Praeparanden-Unterricht*).

German.—Same as in first class.

Latin.—Syntax: verbal and written translations from German to Latin, and from Latin to German, out of Cornelius Nepos.

French.—Grammar: translation; reading; orthography.

Greek.—Syntax up to verbs in $\mu\iota$: written and verbal translations from German to Greek, and *vice versâ*. Greek characters.

Mathematics.—System of weights and measures; fractions; decimals; mental arithmetic.

History.—Greek and Roman history, including the period up to Clovis, king of the Franks.

Geography.—The world in general, Europe excepted.

Caligraphy.—German and English characters.

Third Class.

Candidates for immediate admission into the third class must not have exceeded their fifteenth year, and must produce certificates of all the classes of the Latin school.

At their examination for admission they must show that they are acquainted with all the subjects required in the examinations for the first and second class; and also with the following subjects:

Religious Instruction.—(*a.*) For Catholics: A knowledge of the third chapter on Means of Grace (*von den Gnadenmitteln*), page 160 to page 228.

(*b.*) For Protestants: Candidates must not only be thoroughly acquainted with the so-called preparatory instruction for confirmation, but must have been confirmed.

German.—Composition: translation from Cornelius Nepos. Reading aloud.

Latin.—Complete Syntax. Written and verbal translations from German to Latin; Cæsar's Commentaries; select passages from Roman historians; prosody; versification.

French.—Translations: German into French, and *vice versâ*; orthography and reading.

Greek.—Rudiments of grammar.

Mathematics.—Algebra; geometry.

History.—German history (from Clovis, king of the Franks), especially that of Bavaria.

Geography.—Europe; including political and statistical relations.

Caligraphy.—German and English characters.

Admission to the Army from the Cadet Corps.

On leaving the Cadet Corps—

(*a.*) Students who have obtained from the Examination Commission a certificate of "especially qualified" are named candidates, first class, for the rank of officer.

(*b.*) Students who have obtained a certificate of "qualified" are sent to a division of the army as candidates, second class, for the rank of officer.

Further, those who have displayed a "marked proficiency," not only as regards scientific acquirements but also as regards conduct and military capacity, may be appointed by the Education Commission to the rank of sub-lieutenant.

These last, however, in common with the candidates mentioned under heads (*a.*) and (*b.*) are required, after six months' service in a division of the army, to pass through the military scientific course in the War School, and at the end of the course to undergo an examination. The same conditions are alike in force for the young nobility entering the army from the *Pagerie* with the *Absolutorium* of a gymnasium.

II. THE WAR SCHOOL.

There are two courses, viz.:—(*a.*) The preparatory course. (*b.*) The military scientific course.

All persons desirous to obtain commissions as officers, whether compelled to enter the army, or volunteers, must undergo the preparatory course at the War School, unless they are in possession of an *Absolutorium* of a Latin or Real Gymnasium.

Candidates for the preparatory course (*a.*) must pass an examination for admission, and as a qualification for admission must have served an entire year satisfactorily in a division of the army.

After the completion of the preparatory course these students are named candidates, second class, for the commission of officers, and as such enter the military scientific course.

The following enter the second course:

(*a.*) Students with the *Absolutorium* of a Real Gymnasium, or coming from the *Pagerie.*

(*b.*) Students who passed the preparatory course successfully.

(*c.*) Those to whom military service is compulsory, and volunteers, both possessing the *Absolutorium* of a Bavarian gymnasium, and being desirous to become officers. These candidates must, however, perform six months' service satisfactorily, and on termination of this service they are named candidates, second class, for the commission of officers.

At the expiration of the military scientific course there is a general examination of all candidates before the "Commission of High Studies and Examinations," and decision is given—

(*a.*) Respecting efficiency for the position of officer.

(*b.*) Respecting the army rank of those who have passed their examination without reference to former rank (*Chargen-verhältnisse*).

Very distinguished conduct before the enemy can alone exempt candidates from this examination.

Candidates examined are classed by the above Commission under the following heads; "*especially qualified*," "*qualified*," and "*not qualified;*" and no candidate for the commission of officer can be named officer without the certificate of "*qualified.*"

Candidates, who have shown the necessary efficiency to entitle them to be appointed officers, are named candidates, first class, for the commission of officer, or, in consequence of the diminished number of officers in the active army, are promoted to be sub-lieutenants.

Only those candidates for the commission of officer, who have received the certificate "especially qualified" in the above final examination of the military scientific course, can present themselves for admission into the War Academy.

III. THE ARTILLERY AND ENGINEER SCHOOL.

In this school, consisting of two courses, each lasting a year, an opportunity is afforded to all candidates, first class, for commissions as officers to devote themselves to technical military science, and to pursue the special studies having reference to the military operations in question; and, in this school, only those candidates for the commission of officer are received, who have successfully passed the military scientific course, and who, at the examination passed before the "Commission of High Studies and Examinations," have been pronounced "*qualified*" not only to remain in the Artillery and Engineer regiment, but especially qualified to enter the Artillery and Engineer School.

Immediately after passing the second course of the War School, and before admission into the Artillery and Engineer School, these candidates must serve six months in an Artillery or Engineer regiment.

Candidates pass over from the first to the second course without a general examination, and should a doubt exist respecting the efficiency of any of the candidates, such candidates will be required to undergo a special examination before the "Commission of High Studies and Examinations," who will decide, in the case of such candidates, whether they are to go through the course a second time, or retire from it.

The same regulations apply for the second course, and the appointments as sub-lieutenants of Artillery or Engineer students are determined according to the number of officers required in those corps.

Candidates for the Engineers are required, after passing through their school, to undergo a six weeks' course of design, during which period each candidate must without assistance make a complete drawing of an edifice.

IV. THE WAR ACADEMY.

The War Academy has for its object the higher scientific and practical education of officers, in every branch of the military profession, on the staff, as also of the higher adjutants. It aims also at the development of all military scientific subjects.

The War Academy has three courses, each lasting nine months, and the intervals are employed in practical exercises.

The number of students in one course must, as a rule, not exceed twelve, and every upper or sub-lieutenant who has served not less than four years with the troops, can attend the academy.

Officers are only admitted into this school who possess the requisite knowledge of their respective branches of the military service.

Further, their conduct must have been highly satisfactory; they must be sound in health, and their pecuniary affairs must be in good order, and they must combine prominent mental qualifications with a tendency to higher scientific attainments.

The "Commission of High Studies and Examinations" decides by examination as to the necessary qualifications for admission; then follows a summons, issued by the Ministry of War, to attend the War Academy, and each time only for one year.

Officers who, on the decision of the Examination Commission, do not display sufficient capacity or zeal, or whose military behavior or moral conduct has not been satisfactory, will not be summoned to attend the next course.

The scientific education of those admitted into the War Academy consists also in—

(*a.*) Attending lectures at the University and the Central Polytechnic School.

(*b.*) Higher lectures upon military scientific subjects.

(*c.*) Exercises in living languages.

The practical education embraces the duties of staff officers and of higher adjutants, acquaintance with the different branches of military service, also corporal activity, and especially exercises on horseback.

Officers who, on the decision of the Examination Commission, have during the three courses of the War Academy displayed zeal, talent, and application, will, on leaving the academy, have their names sent in to the King for especial notice.

Each of the military schools has its own commandant. The Cadet Corps is commanded by a First Lieutenant of Infantry, the War School by a Major of the Quartermaster-General's Staff, the Artillery and Engineer School by a Major of the Engineer Staff, and the War Academy by a Colonel of the General Staff, to whom an Adjutant is attached.

With regard to the systematic process of education pursued in the military schools, and to the application of the different means employed to impart instruction, these establishments are placed under the superior direction of the "Inspection of Military Schools;" in all other respects, they are under the control of the Ministry of War, and the professors employed in them are selected according to their special qualifications.

ROYAL MILITARY SCHOOL AT DRESDEN.

1.—*Organization and Admission.*

The Royal Military School at Dresden was reorganized in 1867, after the war, and organized like the schools of the same rank in Prussia. Formerly it consisted of two separate schools, the artillery school and the *Cadettencorps*, both completing the education of their pupils; but now a higher academy in Prussia must be attended for finishing the professional education, either in Berlin, Erfurt, &c.

By the new "regulative," the *Cadettencorps* in Saxony consists of six classes, and has (1,) 20 free scholars; (2,) 84 half-free scholars; (3,) 20 not free scholars—in all, 124. Besides these, "volunteers" may be admitted; but, if foreigners, without any claim to being admitted afterwards to the royal army.

For admission to any of the 124 places, the sons of officers of the army, killed or invalid, or of such subalterns as have served 25 years, and of civil officers of high merits, are preferred to others.

The aspirant must have completed his 11th year of age, and not be over 18 years of age.

In general the boys must have, if 11 years old, the requisite knowledge of Quinta; if 12, of Quarta; if 13, of Quarta; if 14, of Tertia; if 15–17, of Secunda, of a gymnasium, (college.)

On admission, every pupil has to pay 100 thalers for a full equipment, for books, &c.; and to bring with him 12 shirts, 18 pairs of stockings, 18 handkerchiefs, 6 drawers, 1 pair of house shoes, 2 white cotton night-jackets.

During his stay every pupil has to pay, (besides 25 thalers for books when transferred to III,) annually, (*a*,) 50 thalers, if a free scholar; (*b*,) 110 if half free; (*c*,) 210 if not free; (*d*,) 260 if a Saxon "volunteer;" and, (*e*,) 300 if a foreign "volunteer."

2.—*Course of Instruction.*

The course of instruction in the Military School embraces six years, with six classes, of which, as was said before, VI, (the last,) V, IV, and III correspond to V, IV, and III in a gymnasium, II and I to lower

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Document.

Bericht über (report on) *die Kgl. Turnlehrer Bildungsanstalt, von Dr. Kloss*, 1864, pp. 34, (with a representation of the grounds and buildings.)

and upper Secunda, with the only difference, that instead of Greek, instruction is given in English and in the elements of a military education. It will be, therefore, sufficient to mention the course of instruction in the highest class as given in the new regulation.

1. Religion. (The number of lesson hours is not stated.)
2. Latin: Written exercises; Livy, Ovid, Virgil.
3. German: History of literature; explanation of dramatic pieces; free discourses, with a verbal résumé, and debates.
4. French: Translations; extemporalia; compositions; exercises in speaking.
5. Mathematics: Progressions; logarithms, and their application; applying of algebra to geometry; trigonometry; elements of stereometry.
6. English: Oral and written exercises; free discourses on historical and geographical subjects; review of the same in English; reading of poetry.
7. History: Modern history; review of universal history; history of Northern Germany.
8. Geography: Mathematical and physical geography; review of political geography, with particular regard to Northern Germany.
9. Natural philosophy: Electricity, magnetism, sound and light.
10. Drawing of plans; finishing the designs of the survey.
11. Surveying: Topographical surveying on a large scale; drawing of grounds; *croquiren*.
12. Free-hand drawing. (Not obligatory.)

Those cadets to whom, in consequence of the examination at the end of the course, the testimonial of maturity for ensigncy can be given, are presented to his Majesty as "characterized" ensigns, whilst all others who do not answer the demands have to perform, in some other way, their legal service in the army.

V. MILITARY SYSTEM AND EDUCATION IN HOLLAND.

I. MILITARY SYSTEM.

The regular army of Holland is divided into two portions—one of which takes all the ordinary duties of the Dutch possessions beyond the seas, while the other serves entirely in Europe. In the event of war, the Home army is liable to be sent to the support of the Colonial army; but except in such emergency, the officers and men of each portion are as distinct, almost, as though they composed parts of the military forces of two independent countries. The entire military force consists of the regular army of about 52,000 men, which can be swelled to twice that number in an emergency, by militia conscripts and reserve levies.

The Dutch Colonial Army consists of regiments of cavalry and artillery, as well as of infantry, of which the depots for recruiting as well as of arms, ammunition, and ordnance, are at home. But the service companies, when they have once embarked for their colonial stations, return no more as armed bodies—and even as individuals, neither officers nor men return until they have taken part in the avocations of colonial life.

The army of Holland, both in its European and colonial branches is recruited by voluntary enlistment. The term of service is six years, beyond which, however, the soldier not disqualified by loss of health, may remain. The service is not particularly attractive; neither the pay being large, nor promotion from the ranks rapid, or certain, the recruits are not drawn from the most intelligent, and enterprising classes. Still, as discipline is strictly enforced, and the natural courage of the Batavian race is good, there is seldom any outbreak or disorder.

II. MILITARY EDUCATION.

The officers, as a body, are well educated, and belong to the higher class of society, and before admission to the service, they must prove their qualifications by a rigid examination, which is practically competitive, as promotion is determined by the order of merit, as shown in the results. Preparation for the examination

could be made, till recently, (1.) either by joining the Cadet Corps as a volunteer, and after a specified term of service in the field, undergoing an examination in the studies, and practical knowledge required; or (2.) by going successfully through a regular course in the Military Academy at Breda. The army is now officered exclusively from the graduates of the Military Academy.

III. MILITARY ACADEMY AT BREDA.

The Military Academy at Breda, prepares officers for every branch of the service, and is well equipped in respect to buildings, and appliances of illustration and practice, as well as with numerous professors for doing its work as thoroughly as any school can which receives its pupils so young.

Within an extensive redoubt, separated from the town by a rampart and wet ditch, stands an old palace which the late King set apart as a college for officers. Here are good stables and an ample stud, a swimming school, and an extensive plateau, with cannon of every calibre, which supplies the means of drill applicable to each branch of service. The accommodation within doors is excellent. Youths, sleeping in long dormitories, are yet separated one from another by curtains, within which stand each inmate's iron bedstead, his little dressing-table, his basin, jug, clothes-press, and all other matters necessary to cleanliness and comfort. There is a spacious hall or day-room, besides a convenient dining-room, a good library, a well-stocked model-room, a small but judiciously selected museum of arms, with a good collection of minerals and fossils, of chemical and mechanical apparatus, &c. Finally, the class-books used in the place are compiled and arranged by the professors, and, in every branch of science and learning touched by them, appear well adapted to the purposes for which they are intended.

The establishment of the Breda Military Academy, when full, includes—besides the Governor, a major-general, and the Commandant, a colonel—an adjutant, a quarter-master, three captains of infantry, three of artillery, one of engineers, one of cavalry; five first lieutenants of infantry, two of cavalry, three of artillery, one of engineers; two second lieutenants of infantry, one of cavalry, one of artillery, and two of engineers—two medical officers and an apothecary. There are besides, of civilian professors and teachers, seven; and the place is capable of accommodating one hundred and ninety-two cadets. These, whether intended for the European or colonial branch of the service, live and pursue their studies together. The course comprises four years, during the first two of which, all the

cadets are educated together without reference to the specific corps or services for which they may be intended: but with the commencement of the third year, such as may be selected for the artillery or engineers pass into distinct classes, while the remainder go on, by a less abstrusely scientific course, to commissions in the cavalry or infantry.

The qualifications for admittance into the Academy are not extravagantly high. Youths seem to be eligible who can read, write, and spell their own language correctly—who are able to construe an easy Latin author, and exhibit some acquaintance with the French; who are advanced in arithmetic to vulgar fractions, can demonstrate an easy proposition in geometry, and are masters of the fundamental processes of algebra. During the two first years all are well instructed in history, geography, mathematics, fortification, the theory of projectiles, plan-drawing, the French and German languages. After this they break up, and pursue their peculiar studies in different rooms under different teachers. Their progress is tested by severe periodical examinations; according to the results of which, they are either advanced or held back. But as no second trial is granted in the examination for admittance, so two failures at any of the examinations which follow, insure dismissal from the Academy. Finally, prayers are read daily to the cadets in a large hall, where also, if the weather be unfavorable, one of the ministers from the town attends on Sunday to celebrate public worship. When the weather is fine the young men march to church—Protestants under their own officers to a Protestant place of worship—Roman Catholics under like surveillance to a Roman Catholic chapel.

Although the army is to some extent officered from the ranks for meritorious service, or from those who have performed duty in the field under a peculiar system of cadetship, as well as from the graduates of the Military Academy, it is proper to add, that no promotion can be made, or commission issued, until a satisfactory examination has been passed. The prospect of this examination keeps up the habit of professional study and reading, as well as a feeling of honorable rivalry among officers of the same grade.

NAVIGATION SCHOOLS FOR THE MERCANTILE MARINE.

There are ten special Navigation Schools (besides a nautical division in the Academy at Groningen) located in the principal commercial ports, and among the sea-going population. They are generally under the management of local mercantile societies, but subject to government inspection, and final examination, on which the rank of the graduates as first, second, and third mate, depends.

The pupils are admitted on examiuation in the elementary studies, physical ability, and aptitude for sea-service.

The course in the best schools embraces, besides a review of the elementary branches, a knowledge of geography, especially of the climate and products of different countries; mathematics, including trigonometry, nautical astronomy, practical use of instruments at sea, and the calculation of latitude and longitude, a knowledge of the code of signals, the laws of storms and tides, mercantile laws and usages, and practice in letter-writing, keeping the ship's books, and chart-drawing.

Opportunities of practice are secured on vessels in port, in coasters, and even long voyages to the West and East Indies.

Ability to hold the rank of mates depends on the results of the final examination, and promotion from one position to a higher depends on successive examinations, after leaving the schools.

The statistics of attendance at these schools in 1867 were as follow:

Rotterdam, 133 pupils; Leyden, 87; Amsterdam, 87; Amsterdam, 18; Harlingen, 59; Nes, 19; Schiermonnikoog, 84; Vundam, 37; Groningen, 85 Delfzye, 68; Nautical section of the Groningen Academy, 39.

PART V.

MILITARY SYSTEM AND SCHOOLS IN ITALY.

MILITARY SYSTEM AND INSTRUCTION IN ITALY.

I. MILITARY SYSTEM.

As the provinces, duchies, kingdoms, and dominions into which the territory and population of old Italia, in the progress of centuries after the utter destruction of the Western Empire, were divided by conquests, alliance and cessions of reigning families (brought and kept in power by force of armies), were merged, one after another, under the government of the House of Savoy, the military system of Sardinia was extended over the entire kingdom of Italy as now recognized.

The actual strength of the Italian army as constituted in 1869, was as follows:

	Peace Footing.		War Footing.	
	Men.	Horses.	Men.	Horses.
Infantry of the line (80 regiments, 8 of which are grenadiers,....	128,020		245,680	
Bersaglieri (40 battal'ns) riflem'n,	16,165	—	26,495	—
Cavalry (4 regiments of the line, 7 of lancers, 7 light horse, and 1 of guides—115 squadrons)	18,167	13,569	19,000	14,102
Artillery (1 regiment of pontonniers, 3 foot, 5 mounted, with 80 batteries).....	9,646	4,260	16,086	11,234
Six artisan companies, also attached to the artillery.....	1,174	—	1,589	—
Two regiments of sappers of the engineers (36 companies).....	4,132	48	6,793	396
Three regiments of train corps 24 companies).....	2,460	960	9,240	11,340
One administrative corps (7 companies).....	3,173	—	——	
Total.....	189,541	19,027	335,870	37,562

The time of service in the standing army is 10 years, on the implied condition of the men being sent on furlough, in time of peace, for one-half the period. A certain number, distinguished as "soldati d'ordinanza," to which class belong the Carabinieri and some of the Administrative troops, have to serve eight years complete, and are then liberated. In the army of reserve, the time of service

is 5 years. Every native of the kingdom is liable to the conscription, and to be enrolled either in the standing army or the reserve. An exemption in favor of young men studying for the priesthood, was repealed by a law which passed both houses of parliament in May, 1869.

The distribution of the standing army over the kingdom was as follows in the middle of 1869. There were 8 battalions of infantry at and near the capital, 5 at Genoa, 5 at Turin, 9 at Alessandra, 12 in Tuscany, and 120 in the valley of the Po, from Milan to Ancona. The troops in the valley of the Po were supported by 24 squadrons of heavy and 36 squadrons of light cavalry, and 248 pieces of artillery. At Naples there were 18 battalions of the line, 2 of marines, and 3 of bersaglieri; in the Neapolitan provinces, 39 battalions of the line, 20 of bersaglieri, and 32 squadrons of cavalry. There were, finally, 32 battalions of the line in Sicily.

II. NAVY.

The navy of the kingdom of Italy consisted, at the commencement of 1869, of 99 ships of war, armed with 1,032 guns. They were classed as follows:

Steamers.	Iron-clads.		Screw.		Paddle.		Sailing Vessels.	
	No.	Guns.	No.	Guns.	No.	Guns.	No.	Guns.
Frigates, 1st class,	5	79	8	296	....	..	...	..
" 2d class,	7	118	1	36	....	..	2	32
Iron-clad Ram	1	2	....	..	....	..	..	..
Corvettes, 1st class,	2	36	4	94	3	32	4	52
" 2d class,	3	34	6	38	....	..	...	..
" 3d class,	...	..	....	..	4	12	2	20
Gunboats, 1st class,	3	29	....	..	....	..	...	..
" 2d class,	4	8	6	24	....	..	...	..
Transports,	...	..	13	24	20	40	1	6
Total,	22	272	35	508	33	122	9	130
Horse Power,	13,380		9,940		7,850			

The navy was manned in 1869 by 11,193 sailors, 650 engineers and assistants, 1,211 officers (2 admirals, 5 vice-admirals, 12 rear admirals, and 104 captains), and 2 regiments of marines with 234 officers and 5,688 soldiers.

III. EDUCATION OF OFFICERS.

The system of military education of the old kingdom of Sardinia has been enlarged and extended by the government of the Kingdom of Italy so as to embrace the military schools of Naples, without any change in its principles or details.

MILITARY SYSTEM AND EDUCATION IN SARDINIA.

I. GENERAL OUTLINE OF MILITARY SYSTEM, AND MILITARY EDUCATION.

The wars in which Sardinia has recently been engaged, have led to the re-organization of her armies, and to the extension and improvement of institutions for military instruction, but time enough has not yet elapsed to perfect the system.

One-third of the officers are promoted from the ranks; the remaining two-thirds, that is, all who enter as officers, must pass through the Royal Military Academy, and before being commissioned as Captain in the Artillery and Engineers, must have completed the special course in the Complementary School. Admission to the Royal Staff Corps is conditioned on attendance on the lectures of the Staff School, and the results of a competitive examination. The following is a brief outline of the system of military instruction now in operation.

1. The character of the education may be described generally as partly resembling that of Austria, partly that of France. It commences very early. Every Officer who enters the Army as such must have passed through the great Military School, the *Accademia Militare*. The minimum age of entrance is fourteen. The admission is by nomination and not by competition; and the demand has always been under rather than above the requirements of the Army. "Bourses" or Exhibitions to assist pupils in their education, have been established on the Prussian and Austrian, rather than on the French principle. They are granted by the King on the recommendation of the Minister, in consideration of the claims of deceased Officers, or other public servants, and without reference to the merits of the pupils, preference being given to the candidates whose circumstances most require assistance. From twenty-five to thirty of these *Bourses* (or rather *Demibourses*, for no pupils receive entire support such as is given in France,) are given annually. We are informed that a decree will appear almost immediately, throwing open *ten* out of this number to public competition. The entire sum expended upon them is 70,000 francs, about 2,800*l.* per annum.

Passing from this outline of the principles of Sardinian Military Education, as exhibited in the *Accademia Militare*, which may be termed the General Seminary of the Sardinian Army, we shall briefly allude to the *three* remaining Institutions, in which Officers receive instruction and training at later periods of their career.

2. Admission into the Artillery and Engineer School may be considered the reward of the most distinguished pupils of the *Accademia Militare*, who after spending their last year in that Institution in the study of the higher mathematics, chemistry, and architectural drawing, are transferred for the completion of their education to the School of the Artillery and Engineers.

3. The Staff School, the formation of which dates from 1850, is chiefly frequented by Officers of the Infantry and Cavalry, who must be below the age of twenty-eight years upon their entrance. It is carried on upon the competitive system, the Officers being ranged according to merit in their Final Examination, the ablest entering the Staff Corps in that order.

4. Regimental Schools for Officers also exist, and in every Brigade or Division, Officers are taught *topography*, under the supervision of the Chief of the Staff of the Division. Care is taken to make this teaching uniform throughout the Army; and it may be regarded as preparatory to that of the Schools at Ivrea and Pinerol, which accord with the principle of the Prussian Division Schools in requiring that every Officer shall have received professional instruction; but as regards other points, and particularly the period for attending them, these Schools are peculiar to the Sardinian Army. In time of peace, no Officer, excepting those of the Special Arms, can obtain a Company without having studied for a year in one or the other of these Schools, and having passed an examination on leaving it. The Instruction given is mainly practical, Field Fortification, the Secondary Operations of War, and Topography, being the branches of Military Science taught.

These Institutions appear to have been *primarily* established with a view to the instruction of Officers and Non-commissioned Officers throughout the Army, and in order to prevent Regiments or Corps from following some peculiar system of their own. The same motive seems to have led to the gradual reduction in number of the Prussian Division Schools. *Secondarily*, however, these Schools have been made available for the purpose of organizing and drilling the reserve of the Sardinian Army, a large body of Conscripts assembled for a few weeks in the autumn of each year in a camp

about twelve miles from Turin. This object seems to have been attained most successfully.

Quite recently a class has been added to the school at Ivrea for the exclusive education of Non-commissioned Officers aspiring to a commission; and for the sake of economy this class is to be common to Infantry and Cavalry.

It is consequently from this body of officers that teachers are derived for the topographical classes established in each Regiment or Brigade. The Staff School having been recently founded, and a period of active war having intervened since its institution, can not be supposed to have completely organized its system of instruction. We have elsewhere mentioned that Topography, the Art of War, and Fortification, are the branches of military study most attended to; but we have reason to believe that its plan of instruction will be extended. It may not be superfluous to mention the high appreciation in Sardinia of the Austrian General Staff, as tending to confirm our own estimate of the excellence of the Austrian Staff School. We have been recently informed, on the best authority, that some of the most distinguished Sardinian Officers, who, from their service in the Crimea and elsewhere, have been able to compare the merits of different Staff Corps, consider the Austrian General Staff "the best in existence."

As regards the System of Examinations, there is a Standing Board consisting of from *five* to *seven* Officers, presided over by a Lieutenant-General, which superintends all the more important Examinations of the Military Schools, such as those upon leaving the School, &c. The constant Examinations within the School, when the Cadets are being moved from one class to another, are conducted by the Professors.

The expense of Military Education in the Sardinian States amounts to 18,000*l.* annually. The Military Schools are all under the direction of the Minister of War.

5. Two Institutions peculiar to the Sardinian Service are the *Schools for Officers*, one or other of which it is necessary that every Officer under ordinary circumstances should attend for a year before being promoted to the rank of Captain. One of these is for the Infantry, at Ivrea; the other for the Cavalry, at Pinerol. In saying that *every* Officer must attend these Schools, we except that proportion of *one-third* who are promoted annually from the ranks, and whose attendance apparently has not hitherto been required.

Details respecting the organization and instruction of these schools will be found under the following heads.

II. THE ROYAL MILITARY ACADEMY AT TURIN.

The *Accademia Militare* was originally designed by Charles Emanuel, for the instruction of sons of officers of the army and of the nobility in the use of weapons, in horsemanship, dancing, mathematics, and belles-lettres. In the course of time, the institution was converted to its present purpose, of training Officers for the Sardinian Army.

The regular course of study in this school lasts apparently for six years, shortly to be reduced to five years, and the earliest age at which it is *possible* now to enter is fourteen, the *usual* age of admission being fifteen or sixteen. Formerly, boys entered at eleven and twelve, but this practice has lately been altered, to the regret of many Officers, who prefer the plan so commonly adopted abroad, of training Officers to their business as soldiers from very early years.

The peculiarity of this school is that during a portion of the course it educates Officers for all Arms in common. The most talented pupils are then selected by examination for the Artillery and Engineers, which are the two favorite services, and indeed the most aristocratic corps in the Sardinian army. The number of the pupils is limited to 200, but it is rarely complete; at present there are 180 pupils. About half of these pay for themselves a yearly sum of 1,200 francs, 48*l*., the remaining half are supported, or partly supported by the Government. The system of *demi-bourses* prevails here as in France.

The pupils are divided into four classes, according to the years of the course; a fifth class, contains those who have been just selected for the Artillery and Engineers, who work by themselves, chiefly at the higher kinds of drawing and the Differential and Integral Calculus, and Mechanics. These senior pupils are Officers, and have each their separate room. German is taught, and there is a Course of Italian Literature, &c., but no Latin is taught in any part of the school. The system of working (at least with the higher boys) is in rooms where eight or ten are united, and apparently there is something of the *Répétiteur* system.

The arrangements of the house are excellent. The pupils appear to be strictly confined to barracks during the week, but allowed to go out on Sundays. The discipline is said to have been relaxed of late years, and this is attributed by old Officers to a cause which will appear curious in England, viz., to the pupils having *any* holidays at all. This innovation upon the simplicity of the Piedmontese system of education was alleged to have encouraged distinctions

between the richer and poorer pupils, and thus to have injured both the economy and the *Camaraderie* of the school. Great stress was laid here, as at other Military Institutions, on a strictness of discipline very unusual in England. The boys begin their work at half-past five o'clock, and work till seven; then they go to chapel for a short time, and breakfast and recreation follow immediately after. Both are concluded by eight, when they return to their studies for an hour and a quarter; then a quarter of an hour's relaxation is allowed, and the studies are resumed until eleven o'clock. An hour is then devoted to the schools of fencing, riding, gymnastics, or dancing. From twelve to a quarter before two o'clock is allotted to dinner and recreation, and then another hour is spent in the fencing, riding, gymnastic, or dancing schools. A quarter of an hour's recreation is again granted, and from three to half-past four o'clock study is resumed. A quarter of an hour's recreation follows, and half an hour is then given to military exercises, succeeded by another quarter of an hour's interval for rest. Two hours are then devoted to study—from half-past five to half-past seven o'clock. An hour is afterwards allowed for chapel, supper, and retiring to rest.

A monthly account is taken of their work, and the marks then given exercise an influence upon their places in the examinations which take place every year.

The following tables give a full view of the work of the pupils during their six years' course.

DISTRIBUTION OF THE VARIOUS BRANCHES OF STUDY IN THE DIFFERENT YEARS OF THE COURSE, AND GENERAL TIME TABLE FOR THE SCHOOLS.

Classes.	SUBJECTS OF STUDY.	Lessons	
		Months.	In each Week.
First Year.	Catechism,	8	1
	Arithmetic,	1	6
	Plane Geometry,	1	6
	Algebra, 1st Part,	3	6
	Solids,	3	6
	Italian Elocution,	4	5
	History of Italian Literature,	4	5
	French Language,	8	5
	Caligraphy,	7	2
	Soldiers' Drill,	3	2
	Squad Drill,	3	2
	Army Regulations,	2	2
	Dancing,	8	2
	Gymnastics,	8	2
	Figure Drawing,	8	2
	N. B.—This class will be abolished at the cessation of the present scholastic course.		

Classes.	SUBJECTS OF STUDY.	Lessons.	
		Months.	In each Week.
Second Year.	Catechism,	8	1
	Algebra, 1st Part,	8	3
	Solids,	6	3
	Italian Literature,	8	3
	French Language,	8	3
	Battalion and Company Drill,	2	3
	Chasseur Drill,	1	3
	Garrison and Divisional Duty,	2	3
	Law on Recruiting,	1	2
	Figure Drawing,	8	2
	Dancing,	8	2
	Gymnastics,	8	2
	Soldiers' Drill,	2	2
	Caligraphy,	4	2

DISTRIBUTION OF VARIOUS BRANCHES OF STUDY—*continued.*

Classes.	SUBJECTS OF STUDY.	Lessons. Months.	Lessons. In each Week.
Third Year, General Services.	Sacred History,	8	1
	Rectilinear Trigonometry,	8	3
	Geography and Ancient and Mediæval History,	8	3
	Italian Literature,	8	3
	French Literature,	8	3
	War in Detail,	4	3
	Company and Battalion Drill,	5	1
	Chasseur Drill,	1	1
	Rifle Practice and Gymnastics,	1	1
	Topographical Drawing,	8	3
	Fencing,	8	2
	Gymnastics,	8	1
Third Year, Special Services.	Sacred History,	8	1
	Algebra, 2nd Part,	3	4
	Rectilinear Trigonometry,	1	4
	Spherical Trigonometry,	1	4
	Algebra applied to Geometry,	3	4
	Descriptive Geometry (the first 10 numbers,)	5	3
	Geography and Ancient and Mediæval History,	8	3
	Italian Literature,	8	3
	French Literature,	8	3
	War in Detail,	4	3
	Company and Battalion Drill,	5	1
	Chasseur Drill,	1	1
	Rifle Practice and Gymnastics,	1	1
	Topographical Drawing,	8	3
	Fencing,	8	2
	Gymnastics,	8	1
Fourth Year, General Services.	Ecclesiastical History,	8	1
	War in Detail,	5	2
	Art of War, 2nd Part,	3	2
	Artillery,	5	2
	Fortification,	8	3
	Physical Mechanics,	8	3
	Topography,	3	2
	Modern History, History of the Country,	8	3
	German Language,	8	3
	Army Regulations,	3	2
	Military Accounts,	8	2
	Italian Literature,	5	2
	French Literature,	2	2
	Gymnastics,	8	1
	Riding,	8	3
	Landscape Drawing,	8	2
	Topographical Drawing,	3	2
	Fencing,	8	2
Fourth Year, Special Services.	Ecclesiastical History,	8	1
	Infinitesimal Calculus,	8	4
	Descriptive Geometry, 2nd Part,	6	2
	Fortification,	8	3
	War in Detail,	8	2
	Modern History, History of the Country,	8	3
	German Language,	8	3
	Topographical Drawing,	3	2
	Military Accounts,	8	1
	Landscape Drawing,	8	2
	Gymnastics,	8	2
	Riding,	8	2
	Fencing,	8	2
Fifth Year, General Services.	Ethics,	8	1
	Physical Mechanics,	8	3
	Topography,	8	2
	Art of War,	5	2
	Artillery,	6	2
	Landscape Drawing,	3	2
	German Language,	8	2
	Italian Literature,	4	2
	French Literature,	5	2
	Army Regulations,	4	2
	Gymnastics,	8	2
	Fencing,	8	2
	Riding,	8	3
	Military Accounts,	8	2
Fifth Year, Special Services.	Ethics,	8	1
	Calculus,	8	4
	Physics,	8	3
	Topography,	8	2
	Art of War,	5	2
	Artillery,	6	2
	Landscape Drawing,	8	2
	German Language,	8	2
	Descriptive Geometry, 2nd Part,	6	2
	Gymnastics,	8	2
	Fencing,	8	2
	Riding,	8	3

PUPIL SUB-LIEUTENANTS.

Class.	SUBJECTS OF STUDY.	Lessons. Months.	Lessons. In each Week.
Sixth Year, Special Services.	Ethics,	8	1
	Rational Mechanics,	8	6
	Analysis,	2	6
	Chemistry,	8	3
	Architectural Drawing,	8	2
	German Language,	8	2
	Gymnastics,	2	1
	Fencing,	8	2
	Riding,	8	3

GENERAL TIME TABLE FOR SCHOOL DAYS.

From 5 to 5½, Rising, Dressing, &c.
" 5½ to 7 A. M., Study. From 7 to 8, Chapel, Breakfast, and Recreation.
" 8 to 9¼, School of Science and Literature. From 9¼ to 9½, Recreation.
" 9½ to 11, " " "
" 11 to 12, School of Fencing, Riding, Gymnastics, Dancing, &c.
" 12 to 1¾, Dinner and Recreation.
" 1¾ to 2¾, P. M., School of Fencing, Riding, Gymnastics, Dancing, &c.
" 2¾ to 3, Recreation.
" 4¾ to 5½, Military Exercises. From 5½ to 5½, Recreation.
" 5½ to 7½, Study. From 7½ to 8½, Chapel, Supper, Dormitory.
" 3 to 4½, School of Science and Literature.
" 4½ to 4¾, Recreation.

III. ARTILLERY AND ENGINEER SCHOOL AT TURIN.

The *Artillery and Engineer School* (*Scuola Complementaria*,) which is established in a large building in one of the suburbs of Turin, is a School of Application, intended to complete the special education of the Young Officers of the Artillery and Engineers, which the Cadets of those Corps have previously entered upon during their four last years in the *Accademia Militare*. Its course of studies occupies nominally two years, but really only eighteen months, after which the final examinations begin, and the pupils receive leave of absence. The Students do not live in barracks here, but the Inspector of the School seemed to think it desirable that they should do so. The exercises of the day commence, at eight o'clock every morning, with an hour's riding. A lecture then follows, which lasts for an hour and a half, from nine till half-past ten. The rest of the morning is left free till twelve o'clock, when the pupils return to the school till three, and where they study together in large classes in the same room; they have afterwards some military exercises till five, and are then free for the evening.

The number of pupils at the school is twenty; from ten to fifteen for the Artillery, the rest for the Engineers. The subjects of study will show what difference exists in the studies of the two Corps, and we were told that very little preference was shown in the choice of the Students for one over the other. The Engineers do not appear to be at all employed in civil works; indeed, the Government does not allow them to be so, as there are sufficient fortifications in the kingdom of Sardinia to afford them constant employment. The pay of the two Corps is equal, and is very little above that of the Infantry, and the same as that of the Cavalry. The Artillery and Engineers (the *Armi dotti*) appear to be decidedly the favorite and aristocratic corps of the Sardinian army. They rarely enter the Staff Corps, and the reason assigned for this is their unwillingness to quit their own arm of the service. The position of the pupils on entering the Corps is fixed by the Final Examination alone, and is not influenced by marks previously given for industry and application during the course, as is the case in some of the French and German schools—at the Polytechnic, for instance, and at Znaim. The only value of a high position in the Final Examination is that it gives seniority in the Corps.

The direction of the school is intrusted to a Field Officer of Artillery, assisted by two Captains, one from the Artillery, and the other from the Engineers. His authority extends to instruction and discipline.

The scientific instruction is given by professors (effective and supplementary) and by Officers belonging to the various Artillery divisions and establishments, who, together, constitute a Council of Instruction, of which the Director is President.

The examinations to which the Officer Students are subjected are held by a Commission, nominated by the Secretary of War.

Regulations respecting the Professors, &c.

The Professors and Instructors are personally responsible for the teaching of the subjects contained in the programmes and regulation for the discipline of the students in School, for the daily drawing up of the notes and execution of the drawings, and for the constant presence of the students during the time of the instructions and lectures.

The Military Professors and Instructors will maintain constantly among the students the spirit of subordination and military discipline in all its force.

The Professors not possessed of military rank, when reproof is not sufficient to keep the students to their duty, will report the matter to the Director and to the Captains attached to the direction of the School, in order that more vigorous measures may be adopted.

At the beginning of every lecture, the Professors will satisfy themselves that the students have finished the notes preceding it, and the regulated tasks and drawings.

The Professors will also have the power of visiting with arrest students who

are negligent in the execution of the notes and tasks, and those who exhibit a constant indisposition to work, reporting it to the Director of the School.

When the lectures are upon difficult subjects, it is the duty of the Professors sometimes to visit the students during the hours of study, for the purpose of explaining difficulties.

At the beginning of every lecture, the Professors will dictate to the students a summary of the lesson which they are about to explain.

At the commencement of their course of lectures, they will point out to the students the books and treatises to be followed.

At fixed intervals, as they shall judge it most convenient, the Professors will suspend the course of their lectures to satisfy themselves by questions of the attention given and the progress made by the students.

At the opening of their course, the Professors will notify to the Director of the School the hours which suit their engagements best for the giving of the lectures; these hours will be subsequently maintained unchanged throughout the duration of their course. These hours can only be selected out of those fixed in the general time table.

In case of any lectures having to take place out of the lecture-rooms of the School, they will give notice in time to the Director.

If they should consider any change in the programme necessary, they will give notice in writing to the Director of the School, so that he may be able to submit their propositions to the General Commandant.

The Instructors will exact of the students, in the execution of the practical instructions and in the explanation of them, a demeanor perfectly military, and a tone of voice appropriate to the circumstance. All the students, without exception, should render themselves capable of executing the practical tasks and explanations now mentioned with the greatest perfection.

The Professors, as well as Instructors, in concluding their course of lectures, will transmit to the Director of the School a statement showing the degree of instruction acquired by the students, and their conduct in School; the credit for the instruction and for conduct will be given by means of two distinct integral numbers, selected from two to ten.

Duration of the Course and Subjects.

The course of the Complementary School will be terminated in a year and a half.

The students belonging to two successive promotions will participate in the same instructions during the last six months of the first course, and the first six of the second course.

The subjects which will be taught to the Officer-students of the Complementary School are,—

a. Mineralogy and metallurgy.
b. Introduction to applied mechanics, and application of mechanics to machinery.
c. Theory of the combustion of powder; of the movement inside the bore; of the resistance of ordnance; of the volume, weight, and center of gravity of ordnance; projectiles.
d. Use of artillery in war, construction of batteries, service in the field.
e. Permanent fortification.
f. *Course of construction and of military and civil architecture.* } For Engineer-Officers only.
g. *Topography.* }
h. *Geodesy.* }
i. Military bridges and passage of water.
l. Classified nomenclature, and drawing of artillery materials.
m. Manufacture of powder, fire-works, arms, ordnance.

Practical Instructions.

Practical instruction will be given every day to the students of the Complementary School.

The object of this instruction is to render the Officers themselves familiar

with the execution of the operations, and with the proper method of instructing Non-commissioned Officers and soldiers of Artillery.

These instructions, which will be, as far as possible, executed and explained by the Officers of the School, will consist of—

Gymnastics.
Riding, according to the regulations in force.
The pack of the infantry soldier, armament, infantry instruction.
Classified nomenclature of the various parts of horse furniture, convenient adaptation of them; pack of the cavalry soldier.
Principles of the physiology of the horse, and of veterinary science; care of horses.
Nomenclature and use of the field, mountain, siege, garrison, and coast material.
Lading of field and siego carriages, and mountain mules.
Service of field, mountain, siege, garrison, and coast artillery.
Driving and sectional drill, battery and brigade drill.
Regulations for marches, encampments.
Charges and compositions in use in the field, in sieges, and in garrisons.
Judging distance drill, practice; remedies applied to materials in the field.

IV. THE STAFF SCHOOL.

The Staff School at Turin has only existed since the year 1850. Previously to that time the Staff was supplied by picked scholars from the *Accademia Militare.*

The whole Staff Corps of the Sardinian Army only consists of thirty-six Officers, viz., twenty-four Captains, and twelve of higher rank; no one of a lower rank than Captain being admitted even as attached to the corps, a regulation which appeared to be considered inconvenient.

Officers are required to have served four years before their admission, as is the case in the Austrian Staff Schools, and they must not have exceeded their twenty-eighth year. Again, as in Austria, the Officers on leaving the school are ranged strictly in the order of merit, as tested by a final examination; and the ablest obtain appointments to the Staff in the same order. The Sardinian School has, however, some peculiarities, partly arising from the higher position which the Special Arms (*Armi dotti*) of Artillery and Engineers hold in Sardinia than in Austria or Prussia. The method of admission is as follows:—

An Officer requests his Colonel to recommend him for admission to the Staff School. Great caution seems to be observed in giving this recommendation; but having obtained it, an Officer has no further difficulty in entering the School. In consequence of the small numbers of the Staff Corps, the demand for entrance is not very great, and there is accordingly no competitive examination. The numbers in the School have, during the first five years of existence, varied greatly—from fourteen or sixteen to four or six. A year (or rather eleven months) is the time occupied by the studies;

the first six months being given to theory, the last five to practice. The time thus occupied lasts from ten till three in the afternoon.

The amount of knowledge required for admission into the School is stated, in the "Note" of Colonel Petitti, to be an acquaintance with Geometry and Algebra, as far as Equations of the Second Degree.

The practical work consists in the usual surveys of countries, plans, &c. The young Officers are taken by the Inspecting Colonel of the School into the country, and worked hard for four or five months. There have hitherto been only places for one or two of these Officers on the Staff at the end of the year, and these (as has been already mentioned) have always been the most distinguished pupils of the School. The rest become teachers in the regimental schools. Officers leaving the Staff School do not appear to have a right to a step immediately (as in Austria) by virtue of their having been at the School; but the Sardinian system of making all the appointments above the rank of Major by selection gives them a prospect of advancement. Examinations are held in the School every three months, at which the Professors give marks of proficiency; these are combined with those obtained in the final examinations in determining the position of the pupils.

The Professors in the Staff School are all military men. The building is very good, and, although small, contains a library, instruments, museum, and all the apparatus for maps.

Among the conditions which must be met favorably to be admitted to the Royal Staff Corps are the following:—

Physique:—

If the constitution is robust, sufficiently strong, or weak.
If the sight is good, acute, or short.

Intellectual Qualities:—

If the intelligence is prompt, clear, reflective, and the mind orderly or confused.
If he is ready of speech, or uncommunicative.

Moral Qualities:—

If he is honorable, and of a good disposition, with much or little expansion of character.
If of conciliatory or rough manners.
If peaceable, quick, or irascible.
If active, resolute, authoritative, timid, or feeble.

Education:—

What degree of instruction he has arrived at in mathematics, in the theory and practice of surveying.
What ability in plan-sketching and topographical drawing.
If he cultivates any other branch of knowledge connected or unconnected with the Institute itself, and what.
If he is master of the Italian and French languages, so as to speak and write them with facility and correctness.

If he is acquainted with, and if he can speak, other languages.
If he is addicted to study.

Conduct:—

If his behavior is dignified, as becomes a soldier and a citizen.
If he enjoys the good-will of his superiors, the esteem of his comrades and inferiors.

Mode of discharging his Duty:—

If he discharges his duty with exactness and zeal, or remissly and ill.

Particular Aptitude:—

If he is more especially fitted for the duties of the surveying, topographical, or military branch of the service.
If he has shown aptitude for teaching.
If he is adapted for progress in the Corps, or in the Infantry or Cavalry services.

Miscellaneous Information:—

N. B.—Under this head will be inserted those notices which, finding no place under the preceding heads, contribute towards a fuller information respecting those Staff Officers who, in consequence of circumstances and duties special and unconnected with the service of the corps, may afford ground for special mention.

V. REGIMENTAL SCHOOLS OF IVREA AND PINEROL.

The requirement of professional study from Officers after entrance into the Army is a point almost peculiar to the Sardinian service. The *principle* of the Prussian Division School is, indeed, almost the same as that of the two Schools we are about to describe; but the examination for which the Division Schools prepare is a qualification for obtaining a commission, and not (like that of the Sardinian Schools) for subsequent promotion. And this difference is partly owing to an obvious cause, the slowness of promotion in the Prussian Service. If the Division Schools and their examination were placed before the promotion to a Captaincy, the candidates attending the School would be in most cases nearly forty years of age.

Some instruction in Topography is given to the Officers of every Regiment in the Sardinian Army, under the direction of the Chief of the Staff of the Division. Care is taken to render the teaching uniform throughout the Army, and it may be considered as a preparation for the more systematic instruction given in the Schools of Ivrea and Pinerol. The former of these is intended for the Infantry; the latter for the Cavalry. Every Officer, excepting those of the Special Arms, must have passed a year of study in one or other of these Schools, as well as a subsequent examination, before he can obtain a Captaincy.

The studies are mainly practical, as may be seen from the "Prospectus of Instruction" annexed. Topography, Field Fortification, and Secondary Operations are the only branches of Military Science

in which instruction is given; and upon these much care appears to be bestowed.

One-third of the Officers of the Sardinian Army are promoted, as has been mentioned, from the ranks. Accordingly, a class has been recently added to the School of Ivrea, intended exclusively for the Education of those Non-commissioned Officers who aspire to a Commission. This class is to be common to Infantry and Cavalry.

The following extracts from the Regulations of the Minister of War, will exhibit the practical character of instruction in this class of schools.

Prospectus of Instruction to be given to Lieutenants in the Military School of Infantry.

Soldiers' Drill, Squad, Company, Battalion, and Chasseur ditto, &c.
Fencing with the Bayonet.
Exercise of the various Arms, &c.
Musketry Practice.
Regulations of Discipline, Garrison and Field Regulations, Army Accounts.
Secondary Operations of War.
Topography.
Field Fortification.

School of Topography.

It is decided that such instruction [in Topography,] shall take place from the commencement of March till the end of July.

This will be obligatory on Officers who have not passed the age of thirty years.

Those Corps, however, who may think that they can thus employ themselves in the winter also for the hour or so which may remain over after the other occupations of the Officers, shall have the power of establishing, from the beginning of November, a school, in which drawing and other preliminary acquirements may be taught.

This School will be attended especially by beginners and the less educated, who will thus be able better to profit at the beginning of March by the lectures given to the Officers more advanced in this study.

The Schools will be instituted for regiments or brigades, according as the General commanding the Division shall determine, upon the report of the Chief of the Staff, regard being had to the Director who can be assigned to them and the opportunities afforded by the situation.

In cases, however, where it may be convenient, they can institute Divisional Schools as well, which will be attended by the Officers of the different corps already more advanced in the study.

There they will be exercised, by direction of the Chief of the

Staff, in the various subjects taught in the School, especially in the application upon sketches of themes of secondary operations of war, and will be taken into the field to execute surveys on the spot with the instruments and by the eye.

In this case, in the Regimental Schools, the less educated officers will be trained under the direction of Officers who have given proof of sufficient capacity.

The Officers of the Detachments of Cavalry or of the Rifles, for whom it may not be convenient to establish separate schools, will attend those schools of their garrison to which they are assigned by the General Commandant of the Division upon the proposition of the Chief of the Staff.

Inasmuch as this Ministry is careful to provide the Schools of Topography with the instruments necessary for the practical training upon the ground, it makes known henceforward the implements with which they must be provided, at the charge of the Treasury, in cases where they do not already possess them, viz. :—

Small tables, with desks. Seats or stools. Slate, with stand. 2 pieces of Indian ink. 2 ditto of French blue. 2 ditto of gum. 2 tablets of carded wool. 1 case of mathematical instruments. 2 plane rulers of one metre each, besides some rulers of various dimensions, the necessary paper for themes, &c. 2 penknives. Some pencils. 1 paper of steel pens for drawing. Half a bundle of crows'-quills. Chalk for the slate, and sponge. Inkstand, with ordinary ink. 2 crayons (*coulé*) of No. 2. 2 ditto of No. 4. 2 pieces of Indian rubber.

GENERAL SYLLABUS OF INSTRUCTION FOR THE INFANTRY OF THE LINE.

Months of November, December, January, February and March.

Recruits will be kept separate from the seniors during these five months in all the instructions (except the drills.)

They will be instructed progressively once a day in soldiers' and squad drill.

They will attend daily the gymnastic exercise and the school of reading and writing.

N. B. As they shall progress by degrees in the various branches of instruction, they will take their part in the service, at first on duty where arms are not required, and afterwards with their arms, as much as possible always upon public holidays.

Seniors will have to attend the school of reading, writing, arithmetic, and gymnastics daily.

The recruits as well as the seniors will be prepared for the practice range, during the months of February and March, by aiming at the butt and firing at the candle.

The Officers, especially the juniors, will be encouraged to exercise themselves in gymnastics, and to frequent the School of Topography.

The Captains will be taught riding as much as possible where they are in garrison with Cavalry.

In the months of February and March the Officers will be further prepared in the appropriate theory, with a view to the instruction of the following months, and all without exception will have to practice firing with the rifle.

April and May.

There will be no further distinction made between the recruits and seniors.

They will pass successively through soldiers', squad, and company drill, bayonet exercise, and rifle practice at the butt.

The school of reading, writing, and arithmetic, and gymnastics, will be continued at least for the lower classes.

The Captains will give instruction to their companies, especially in bad weather, on the subject of packing necessaries, and on the general behavior of the soldier under different circumstances on and off duty, showing them also the manner of making reports in a few clear and concise words.

The Officers will be prepared by the appropriate theoretical training for the instruction of the following months.

The School of Topography will be continued as much as possible for the Officers who desire to attend it.

June, July, August.

They will pass successively through battalion drill and regimental and brigade manœuvres.

The rifle practice at the butt will be continued.

The *Chasseur* exercise will be taught.

The swimming school will proceed with the utmost possible activity.

The school of reading, writing, and arithmetic, and gymnastics will be continued at least for the lowest classes, as much at least as the instructions in other subjects, and especially swimming, permit.

The Generals of Brigade will explain theoretically to the superior Officers and Captains, and these latter to their own companies, the nature of service in the field.

September.

By frequent marches instruction will be given in field service, practical in its nature, and separate for every arm.

Manœuvres and evolutions appropriate to the ground will be gone through.

The troops will be disposed for the defense of a village or a position, of a stream, or the like.

October.

The instruction in the field will continue as much as possible, and especially in the garrisons where troops of different arms are quartered, one part of the force can be opposed to the other, and, where the service of the place permits it, by calling in the assistance of the National Guard, the garrison will be able entirely or in part to absent itself for two or three days.

GENERAL RULES RELATING TO THE INSTRUCTIONS.

1. As far as is possible the soldiers should receive at least two lessons in the day.

2. In the months of April, May, June, July, and August, the drill in the *place d' armes* will take place only once a day, the other will be in the barrack or the neighborhood.

3. The Officers should give the instructions themselves, and should never appear as idle spectators before the soldier.

The subalterns will themselves conduct the soldiers' and squad drill, and the bayonet exercise.

The Captains will be careful to instruct their own companies. At the rifle practice all the Officers of the Company should be present and interest themselves for the good working of so important a subject of instruction.

4. During recreation times, and in all those kinds of instruction which do not require silence and immobility, the Officers will be careful to converse with their inferiors, and to study their character and qualities, praising and encouraging the good to do well, and visiting with words of blame more or less severe those who are ill-regulated in their conduct.

5. In order to interrupt as little as possible the course of the instructions, the Colonels and Generals of Brigade will avail themselves of the festivals accurately to review the men before and after mass.

6. In forts the Infantry will be exercised at the service of guns according to

the directions which will be given to the Officers of Artillery commanding in them.

7. Some Non-commissioned Officers in every regiment will be trained as the carpenters for making cartridges.

8. In the interior of the barracks the men will be encouraged to amuse themselves, and be gay, rather than to loiter about in idleness. It will be most advantageous to introduce singing to music, as was done in the camp of 1846.

9. In the month of August, Staff Officers will be dispatched to the principal garrisons who, being attached to Generals of Brigade and Division, will prepare with them the projects and plans for the field instructions of the months of September and October. These Staff Officers are further particularly charged to study the environs, and to point out in reports for that purpose the most important military positions, and the mode of occupying them.

10. Appropriate instructions concerning the rules to be observed in the rifle schools, concerning the swimming school, and the exercises in the field, will be forwarded at the proper time.

VI. SCHOOL OF ARTILLERY IN THE ARSENAL.

Men, who are destined to work in the arsenal, receive here practical instruction in their art. The arsenal contains, 1st, a chemical and metallurgical laboratory, in which analysis, &c., are performed; 2d, a mineralogical collection, containing 1100 specimens of minerals, and many models of crystalization, besides a complete collection of specimens from the territory of Genoa; 3d, a collection of philosophical apparatus, containing 600 different machines and instruments, partly from Puxy and Dumotier of Paris, and partly from Zest and Brabante of Turin; 4th, a library containing the best books on Mathematics, Natural Philosophy, Astronomy, Geology, Geography, &c.; 5th, a foundry of cannon, which includes the foundry properly so called, the atelier of modelers, the hall of models, the ateliers of trepans and of engravers; 6th, the lithographic establishment; 7th, the machine shop; 8th, a manufacture of all kinds of arms for the army and navy; 9th, the atelier of bombardiers; 10th the manufacture of gunpowder, and refinery of saltpetre; 11th, a forge for gun-barrels.

SCHOOL OF NAUTICAL INSTRUCTION AT GENOA.

The course of instruction in the Nautical Institute at Genoa embraces:—1. Nautical Astronomy and Navigation; II. Mechanics and Steam Engine; III. Maritime and Commercial Law; IV. Geography and Meteorology.

I. Nautical Astronomy and Navigation.

Introduction: 1. Nautical art in general; different sciences attached; need of varied knowledge for captains; special applications of mathematics to navigation. 2. Method to be pursued in carrying on nautical studies.

Plane Navigation: 3. Figure and dimensions of the earth; equations in equal spheres of a circle traced on the same. 4. Methods for determining the course of the ship; the compass. 5. Demonstrations of the principles on which the solution of problems of navigation rest, reduction tables. 6. Given two of the four quantities, how to find the other two in determining the position of a ship. 7. Reduction of a straight course; degree of confidence to be placed in results. 8. Maritime charts; how constructed; resolution of problems.

Nautical Astronomy. 9. Elementary notions of astronomy; special objects in teaching this science to seamen. 10. Astronomical tables in use among different nations, and how to use them. 11. Instruments for reflexion, and principles of construction; verification, rectification, and use of the sextant, octant, and artificial horizon; corrections to be made on the heights and angular distances observed; depression; refraction; parallax, semi-diameter. 12. Examination of the principal problems relative to the measure and transformation of time. 13. The chronometer; absolute state of the chronometer; diurnal variations; comparison; use of chronometers. 14. Compass; its construction and verification; determination of the declivity; tables of deviation; correction bars. 15. Different methods for determining the latitude and longitude at sea. 16. The tides, their fundamental theory; calculations regarding them. 17. Hydrographic charts; topographical instruments, and different projections.

II. Mechanics and Steam Engine.

Introduction: 1. Necessity for the use of mechanics and physics for the shipmaster, naval constructor and machinist. 2. Method of giving such instruction to seamen.

Mechanics:—Motion considered geometrically; composition; decomposition. 3. Transformation of motion. 4. Force; composition and decomposition of force; equilibrium. 5. Center of gravity, and how to find it; application of the same, on the theory of the ship. 6. Theory of simple machines; principal machines. 7. Principle of force. 8. Blows. 9. Resistance of materials; experimental elements of resistance, and elasticity of the principal substances in use in naval construction. 10. Mechanic of fluids; demonstrations of its principal theorems; application of the same to the stability of the ship.

Steam Engines:—11. General notions on steam; mechanical element of heat; thermometers; tension; expansion; condensation of steam. 12. Steam engines generally; examination and description of its organs, and its different forms and applications. 13. Marine steam engines, and different systems on which they are constructed. 14. The boilers and their different types. 15. Combustibles and their different kinds. 16. Different systems of propulsion. 17. Mixed Navigation. 18. Historical summary of the origin and progress of machine and steam power.

III. Maritime and Commercial Law.

Introduction: 1. Necessity of general culture to shipmasters; study of the native tongue; foreign languages; history; methods of gaining such instruction. 2. Necessity of the study of public maritime and special law, and commercial law; method of giving such instruction.

International Public Maritime Law: 3. The sea, and the laws by which it is governed; freedom of the sea; restrictions to this principle. 4. International maritime jurisdiction; treaties; reciprocity; consular agents. 5. War, embargoes and reprisals; letters of marque; capture; neutrality; blockade; contraband of war. 6. The latest modifications.

Internal Public Maritime Law: Territorial sea; harbors and shores; administrative division of the boundaries of states, and docks. 9. Laws applicable to wooden and iron ships, sailing and steamships. 10. Nationality of the ship. 11. Law applicable to the *personel* of seamen. 12. Customs, laws, sanitary and police, as regards navigation. 13. Wrecks and recovery. 14. Maritime crimes and penal mercantile jurisdiction.

Private Commercial Maritime Law: 15. Ownership of ships; privileges of ships. 16. Contract of freight; insurance and bottomry bonds; averages; jettison and abandonment. 17. Duties and responsibilities of the master toward the freighterer, the shipper, the crew, and the passengers. 18. Legal relations arising from commercial operations; bills of exchange; partnership and agency.

IV. Geography and Meteorology.

Introduction: 1. Necessity of this knowledge to seamen. 2. Relations between geography and meteorology. 3. Historical development. 4. Fundamental principles of geography, astronomy, and mathematics, and methods of instruction.

Physical Geography and Meteorology: 5. Fundamental principles of geology; physical configuration of the earth; forces which determine the formation of continents and islands; extension of lines, &c. 6. Description of different parts of the globe. 7. Physical geography of the sea; its extensions, divisions, depths, soundings, temperature, phosphorescence, colors, tides, currents, storms. 8. Descriptive hydrography—oceans, their divisions and dependencies; the rivers and lakes in different parts of the globe. 9. The atmosphere—its extension, temperature, and the thermometer; different thermometric scales; atmospheric density and pressure; the barometer—different barometric scales; the winds—general, periodical, variable; hurricanes; storms; law of storms; watery luminaries and electric meteors; signs and forecasts of the weather. 10 Magnetism—magnetic action; declension of the magnetic needle; the compass. 11. Geographical distribution of minerals, plants, and animals, utilized by man. 12. Man as a geographical modifying agent.

Political Description: Statistical and commercial geography. 13. Divisions, population, wealth, finances, commerce, and other statistical data of different states, in different divisions of the globe.

PART VI.

MILITARY SYSTEM AND SCHOOLS IN RUSSIA AND OTHER STATES.

VIII. MILITARY SYSTEM AND EDUCATION IN RUSSIA.

I. MILITARY SYSTEM.

The Emperor is commander-in-chief of all the forces, by sea and land, assisted by the Staff-Office, the members of which are expert linguists, as well as scientific experienced and military officers. The army is under a Minister of War, assisted by a colleague and a military council. The office of Master of Ordnance is generally filled by a grand prince. The regular force, or army of occupation consists of about 783,000 men, which can be easily swelled to at least 1,200,000, as the whole male population are liable to serve when summoned. The army is mainly recruited by conscription, which falls on the serfs and laboring population, as the nobility, officials, clergy and merchants are exempted. The term of service is twenty years for the guards, twenty two for the line, and twenty-five for the train and military servants. But few pensions are granted to discharged or furloughed soldiers, although veteran soldiers are frequently appointed to situations as doorkeepers, watchmen, overseers, &c., in government establishments and public institutions.

Promotion by seniority, imperial favor, and good conduct on the field. Every officer must be educated and trained to his business, and serve from the lowest to the highest rank. Non-commissioned officers, musicians, assistant veterinary surgeons, head workmen in the military workshops and factories must all be trained for their special duties. A large portion of these classes are the sons of soldiers, who have been surrendered by their parents to the government, who receive them at the age of six or twelve, by special arrangement. They are termed *cantonists.* Among the special military schools of a technological character are, eleven for garrison artillery; three for armories; three for powder mills; three for arsenals; one for riding masters; one for fencing; one for accountants; one for topographical drawing, &c.

II. MILITARY SCHOOL FOR OFFICERS.

The officers of the Russian army obtain their first commission after passing through the Military Schools or Cadet Corps, or if qualified in scientific and other instruction, ascertained by open examination, by serving as privates six months, and as sergeants or ensign two years. Applicants for the Staff Corps, must have served as officers two years, must be recommended by their superior, and have been two years in the Staff School—and there pass an honorable examination in military history and strategy. The following statistics are taken from the *Kalender* of the St. Petersburg Academy, for 1859.

I. Under a Commission or Board of Military Instruction, which reports directly to the Emperor, there are

3	Military Schools of Special Application, viz.:					
1	The Nicholas Academy of the Staff, with	22	teachers	and	250	scholars.
1	The Nicholas Upper Engineer School, "	50	"		126	"
1	The Michael Artillery School,..... "	32	"		117	"
1	Page Corps, or College..... "	41	"		159	"
1	Ensign's School of the Guards,..... "	31	"		206	"
22	Cadet Corps or Military Colleges,..... "	723	"		7440	"
27		899	"		8,298	"

The Cadet Corps, or Military Schools, receive their pupils young, and impart a general as well as a scientific education, preparatory to entering the Special Schools of Application either for Engineer, or Artillery, and later in years and experience, the Staff School. These Special Military Schools are not surpassed by any of the same class in Europe.

II. Under the Ministry of War there are the following Scientific Establishments and Schools.

22	Military Schools, with.....	326	teachers and	10,000	scholars.
3	Lower or Element. Artillery Schools,	22	"	166	"
1	Topographers' School, with	13	"	140	"
1	Medico-Chirurgical Academy, with	35	"	978	"
	Military Hospitals,.....			1,020	"
3	Veterinary Schools,.....			12,304	"

The Military Schools are of an elementary and technological haracter, and are intended to supersede a class of schools known s the *Cantonist* Schools.

The experience of the Crimean War demonstrated to the world, he wise forecast of the Russian government in providing for the horough scientific and practical training of the officers of her great rmies as was confessed by the "*London Times*," in the bitter dis appointments of the English people with their own officers.

THE IMPERIAL STAFF SCHOOL AT ST. PETERSBURG.

[Extracts from Governmental Regulations.]

I. GENERAL DIRECTIONS.

A MILITARY Academy, the highest institution of its class, is founded in St. Petersburg, to educate Officers for the service of the General Staff, and to promote the diffusion of Military Science in general. Its special functions are—

1. To prepare Officers for the special service of the General Staff.

2. To furnish to a certain number of Officers from the Artillery and Chief Engineer School a course of Grand Tactics and Strategy, on the same principles and to the same extent as it is furnished to the Officers preparing for the Service of the General Staff.

3. To apply all the means indicated in these Regulations to the diffusion of Military Science.

From forty to fifty Officers shall be educated in the Academy for the special service of the General Staff, and about ten from the Artillery and from the Chief Engineer School.

The Military Academy is under the immediate control of the Chief of the Staff of His Imperial Majesty, and is under the direction of a President appointed by the Emperor.

A Council, presided over by the President, considers and determines all important questions relating to Studies and Economic Administration.

A Vice-President, appointed by the Emperor, is associated with the President to assist him in the performance of his official duties.

The Officers receiving an education for the General Staff are placed under the control of four Staff Officers appointed by the Emperor.

The subjects of Study and the Scientific Course are divided into two Sections, the Theoretical and the Practical.

The number of Professors, Adjuncts, and Teachers is determined according to circumstances by the Academic Council, with the approbation of the Chief of the Staff of his Imperial Majesty.

The Salaries of the Officials for the internal service of the Academy are fixed in the List annexed to these Statutes.

It is the most sacred duty of the whole Staff of the Academy, and in particular of the Chiefs and Professors, never to lose sight of its object; and while they devote themselves to extend the knowledge of the student Officers, to impress upon them, by teaching and example, the precepts of the purest morality, the true and exact performance of their professional duties, an unconditional obedience to their superiors, and an inviolable devotion to the throne and their country.

The Academy has a peculiar Seal.

II. ADMISSION TO STUDENTS.

Only Superior Officers can enter into the Academy, and these up to the rank of Staff Captain if they serve in the Guards, Artillery, or Engineers; up to the rank of Captain, if they belong to an Army Regiment.

The Directors of the Noble Guard School, of the Page Corps, of the First, Second, Pant, Moscow, and Finland Cadet Corps, have the right to propose in the proper quarter, for admission into the Academy, the most distinguished Officers who have left these military institutions.

The Officers proposed for admission into the Academy must be at least eighteen years old, and be distinguished for capacity, industry, diligence, morals, and good conduct.

Officers from the Regiments and Artillery Brigades must present testimonials of blameless morals, conduct, and zeal for the Service from the Chief of their Division. Officers from the Engineer Battalions must present similar testimonials from the Chiefs of their Brigades.

Those who give testimonials are strictly responsible for their truth, as are the Chiefs of the Military Schools for the capacity and qualifications of the Officers they propose.

Admission into the Academy depends upon a strict examination in the following subjects:—

a. Languages:

Russian, German, or French.

b. Mathematics:

Arithmetic, Algebra to Equations of the Second Degree, Plane and Solid Geometry, and Plane Trigonometry.

c. Military Sciences:

The Principles of Intrenchment, Fortification, and Artillery.

d. Evolution:

Evolutions of a Battalion of Tirailleurs, of a Squadron, of a Whole Line, of a Scattered Front (*Zerstreuten Fronte,*) and, lastly, the Service of Outposts.

e. History:

General History of the World to the sixteenth century in its chief epochs, particularly in reference to Russia; special Histories of the European States in modern times.

f. Geography:

Universal Geography, and particularly that of the Russian Empire and the neighboring States.

Besides this, a clear conception of Situation, Plans, and Topographical Charts is required.

III. METHOD OF INSTRUCTION.

The Scientific Course is divided into two Sections,—The Theoretical and the Practical. The Theoretical part of the higher Military Sciences is expounded by the Professors, their Adjuncts, and the Teachers. Those Officers who belong to the Practical Section exercise themselves under the guidance of the Professors.

a. In Written Exercises on any proposed Military Subject.
b. In the composition of Military Descriptions (*Beschreibungen,*) of every kind.
c. In the Art of taking Military Surveys of a Country, and of judging the Tactical Nature of a Ground.

In each Section there are from twenty to twenty-five Officers destined for the Service of the General Staff, and from four to five from the Artillery and Chief Engineer School.

These Officers, according to their capacities and attainments in the Military Sciences, enter either into the Theoretical Section or into both the Theoretical and the Practical Section at the same time, and remain in each a year.

The complete Academic Course in both Sections extends over two years.

The following subjects are taught:—

a. Russian literature, with particular reference to the composition of Military Essays in a faultless style, and to the style of the Military Chancery (writing department of the War Office.)
b. General ideas on Artillery, and more precise details on the same subject as a Special Arm; its use in the open field and in sieges.
c. Petty Tactics in the employment of a single Division, with which all Officers must be thoroughly familiar, as this is indispensable to all. To this is joined the theory of the formation of columns, of their use, of the effect of the fire of Infantry, and lastly, the explanation of all evolutions with the three arms which are usually employed for movement, deployment, or forming in order of battle.
d. The Elements of Topography and Geodesy, of Military Drawing, and the art of measuring situations by the eye.
e. Military coup d'œil (*Scharfblick,*) and the art of judging the tactical nature of ground.
f. Castrametation, or the art of encamping, and the theory of positions.
g. Logistic, or all that relates to the details of marches, either in presence of the enemy, or in the movement of troops from one place to another.
h. Intrenchment and fortification, as far as regards the attack and defense of intrenched camps and fortified places, and the effect of intrenchments and fortifications on the operations of an active army.

i. Grand Tactics, embracing the various systems of the Order of Battle; and the formation and employment of the Three Arms, and treating of unexpected engagements or the sudden collision of two hostile Divisions.
k. The Military Geography of Europe, particularly that of the Russian Empire and the neighboring States.
l. Military Statistics, or knowledge of the land and sea Forces and warlike means of all the European States.
m. Strategy in all its extent; with a criticism on the last wars, and an indication of the events which demonstrate the influence of this science on the success of a campaign.
n. A general view of military history in its most remarkable periods, from the earliest times to Peter the Great, and a more complete view of the Military History of modern times.
o. The literary History of the Military Sciences, with a criticism on the best ancient and modern writers on the History of War; and a special reference of those who may contribute to the further education of the Officers after their departure from the Academy.
p. Duties of the General Staff Officer in times both of peace and war.
q. The art of riding.

The officers of the Practical Division are employed on the same Sciences; not, however, during the hours of lecture, but by practicing under the direction of the Professors, and according to the regulations of the Academic authorities.

The subjects they are employed upon are principally the following:—

a. Topographical and Tactical description of ground after inspection.
b. Military Geography and Statistics.
c. Logistic.
d. Grand Tactics.
e. Strategy.
f. Military History.
g. Literature of the Military Sciences.
h. Designing plans of battles and manœuvres, as exercises in Topography, Logistic, and Tactics.
i. Historic reports, and keeping the usual journal of the General Staff.
j. All that belong to the survey of a country, and the practical working of the Artillery and Siege operations.

Teachers are appointed for those officers who require to be perfected in the French or German language.

All the sciences are taught in the Academy in the Russian language; and an exposition in French or German is only allowed when dictated by circumstances, and then a special permission must be first obtained from the Chief of the Staff of his Imperial Majesty.

The Officers of the Practical Section are also required to use their native tongue in their written exercises, except in one or two composed in a foreign language by the direction of the authorities.

In summer, the Officers of the Theoretical Section repair to regiments to which they are directed to learn the camp service. The Officers of the Practical Section make surveys and reconnaissances,

mark out camps and proportionate intrenchments on a given ground. At the time of grand manœuvres, they are associated with Officers of the General Staff, and have the opportunity of witnessing the practical exercises of the Artillery and Sappers, in order to be able to make a report as eye-witnesses on the effect of Artillery and Siege operations.

IV. LOCAL REGULATIONS.

All Officers receiving an education in the Academy are entered on the rolls of their Regiments, Artillery Brigades, and Sapper Battalions, as supernumeraries and detached Officers, without, however, losing their standing or right of promotion by seniority, their pay, servants' rations, or any other advantages enjoyed by Officers present with their troop.

Those Officers who enter the Academy from the Regiments of the Garrison of St. Petersburg continue, while they belong to it, to perform the front service of their Regiments; those who come from the Artillery and Sapper Brigades, or from Regiments not stationed in St. Petersburg, are attached for the front service to one of the Regiments of the Garrison of St. Petersburg; the necessary arrangements are made by the authorities of the Guard Corps.

The Officers of the Artillery and Chief Engineer School, having only to attend the Course of Grand Tactics and Strategy, retain their posts while studying in the Academy.

Four Staff Officers, appointed by the Emperor, have the immediate control of the Officers preparing themselves for the service of the General Staff; they are to exercise a vigilant supervision over them, and to report on their conduct to the Vice-President; they are the organ by which all orders reach the Officers, and they form a Court of the First Instance in matters relating to the Service.

One day in the week is devoted to drill, and every day two officers mount guard with the first division of the garrison of St. Petersburg.

The Officers are to devote exclusively to study the leisure hours at their command after the performance of front and garrison duties; and are to observe, in all respects, the Statutes of the Academy.

To facilitate, economically, the residence of the Officers in St. Petersburg, they receive, with the exception of those belonging to the Guard, besides their usual pay and an allowance for quarters according to their rank, an annual allowance of 500 roubles, which is paid in the Academy.

Officers ordered to survey a country, or to make a reconnaissance,

receive their traveling expenses from the Commissariat, according to the distance to which they are sent, and in proportion to their rank: their board expenses are not allowed.

V. REGULATIONS RESPECTING PROMOTION.

The course is terminated, and Students finish their career, in October annually.

At the same time, Officers are removed from the Theoretical section to the Practical, making place for candidates who wish to enter the former.

At their departure from the Academy the Officers receive from the Academic Council testimonials of conduct and scientific attainments, with a memorial of the rewards which they receive at leaving.

On leaving the Academy the Officers have to act as follows: those who belonged to the Artillery, or Chief Engineer School, repair to their highest Commanding Officer; the rest, who were educated for the service of the General Staff, return to their Regiments, Artillery Brigades, or Sapper Battalions, on whose rolls they remain as supernumeraries and Officers reckoned as of the General Staff, until they are formally transferred to the latter.

The rewards to which Officers can acquire a claim at leaving the Academy are the following:—The most distinguished is promoted to the lowest rank (on the Staff,) and receives a golden medal; he is only entitled to this if all the teachers give him the full number balls, and unanimously recognize him as most conspicuous for attainments. Besides this, he must have written a satisfactory essay on a given theme, relating to some important war, and have been blameless in moral conduct during his residence in the Academy. The student who is recognized as second, both in attainments and behavior, and has also obtained the full number of balls, is rewarded with the great silver medal, and receives double pay for a year. The student who obtains the third place in attainments and behavior, and the full number of balls, receives the little silver medal, and double pay for a year. Each medal bears the name of its possessor. Besides this, the names of all those who obtain one of the three above-mentioned rewards are engraved on marble tablets, which adorn the walls of one of the halls of the Academic building.

Should any of the Students feel no inclination for the service of the General Staff, even after a successful termination of the Theoretical Course, he may always request to be dismissed to his Regiment, Artillery Brigade, or Sapper Battalion.

Every Officer who at his departure from the Academy obtains a testimonial of having accomplished the object of his admission, and in consequence is provisionally destined for the service of the General Staff, if he continues after his return to his Regiment to educate himself for his vocation, and distinguishes himself by observance of a strict discipline, by conduct and zeal for the service, is rewarded at the end of a year by being completely transferred to the General Staff; and if he belonged to the Young Guard, the Artillery, or a Sapper Battalion, his right to promotion immediately commences; not so if he belonged to Troops of the Line.

Every year, on the 1st of January, the Chief of the Regiment, Artillery Brigade, or Sapper Battalion in command of an Officer reckoned as of the General Staff, forwards his form and his conduct list to the Quartermaster-General of the General Staff, who lays it before the Chief of the General Staff. At the same time the above-mentioned papers are communicated to the Chief in command of the Officer.

Besides this, the above-mentioned Chief makes a similar report on the zeal for the service and moral conduct of the Officers twice a year, namely, on the 1st of March and the 1st of September; and at the same time reports exactly on the way in which he performs the service of the front.

No Officer reckoned as of the General Staff is to be charged with the duties of Paymaster service in his Regiment, or employed as Quartermaster; and if any General wishes to select him for his Adjutant, he must first communicate with the Quartermaster-General of the General Staff.

If the General Staff is increased in time of war, or if any work on which it is employed requires to be accelerated in time of peace, the Chief of the General Staff commissions the Quartermaster-General to select the requisite number out of the Officers who are reckoned as of the General Staff. The latter then makes the selection, and announces the names of the Officers selected to their highest Commanding Officer. As soon as the object proposed is accomplished, these Officers return back to their commands. Such a selection, however, can only fall upon those who have spent at least two years with their commands after their departure from the Academy. If in the meantime an Officer has become Chief of a Battalion or Squadron, he shall not be transferred from this post before the lapse of a year. As soon as any of these Officers, or, in general, any Officer, who has left the Academy, reports himself at

his Corps, his Chief immediately announces his arrival to the Quartermaster-General of the Staff.

To familiarize the Officers reckoned of the General Staff with the rules of the Art of War while they remain with their commands, and to practice them in the duties which belong to Officers of the General Staff, the Quartermaster-General is directed to charge them with such duties as may develop their talent, without, however, removing them for that purpose from the service of the front. These commissions of the Quartermaster-General are communicated through their superior Officers, who are directed not only to watch over their performance of these commissions, but also to assist them therein to the utmost of their power.

MILITARY SYSTEM AND EDUCATION IN SWEDEN.

I. MILITARY SYSTEM.

The Swedish army is composed, according to official data in Martin's Year Book, of five distinct classes of troops, viz.:

1. The *Indelta*, or national militia, paid and kept, not by the Government, but by the landowners, and, to some extent, from the income of State domains expressly reserved for this purpose. Every soldier of the *Indelta* has, besides a small annual pay, his *torp*, or cottage, with a piece of ground attached, which remains his own during the whole period of service, often extending over forty years, or even longer. In time of peace, the troops of the *Indelta* are not called up for more than a month's annual practice, and for the rest of the year are free from military duty. In time of war, an extraordinary *Indelta* has to be raised by landowners, who, on this account, enjoy certain privileges, including non-contribution to the cost of the peace establishment. When the soldier dies, his widow turns over the holding to his successor, whom the owner of the land is bound to provide within three months. In the location of the officers, regard is had to the situation of the men who compose the company, regiment, and larger divisions.

2. The *Beväring*, or conscription troops, drawn by annual levy, from the male population between the age of 20 and 25 years. The law of conscription, which admits the right of purchasing substitutes, was introduced into Sweden in 1812. About 19,000 men are drafted annually, one-tenth of which number, on the average, find substitutes for themselves, at a cost of from 10*l.* to 25*l.*

3. The *Värfvade*, or enlisted troops, to which belong the royal life-guards, the hussars, the engineers, and the artillery. The men may engage for either three, or six, or twelve years; but the greater number are for six years, peculiar inducements being held out for this term.

4. The volunteers, first organized in the year 1861, by the spontaneous desire of the population of the kingdom. In time of peace the volunteers are individually free, and bound by no other but their own rules and regulations: but in time of war they may be

compelled to place themselves under the command of the military authorities.

5. The militia of Gothland, consisting of twenty-one companies of infantry, organized in a similar manner to the *Indelta*, yet quite independent of the latter. They are not compelled by law to serve beyond the confines of the Isle of Gothland, and have a separate command from the other troops.

The armed forces of Sweden, not counting the Volunteers, consist altogether of—

Indelta,	33,405	rank and file.
Beväring,	95,295	" "
Värfvade,	7,692	" "
Militia of Gothland,	7,921	" "
Total,	144,313	

In the organization of the army, as here enumerated, 85,000 men belong to the infantry of the line; 6,000 to the cavalry; 5,000 to the artillery, and the rest to the irregular militia. The number of volunteers was returned at 40,848 in 1869, but about one-third of these formed part also of the *Indelta*. In the parliamentary session of 1862, and again in the sessions of 1865 and 1869, the Government brought bills before the Diet for a reorganization of the whole of the army, on the basis of extending the conscription, reforming the *Indelta*, and doing away, to a great extent, with the *Värfvade*. But neither of these propositions was adopted by the representatives of the people, whose habits are not easily set aside.

Navy.

The Navy of Sweden was reorganized in 1866–67, being divided into two distinct parts; the first to serve as an ordinary fleet of war for aggressive as well as defensive purposes, and the second stationary, and solely devoted to coast defense. It consisted in 1869 of—

6 Iron-clads, of 638 horse-power, and	10	guns.
21 Unarmored steamers, of 2,810 horse-power and	127	"
16 Sailing vessels, with	376	"
158 Gunboats and floating batteries,	551	"
Total, 201 vessels, of 3,458 horse-power	1,064	guns.

The iron-clads are built after the American model; one a turret ship, called the "John Ericsson," is partly covered with steel armor. There were 6,453 sailors and marines in active service, and 28,000 men were on furlough or attached to the fleet of reserve and coast defense.

The expenditure for the army in 1869 was 9,528,600 *riks dalers*, and for the navy 3,963,800. The indebtedness of the state is about $41,000,000, mostly contracted in aid of a system of railways.

MILITARY SYSTEM AND EDUCATION IN NORWAY.

I. MILITARY SYSTEM.

THE armed forces of Norway, as organized by law in 1866, consisted in 1869 of the following:

1. The regular army, with reserve, raised partly by conscription and partly by enlistment, which must never exceed 12,000 men in time of peace, and can not be increased above 18,000 men without the special consent of the Storthing. The average number in time of peace for ten years past, is about 6,000. The term of service is seven years, but the men are on duty only 42 days in the first year, and this past, they are sent home on furloughs, with an obligation to meet for annual practice of 24 days during the following six years.

2. The Militia or *Landvaern*, which consists of all able-bodied male citizens 18 years of age, who for three years must, at stated periods, be trained in the use of arms and field exercises, and at the end of this time, be enrolled in

3. The final Levy, or *Landstorm*, where he is liable to be called out in time of war, until he is 45 years of age.

The normal strength of the armed forces of Norway in 1869 was returned at 47,714 on a peace footing, and 112,225 on a war footing, and required an appropriation of 1,215,500 *specie dalers*, making the cost of the Norwegian soldier (on the average of 6,000 men under arms), $155 per annum.

The King has permission to keep a guard of Norwegian volunteers, and to transfer, for the purposes of common military exercises, 3,000 men annually to Sweden; otherwise a soldier of Norway can not set foot in Sweden; or one of Sweden, in Norway.

The naval force consists of 20 vessels, of 2,280 horse-power, and 168 guns, manned by 2,248 sailors, who are volunteers out of 60,000 men in the maritime conscription, which includes all seafaring men of the seaports, between the ages of 22 and 35.

Three of the vessels are iron-clad monitors.

In order to utilize the vessels of the navy they are attached to the postal service, and are employed in carrying the mails and passengers, under a special minister, charged with the mail service. The navy and post service cost in 1869, 1,172,815 *speciedalers*.

MILITARY SYSTEM AND EDUCATION IN DENMARK.

I. MILITARY SYSTEM.

THE armed forces of Denmark as organized in 1870, consists of—

1. The Regular or active army, and—2. The army of Reserve.

By the law of 1867, every male citizen who has completed the age of 21, is liable to service for eight years in the former, and to be enrolled ready for special call for eight years more in the latter.

The Kingdom is divided into five territorial brigades, and each brigade in four territorial battalions, in such way that no town except the capital, will belong to more than one battalion. Each territorial brigade furnishes the contingent of a brigade of infantry and one regiment of cavalry. The artillery contingent is furnished, one half by the two first territorial brigades, and the second half by the three other divisions. The forces therefrom comprise 20 battalions of infantry of the line, with 10 depot battalions and 10 of reserve; 5 regiments of cavalry, each with 2 squadrons active, and 2 depots; and 2 regiments of artillery, in 12 battalions. The total strength of the army, exclusive of the reserve, is 36,782 rank and file, with 1,068 officers, on the peace footing, and 47,725 men, and 1,328 officers on the war footing. About one half of the enrolled regular army are usually on furlough. The drilling is divided into two periods; the first lasts six months for the infantry; five months for the field artillery and the engineers; nine months and two weeks for the cavalry; and four months for the siege artillery and the technic corps. Each corps must drill each year during thirty to forty days.

The navy comprises the following vessels, all steamers:

Six *iron-clads*, with an aggregate of 2,455 horse-power, and with 65 guns—two of which are turreted, armed each with two of Armstrong rifled cannon; 12 *unarmored vessels* of 1,820 horse-power, and with 192 guns; 7 gun-boats of 480 horse-power and 38 guns; 6 paddle-steamers, of 1,060 horse-power and 38 guns. The navy in 1869 was manned by 901 men, and officered by 15 commanders, 34 captains, and 67 lieutenants.

The budget for 1869 provided 3,783,978 *rigsdalers* for the army, and 1,676,681 for the navy.

PART VIII.

MILITARY SYSTEM AND SCHOOLS IN GREAT BRITAIN.

X. MILITARY SYSTEM AND EDUCATION IN ENGLAND.

I. MILITARY SYSTEM.

The British army originated in the feudal system, by which the great barons were bound to furnish a contingent to the army of the State; and their vassals were bound to attend them in person, and to furnish each the contributions in men, horses, arms, and other materials of war, for which he was liable by the tenure on which he held his lands. When regal power absorbed the privileges of the great feudatories, the people were expected to provide themselves with arms, and, in case of invasion, to respond to the summons issued through officers commissioned by the sovereign to array the fittest men for service in each county. In the time of Henry VIII, lord-lieutenants and deputy-lieutenants of counties were first appointed as standing officers for assembling and mustering the military forces. For a time, contracts were made with "captains," who undertook to provide, clothe, and feed a certain number of fighting men for a given money allowance. In the reign of Charles I, the important question arose, whether the King of England did or did not possess the right to maintain a military force without the express consent of Parliament. Charles II, was compelled to abandon all control of the army, except a body guard of 5,000 men, sanctioned by Parliament. These regiments still exist, and are proud of their genealogy. They are the First Foot Guards, Coldstream Guards, Life Guard, Oxford Blues, the Royal Scots, and the Second Queen's Royals."* The Declaration of Rights, in the time of William and Mary, settled in positive terms "that the raising and keeping of a standing army in time of peace, without consent of Parliament, is contrary to law." The first Mustering Act was passed in 1689, to last for six months; but it has been annually renewed ever since, except in three particular years; and it constitutes the only warrant on which the whole military system of England is exercised by the sovereign with the consent of Parliament. For 172 years, with only three interruptions, the ministers of the crown have an-

* Two regiments created in the reigns of Richard III, and of Henry VIII, the first styled *Gentlemen Pensioners*, or *Gentlemen at Arms*, consisting originally exclusively of noblemen, and the latter, *Yeomen of the Guard*, still exist. The latter is the only body that has the privilege of traversing London with flags flying, drums beating, and fixed bayonets.

nually applied to Parliament for permission to raise a military force and for money to defray expenses. The sovereign can make war and bestow military employment and honors; but the House of Commons can refuse supplies.

Military service in England is voluntary, except in rare cases, and then only in the militia. As the chances of promotion from the ranks are small, the recruits are drawn from the most necessitous classes of the community, or the least fitted for industrial pursuits. The system of recruiting, with the bounty and machinery of deception is the most characteristic feature of the British army as compared with those of Europe, and makes the distinction between officers and men more broad than in any other service.

The British army, in its completeness, is theoretically commanded by the sovereign, assisted by the secretary of state for war in some matters, and by the commander-in-chief in others. The component parts are the household troops, the infantry of the line, the ordnance corps, comprising artillery and engineers, and the marines. There are also certain corps, raised and belonging to the principal colonies; the troops in India; the yeomanry cavalry; the dockyard battalions; the volunteer artillery and rifles; the enrolled pensioners, etc. In 1814, the regular army reached 200,000, and at the close of the war, 10,000 officers were retained on half pay. In 1860–61, in the army estimates, provision was made for the following force, viz.:

	Home and Colonies.	India.	Total.
Cavalry	11,667	7,243	18,910
Infantry	103,169	66,345	169,514
Artillery	22,675	5,482	28,157
Engineers	4,730	——	4,730
Staff & Depot	1,121	13,420	14,541
Total	143,362	92,490	235,852

Under the column "India" are included only troops *sent* to India, and paid for out of the Indian revenues. Of the total 235,852 forces, 10,459 are officers, 17,670 non-commissioned officers, and 207,723 rank and file. For the use of this army, 24,342 horses are provided. The total expenditure sanctioned by Parliament in 1860 was £14,800,000, viz.:

Military Pay and Allowances, £5,500,000; Civil Salaries and Wages, £1,800,000; Stores and Works of every kind, £ 5,400,000; Pensions, Retired Pay, &c., £2,100,000.

The military force of various kinds within the United Kingdom, excluding the troops in East India, on the 1st of June, 1860, was 323,259, viz.:

Regulars (service companies,) 68,778; Regulars (depot companies,) 33,302, Embodied Militia, 15,911; Disembodied Militia—Effectives, 52,899; Yeomanry Cavalry—Effectives, 15,002; Enrolled Pensioners—Effectives, 15,000; Volunteer Rifles and Artillery, 122,867.

The total force of the United Kingdom in 1870–71, was as follows:

				Total.
Officers on the General and Departmental Staff,.....				1,239
Regiments.	Officers.	Non-com., &c.	Rank and file.	
Royal Horse Artillery,.....	78	138	1,834	2,050
Life-Guards and Horse-Guards,.	81	192	1,029	1,302
Cavalry of the Line,.....	465	969	7,733	9,267
Royal Artillery,.....	661	1,550	12,866	15,087
Riding Establishment,.....	7	13	205	225
Royal Engineers,.....	539	564	3,879	4,836
Army Service Corps,.....	8	386	1,801	2,195
Foot-Guards,.....	237	453	5,220	5,910
Infantry of the Line,.....	2,934	6,468	51,990	61,392
Army hospital corps,.....	1	165	694	860
West India Regiments,.....	104	150	1,680	1,834
Colonial corps,.....	58	149	1,632	1,839
Total,.....	6,276	11,197	90,593	108,066
Depots of Indian Regiments.				
Cavalry,.....	27	54	513	594
Infantry,.....	200	600	5,000	5,800
Total,.....	227	654	5,513	6,394
Recruiting and Teaching Estab'ts.				
Cavalry Riding School,.....	2	2	—	4
Infantry Depots,.....	5	9	—	14
Recruiting Establishments,....	6	17	—	23
Inst. in Gunnery and Engin'ing,	10	57	62	129
Total,.....	23	85	62	170
Training Schools and Factories.				
Cadet Company, Woolwich,....	10	20	9	39
Royal Mil. College, Sandhurst,.	17	30	1	48
Regi'al Schools and Factories,..	32	281	7	320
Total,.....	58	331	17	407

The total force of officers and men was 115,037, viz.

General and Department Staff,.....	1,239
Regiments,.....	108,066
Depots of Indian Regiments,.....	6,394
Recruiting and Teaching Establishments,.....	170
Training Schools and Factories,.....	407

The British forces in India, exclusive of depots at home, comprised the following troops, in 1870–71:

	Officers.	Non-Com.	Men.	Total.
Royal Horse Artillery,.....	200	253	2,680	3,133
Cavalry of the Line,.....	225	424	3,672	4,321
Royal Artillery and Engineers,.....	1,016	795	7,936	9,747
Infantry of the Line,.....	1,500	3,262	41,000	45,762
Total,.....	2,941	4,734	55,288	63,963

In addition to the troops above mentioned the army estimates include appropriations for four classes of reserved or auxiliary forces, viz.:

1. Disembodied Militia,.....	128,971	officers	and men.
2. Yeomanry Cavalry,.....	15,435	"	"
3. Volunteers,.....	25,688	"	"
4. Enrolled pensioners,.....	31,102	"	"
Total enrolled number,.....	201,196	"	"

In England and Wales the Militia Establishment comprises 42 regiments, with 5,066 officers; in Scotland, 16 regiments and 670 officers; in Ireland, 48 regiments, with 3,463 officers.

By Act of 1870, in case of invasion, rebellion, or insurrection, or of imminent danger thereof, the Militia, in pursuance of an order of Her Majesty in council, can be called out (the whole or any part) and embodied for actual service; but when so called out, her proclamation must be communicated to Parliament within ten days. By recent Royal Warrant, a lieutenant of the Militia is made eligible to appointment of sub-lieutenant in the Regular Army, and in the localization of the military force of the United Kingdom, the Militia, Yeomanry and Volunteers, are to be brought into closer connection with the Regular Army.

The total cost of the British army, voted by Parliament in 1870–71, was £13,093,500, besides a supplementary vote of £2,000,000 towards defraying the expenses of the military and naval services of the kingdom. Of the regular expenses, it appears from official statements that £893,200 were for the Militia and Inspection service; £81,900 for the Yeomanry; £412,400 for volunteers; and £76,000 for enrolled pensioners and army reserve force.

EDUCATIONAL ESTABLISHMENTS FOR THE ARMY.

The sum of £140,700 was devoted to military education, in the estimates for 1871, when the educational establishments provided for the army were as follows:

Royal Military College at Sandhurst, preparatory for Infantry and Cavalry Officers.
Royal Military Academy at Woolwich, for service in the Artillery and Engineers
Royal School of Military Engineering at Chatham.
Staff College at Woolwich.
Advanced Class of Artillery Officers at Woolwich.
School of Gunnery at Shoeburyness.
Survey Classes at Aldershot.
School of Musketry at Hythe.
Army Medical School at Netley.
Royal Hibernian Military School at Dublin.
Regimental Schools for Children of Soldiers.
Garrison Schools and Libraries for Adults.
Schools and Asylums for Orphan Children of Soldiers at Dublin and Chelsea.
Training School for Army Schoolmasters in Chelsea Military Asylum.
Military School of Music at Kneller Hall.

II. ROYAL NAVY.

The administration of the Navy of the United Kingdom is vested in the Board of Admiralty, composed of five members, who are styled "Lord Commissioners for executing the office of Lord High Admiral," which was formerly charged with all naval matters. The First Lord Commissioner is a member of the Cabinet, and dispenser of patronage, and, with his associates, goes out with the Premier.

The effective strength of the Navy in February 1, 1869, was:

Classes of Ships.	*Steam.* AFLOAT. Iron.	AFLOAT. Wood.	BUILDING. Iron.	*Sailing.* AFLOAT.	*Total.*
Armor-plated ships, 1st Class,	1	–	1	....	3
" " 2nd "	3	–	3	....	6
" " 3d "	5	4	–	....	9
" " 4th "	3	5	–	....	8
" " 5th "	4	–	–	....	4
" " 6th "	–	2	–	....	2
" " Sloops and gun-boats,	3	2	–	....	5
" " Special, with turrets,	5	1	5	....	11
" " Floating batteries,	3	1	–	1	5
	27	15	9		
Total iron-clads,	42		9	1	52
Ships of the line (screw),	43		2	2	47
Frigates (screw),	29		–	–	29
Frigates (paddle),	3		–	1	4
Block ships (screw),	1		–	2	3
Corvettes (screw),	24		–	–	24
Sloops (screw),	33		–	1	34
" (paddle),	7		–	1	8
Small vessels (paddle),	8		–	–	8
Dispatch vessels (paddle),	4		–	–	4
Gun vessels (screw and double screw),	50		1	–	51
Gun-boats (screw),	58		1	9	68
Tenders, tugs, &c., (screw),	14		–	–	14
" " " (paddle),	38		–	–	38
Mortar ships (screw),	—		–	2	2
Troop and store ships (screw),	11		–	–	11
" " (paddle),	1		–	–	1
Transports for India reliefs (screw),	5		–	–	5
Yachts (paddle),	4		1	–	5
Total screw,	310		14	–	324
" paddle,	65		1	–	66
Grand total,	375		15	18	408

Not included in the above list are several ships for the defense of the colonies. The total naval force, August 30, 1870, was:

In Commission—238 ships, of 57,205 horse-power, 1,984 guns and 314,449 tonnage. *In Reserve, &c.*, 318 ships, 64,286 horse-power, 3,610 guns, and 318,845 tonnage. The total number of officers, seamen, boys and marines, in 1870–71, was 55,430, besides 4,300 in the coast-guard and 1,270 in the Indian service. Among the officers were 143 flag officers; 29 superintending dockyards, and 3,193 other commissioned officers on service.

III. MERCANTILE MARINE.

The Mercantile Marine of the United Kingdom in number of vessels, their registered tonnage, and men employed, together with the value of property and number of passengers transported in them, exceeds that of any other country. The total number of vessels in the home and foreign trade, registered in 1869, was 21,881, with a tonnage of 5,575,303, employing 202,477 men, and freighted with imports and exports to the total value of 532,475,266*l.*

All matters relating to merchant ships and seamen, and the mercantile marine generally, are committed to the general superintendence of the Board of Trade, which, as constituted in 1786, is composed of certain high officers, (members of the Privy Council), and its President is a Cabinet officer. To this Board all consular officers, all officers of customs abroad, and all local marine boards and shipping masters must make reports in matter and form as required. Inspectors, duly appointed by this Board, may visit any ship, examine any registry, machinery, boats, equipments, &c., to ascertain if they are conformable to law. In every seaport a Shipping Master is appointed by the Local Marine Board, who must keep register of names and character of seamen, facilitate their engagement and discharge, as well as the apprenticeship of boys to sea-service. The Local Board must provide for the examination of persons who intend to become masters or mates according to rules laid down by the Board of Trade. And to such as pass a satisfactory examination as to sobriety, experience, ability, and general good conduct on board ship, shall be given a certificate of competency; and to those who have served as masters or mates, under certain conditions, a certificate of service with specifications must be given. Shipping Masters must assist, when applied to by parents or guardians, or masters of ships, in apprenticing boys to the sea-service. No person can be employed as master or mate, who does not hold a certificate of competency, and under certain conditions, of service. Opportunities of preparing for these examinations are now provided in all the large seaports, in Navigation Schools; and the Government, through the Department of Science and Arts, encourages the study of astronomy, navigation, steam and steam machinery, and other branches, which are serviceable to officers in command of vessels, whether propelled by sails or engines, by making appropriations of money to schools according to the number of pupils who pass satisfactory examinations in these studies.

MILITARY EDUCATION.

The following account of the institutions for military education in England is abridged from an article in *Blackwood's Magazine* for November, 1858:

There exist in this country three military seminaries—the Royal Military Academy at Woolwich, where youths are educated for service in the Artillery and Engineers; the Royal Military College at Sandhurst, where cadets are prepared for the Infantry and Cavalry; and the Honorable East India Company's Military School at Addiscombe, which educates simultaneously for the Artillery, Engineers, and Infantry services of the three Presidencies. Supplementary to these are the School of Practical Instruction at Chatham, where passed cadets from Woolwich and Addiscombe learn practical engineering; and the senior department at Sandhurst, supposed to be a Staff school, into which officers of infantry and cavalry are, under certain restrictions, admitted.

I. The Military Academy at Woolwich came into existence in the year 1741. It was created by George II., to supply a want under which the English army then suffered, by giving some instructions in matters connected with their respective arts to officers and men who served in the Artillery and in the Engineers. Its beginnings were of the humblest imaginable order. A single room in a house at Woolwich, where the Board of Ordnance used occasionally to assemble, was set apart by Government as a hall of study; and two masters were appointed to give lectures by rotation, during four consecutive hours, in three days of every week. At first only the officers of the single battalion composing the English Artillery and of the corps of Engineers were required to attend. By and by the room was thrown open to the non-commissioned officers and privates also, and eventually the cadets, of whom five were supposed to be on the strength of each company of Artillery, repaired thither in like manner. But the cadets being the sons of the officers of the corps, as they neither dressed in uniform, nor were under any military control, proved very difficult to manage; and the difficulty led to a great change as well in their condition as in that of the Academy itself.

In the year 1744 the cadets were, for the first time, clothed in uniform, and collected into a distinct company. Two officers, with a drum-major, undertook the management of them; and the arrangement worked, or was supposed to work, so satisfactorily, that by little and little, as the regiment enlarged itself, the numbers composing the Cadet Company were increased also. In 1782 they had grown from twenty to sixty; in 1798 to a hundred; after which steps were taken to lodge and board, as well as to educate and drill them, apart from the residences of their fathers. Hence, after trying for a while to accommodate some in a separate barrack, while others were billeted on private persons at a payment of 2s. a day per head, the pile which now attracts the attention of the passer-by on Woolwich Common was erected. And by the addition of a lieutenant-governor, and a whole host of officers and professors, it grew into the sort of establishment which is familiar to most of us. In 1806 the staff of officers and teachers appointed to the Cadet Company consisted of—

1. Lieutenant-Governor; 2. Inspector; 3. Professor of Mathematics; 4. Professor of Fortification; 5. Mathematical Master; 6. Arithmetical do.; 7. French do.; 8. Fortification do.; 9. Landscape-drawing do.; 10. Figure-drawing do.; 11. Second French do.; 12. Fencing do.; 13. Dancing do.; 14. First Modeller; 15. Second do.: 16. Clerk.

In 1829 the fencing and dancing masters were discontinued, and a chemical lecturer appointed. In 1836 three new masters were added; and in 1857 the staff stood thus:

Military.—A Governor; one Second Captain, commanding; one do. for Practical Class; four First-Lieutenants; one Quartermaster; one Staff-Sergeant; seven Drill-Sergeants; one Paymaster's Clerk; one Assistant do.; Servants.

Civil or Educational.—A Chaplain; Inspector—a Lieut.-Colonel of Artillery; Assistant do.—Major, R. E.; Professor of Fortification—Lieut.-Col., R. E.; two Assistants—Second Captains; Professor of Mathematics; seven Mathematical Masters; Master of Descriptive Geometry; Master for Geometrical Drawing; Drawing-Master for Landscape; Second do.; Master for Military Plan-Drawing—Brevet-Major, R. A.; Instructor in Surveying and Field Works—Captain, R. E.; Assistant do.—Captain, R. A.; Instructor in Practical Artillery—Second Captain, R. A.; Assistant do.—Second Captain, R. A.; four French Masters; four

German do.; Master for History and Geography; Lecturer in Chemistry; Assistant to do.; Lecturer in Geology and Mineralogy; Lecturer in Practical Mechanics, Machinery, and Metallurgy; Lecturer in Astronomy and Natural Philosophy; Clerk; First Assistant do.—a Sergeant; Second do.—Bombardier; one Drill-Sergeant—Practical Class; Modeller, Modelling Smith, Servants, &c.

Admittance to the Academy was, till very lately, obtained only on the nomination of the Master-General of the Ordnance. There was a preliminary examination, it is true; but this all except the dullest might calculate on passing, and the ages of entrance ranged between fourteen and sixteen. In 1835 the minimum age was raised to fifteen, the maximum to seventeen; while candidates were called up to compete for admission in the proportion of four youths for every three vacancies. The arrangement did not avail to produce any radical change in the spirit of the institution. The preliminary examination still proved to be a "pass," and no more; and so it continued till those political views obtained the ascendant which abolished altogether the office of Master-General and Board of Ordnance, and gave us in their place a Secretary of State for the War Department.

Occasions had arisen, even under the old regime, when young men were permitted to enter the service of the Artillery under what may be called exceptional conditions. During the pressure of the great war of the French Revolution, the demand for officers became at one time so urgent, that it was found necessary to dispense with a regular academical education, and to give commissions to candidates who were pronounced by competent examiners sufficiently conversant with mathematics and physical science to enter upon the practical duties of their profession. Lord Panmure, taking advantage of the precedent thus furnished, threw open Artillery commissions in 1855, and has continued ever since to treat admission into the Royal Military Academy as a prize for which the youth of the United Kingdom may freely compete.

The subjects of study to be pursued in the Royal Military Academy at Woolwich, not less than the mode of dealing with them, and the text-books to be used, have hitherto been prescribed to the most minute particular by regulation. They embrace Mathematics, Fortification, Descriptive Geometry, French, German, Plan-Drawing, Geometrical Drawing, Landscape Drawing, History and Geography; to which, during his continuance in what are called the "theoretical classes," the attention of the cadet is confined. When he enters the "practical class," the student is instructed, over and above, in Practical Artillery, Surveying and Field-Works, and attends lectures in Astronomy, Chemistry, Geology, and Mineralogy. As many as five years may be spent by a young man in going over this course—viz., four years in the "theoretical," and one year in the "practical" class—though the average period of actual residence does not appear to exceed two years and a half or three years. There are periodical examinations at the end of every half-year, the second of which, by its results, determines whether the young man shall be allowed to go on to a commission, or be removed from the Academy.

The moral tone of this military college has never, we regret to say, been of a very high order. Excellent men have been at the head of it, and the ability of the professors and teachers appointed to instruct admits of no question. Yet few right-minded officers look back upon the years spent in the cadet barracks except with disgust. It is not very difficult to account for the circumstance. Long after Continental nations had seen the absurdity of pressing upon boys the sort of training which belongs to men, we refused to be guided by their experience, and persisted, both at Woolwich and elsewhere, in our endeavor to accomplish an impossibility. "Boys of fourteen, fifteen, and sixteen," says a very high authority on this subject, "require much personal supervision in order to form their characters, which young officers, very often appointed without any sufficient knowledge of their tempers and habits, cannot be expected to bestow. Such officers may indeed be able to superintend drill, but not moral training. Rarely do they draw the cadets towards them, and become their advisers; more frequently repel them by a harsh dictatorial manner, the cadet being in their eyes a soldier. There has been also, during all the time I have known the Academy, great inconsistency in treating the cadets. Honor is constantly

talked of, and yet doubts as to their truthfulness are not unfrequently expressed. I have heard even the lie given in rough and emphatic terms. Confidence is professedly placed, and yet offences are found out in a way that shows that no confidence existed. Hence a contest arises between the officer and cadet, and the latter becomes tricky and disingenuous."

In these emphatic words Colonel Portlock has struck at the root of most of the evil which has long been felt, and heretofore combated without success, in the Royal Military Academy at Woolwich. Whatever is wanting in the morale of that establishment, it owes to the original sin of its constitution. We know how to deal with boys so long as we recognize their boyhood, even while appealing to the point of honor among them. But we no sooner dress them up in uniform, and affect to treat them as soldiers, than we lose all moral control over them. They smoke, drink, swear, and fall into other vices, not because they are overcome by any irresistible temptation, but because they look upon such acts as tokens of manhood. And the corporals, who report readily enough for insubordination, and the officers, who punish for what they call military offences, take little heed of worse things; partly because, in a military point of view, they are scarcely criminal; partly because, not being regarded as such, they are seldom brought under the notice of the superior authorities. How a seminary so conducted and so managed should have given to the Artillery and Engineers a body of officers distinguished, as those of both arms unquestionably are for talent, intelligence, and gentlemanly bearing, would be inexplicable, were not the fact well known, that one of the first lessons taught to the young lieutenant, after quitting the Academy, is to throw off the habits which he had contracted there, and to adopt the high moral tone and excellent habits of his regiment.

It was partly with a view to provide a palliative for this admitted evil, partly to encourage in our young Artillery officers the habit of sustained study, that they were required, by a recent regulation, "to place themselves under the orders of a director of studies for half a year after obtaining their commissions. Meanwhile cadets who are appointed to the Engineers proceed to the training-school for that arm at Chatham; where they go through a somewhat careful course of surveying, and are instructed less elaborately in architecture, civil as well as military, and in mining, sapping, pontooning, and so forth. According to the report of the Commissioners, it does not appear that they reach their new field of instruction over and above well prepared to make the most of it. Indeed, the whole of the Woolwich system is by these gentlemen condemned in terms as decided as is consistent with good breeding.

II. It was not till the year 1804 that the propriety of training young men in ever so slight a degree for the service of the infantry and cavalry, seems to have occurred to any statesman or soldier in this country. Appointments to both arms took place for a time by purchase only, and by and by, when the numbers of the rank and file increased, through the weight of influence, personal, political, or social. Moreover, when the pressure of the great war was at its height, a third door of entrance to military rank was opened, and ensigncies and captaincies, and even lieutenant-colonelcies, became the prize of private gentlemen who were able to bring certain fixed contingents of able-bodied men under the royal standard. So far as the candidates for commissions themselves were concerned, however, the same even-handed justice was meted out to all. Nobody took the trouble to inquire whether the candidates were qualified morally, intellectually, or physically. He might be a pimp and blockhead, or lame, or deaf, or blind; but so long as his patron had the ear of the Government, or the men whom he brought with him were able to pass muster, his commission, whatever it might be, was secure.

The Military College at Sandhurst consisted at first, as it still consists, of two departments—one, called the Junior Department, for cadets—the other, the Senior Department, for officers desirous of qualifying for the Staff. But it had, in its original constitution, this marked advantage over the arrangement which has since been effected, that whereas now cadets and officers occupy portions of the same range of buildings, and come under the instruc-

tion of the same professors, they were, in 1804 placed, the one at Marlow, the other at Highwickam—each class of students having its own teachers, though both were subject to the control and management of the same military administration.

As first constituted, the junior department afforded both an asylum and a place of education for the sons of officers exclusively. Youths once admitted ceased to be a burden to their friends, except for the necessary expenses of travelling; they were housed, clothed, and educated at the public expense. But no sooner was the great war ended than Parliament began to slacken in its gratitude to the army, and by little and little the grants for military education fell off, till in the end they ceased altogether. As a necessary consequence, the numbers of persons seeking education at the Military College fell off in like manner. And now the junior department exhibits a muster-roll of 180 cadets only, while the strength of the senior department has dwindled to nine individuals. To be sure, other causes than the withdrawal of public support from the institution have operated to produce this latter result. Whatever it might have been forty years ago, the senior department at Sandhurst is certainly no Staff school now. Indeed, the only science effectively taught there seems to be mathematics; and it is a curious fact, that though the army abounds with officers who have passed through that school, and taken high honors, the instances are rare in which Staff appointments have fallen to the lot of any of them.

Lads are admitted into the junior department at Sandhurst between the ages of thirteen and fifteen. The preliminary examination is of the most trivial kind, and the instruction communicated is, for half the course, that of a common school not of the highest order. No doubt each youth may, if he be disposed, master more than the elements of a good deal of science; for over and above physical geography and history, instruction is given in practical astronomy, dynamics, and statics, practical mechanics, co-ordinate geometry, the differential and integral calculus, trigonometry and mensuration, Euclid's Geometry, attack and defence of fortresses, practical field-fortification, course of military surveying, the Latin, French, and German languages. Unfortunately, however, there is no compulsion to study, nor any inducement, unless the youth aspire to win for himself a commission without purchase.

III. The Hon. East India Company's College at Addiscombe approaches nearer in its constitution and objects to what a military school ought to be, than any other of which we can boast in this country. It came into existence in 1818, previously to which date the Directors were in the habit of sending to Woolwich, for instruction, youths to whom they had given cadetships in the Company's Artillery and Engineers. When first founded, it was intended as a place of training exclusively for these young gentlemen; but the benefits derived from it became so obvious and so great that the Court of Directors gradually enlarged its views, and now young men are educated at Addiscombe not only for the Company's Artillery and Engineers, but for their infantry also. And herein it is that the Directors have mixed up evil with good. They consider an Engineer cadetship as their great prize, and next to that a cadetship of Artillery; and they select for these appointments, not the youths who may have exhibited special talents for either arm, but the best men, or the men reported as generally best, of their batch. The consequence is, that to the infantry—for good service in which talent is as much required as for either the Artillery or Engineers—the idlers of the College are appointed, while many a clever lad, who would have shone as an infantry officer, becomes an indifferent engineer or gunner, simply because he has been posted to an arm for the practical operation of which he has no genius.

In all other respects the Military School at Addiscombe may be fairly said to surpass both Woolwich and Sandhurst. In the first place, youths enter there almost invariably at a more mature age. Though eligible for admission after completing their fifteenth year, they seldom, if ever, come up for examination till after they have turned seventeen. In the next place, the entrance examination is more severe than either at Woolwich or Sandhurst;

and in the third and last place—and this is the most important condition of the whole—cadets must complete their course at Addiscombe in two years, unless for special reasons, such as sickness, they be allowed to prolong their stay one half-year more. Now, lads may linger on at Woolwich four, and even five years, gaining this remarkable advantage from their stupidity, that when forced to compete at last for choice between Artillery and Engineers, they compete with youths who may have had but two years' training. And at Sandhurst, the course which nominally covers four years, may, if the youth have interest at headquarters, be completed, as far as his appointment to a commission completes it, in four months.

The general education given at Addiscombe is certainly not inferior to that which the cadets receive either at Woolwich or at Sandhurst. It embraces, indeed, almost entirely the same subjects which are set down in the curriculum of the others—including lectures in geology, chemistry, and artillery. But it undeniably falls short in specialties. Hence, after completing his course at Addiscombe, the Company's cadet intended for the Engineers proceeds to Chatham, where, side by side with young men from Woolwich, he receives practical instruction in his art. For the Artillery cadet, on the other hand, there is no practical school. Like his comrade intended for the service of the Infantry, he proceeds at once from Addiscombe to India, and learns there how to turn to account the theoretical lessons which have been communicated to him at home.

Another distinction deserves to be noted between the constitution of the school of Addiscombe, and that as well of the Royal Military College as of the Royal Military Academy: Though all alike put from them the eleemosynary element, at Addiscombe alone is strict impartiality in the matter of payments observed. The youth who enters there, whether he be the son of an earl or of a subaltern's widow, must be provided with his £100 a year, besides about £25 more to cover the cost of books, instruments, and uniforms. Both at Woolwich and Sandhurst there is a graduated scale, which exacts more from a general officer than from a subaltern, and more from a civilian than from either. The orphan of an officer dying in poor circumstances is admitted into Woolwich on payment of £20 a year. He pays for similar privileges at Sandhurst £40. The son of a gentleman in civil life pays in both cases £125, a sum more than necessary to cover the expenses of his own board and education, but which is exacted in order that there may be a surplus out of which the deficiencies occasioned by the payments of the sons of officers shall be made good.

Most important changes in the system of Military Education in England have been introduced since 1855, by Lord Panmure and the Council of Military Education, inaugurated under his auspices.

1. Admission to the various Military Schools is now gained by open competitive examination.

2. The order and method of studies, and all examinations for promotion, are governed by an independent Board of competent officers, and men of service, called the Council of Military Education.

3. The amount and order of studies in each school are minutely arranged, and each Professor is kept to the prescribed course by the supervision of a Master of Studies.

4. The development of the Staff School has given completeness to the system.

III. FRENCH VIEW OF ENGLISH MILITARY SCHOOLS.

M. Alphonse Esquiros, in the *Révue des Deux Mondes* of September 1860, contributes two articles on the military schools and institutions of England, from which we make a few extracts:

THE MILITARY SPIRIT AND PREPARATION OF ENGLAND.

On what foundation is the assertion based that England is only a first-class naval power? Although never numerous, have not the English soldiers sufficed for all the great eventualities of history? Has not the weight of their arms been felt for centuries past in the balance in which are weighed the destinies of the Continent? Each time that it was necessary to conquer, have they not conquered? I will not awaken irritating recollections. I will not mention the name of a great battle so painful to our national self-love; it will suffice to recall the fact, that recently, England, with a handful of men, has reconquered India. Instead of denying history, it were better to ask by what links the British character is connected with the group of martial nations. The Englishman is not warlike from inclination; he does not love war for war's sake, or maintain an army for the ruinous pleasure of seeing bayonets glitter and banners flaunt. He has an army to defend his territory, his commerce, the immense net-work of his external relations and possessions. Experience has more than once shown him the necessity of placing the pride of riches under the protection of courage. The Englishman has less enthusiasm than coolness. Immovable when attacked, he feels that the responsibility of the labor which has made England an opulent nation rests upon his arms. The military element, therefore, presents in Great Britain peculiar and interesting features. And then, quite recently, besides the regular army, a new independent army has arisen. Yesterday, it existed but as a project; to-day, it fills the towns with the blast of its clarions, passes review in Hyde Park and Holyrood, and covers the plains with the smoke of its skirmishers. I speak of the volunteers, or riflemen. We must investigate the origin of this movement, and the influence it has already exercised on English habits; but before busying ourselves with the army and volunteers, it will be well to study the military schools and arsenals.

REFORMS IN MILITARY EDUCATION AND PROMOTION IN 1856.

The delay and disasters of the operations before Sebastopol aroused the attention of the press and the people to the manner in which officers for the army were trained, appointed, and promoted. The Government was aroused by the emotions of the country, and in 1856, a commission was appointed by Lord Panmure, Secretary of War, to reorganize the education of the officers. That commission visited the different military schools of Great Britain, visited similar institutions in France, Prussia, Austria, and Sardinia, and collected all documents of a nature to enlighten it researches. Its report is a monument of science, and art, and impartiality. The authors of that investigation, Col. Yolland, Col. Mythe, and Mr. Lake, of the Oxford University, pointed out what reform ought to be made in the English system to raise the establishment of military education to the level of the inevitable progress claimed by the present age. They recommended a Council of Military Education, which, placed beyond and above the educating body, should direct the studies of the young men des-

tined for the army. From these various influences—the pressure of public opinion, the commission appointed in 1856 by the Government, and especially the Council of Military Education, arose those happy changes, which we shall endeavor to point out in the military institutions of Great Britain.

ROYAL MILITARY ACADEMY AT WOOLWICH.

Before 1855, the candidates were named by the master-general of ordnance; and although there was an entrance examination, the requisitions were very elementary, and no youth, influentially connected or recommended, was rejected. The results, although the institution furnished some good engineers and artillery officers to the English army, were not satisfactory. Since 1855, the system of appointment and instruction has been re-organized. Appointment on nomination has given place to open competition. A ministerial circular made an appeal to all candidates desirous of entering the academy without distinction of class, or party. Public examinations, thrown open to the youth of England, with independent examinations, succeeded the private examinations within the college walls. The axe was laid at the tree of privilege, and personal merit was substituted in its place.

The entrance examinations take place twice a year, at Chelsea Hospital—the home of disabled soldiers, and the school of orphan soldiers' children—in a large hall hung with the captured trophies and battle flags of different nations. The programme embraces mathematics, simple and practical; history, geography, and English literature; the Greek and Latin classics; the French language and literature; German, chemistry, and physics; mineralogy and geology; geometrical and landscape drawing. To each subject a certain numerical value is assigned. Each candidate is limited to five subjects, including mathematics, which he may select out of the programme, and on his obtaining an aggregate as well as relative number of marks depends his success. The results are made public, and the unsuccessful candidates are allowed another trial to fill succeeding vacancies. Then examinations exercise an indirect but elevating influence upon the schools of the country which send forth the candidates. Competition has put a check upon ignorance and mediocrity, no matter how well backed by social and political influence.

Another reform, not less important than that of competition, or the system of nominations, was that order of the minister of war, lengthening the age for the admission of candidates. That age was fixed between 16 and 20. The inconvenience of submitting young men too soon to military discipline has been recognized with great wisdom by Gen. Portlock.* "The character of adolescents exacts," he says, "a more delicate cultivation than that which must be expected from officers imbued with the command of a military school. In their eyes, no matter how young he is, the pupil is a soldier, and they treat him almost as one. Doubtless they excel in drilling him well; but do they possess the necessary qualities and experience for forming the morals of youth?" Another consequence of the early admissions was the introduction of a sort of confusion and uncertainty in the system of teaching. Now, a distinct line is drawn between the course of studies which precede and which follow admission to the academy. The conclusion was come to that a military academy formed a sort of line of demarcation in life between a good general education which ends, and a professional service which commences. The character, mind, manners of the candidate

* The Inspector of Studies at the Academy, now member of the Military Board of Education.

are supposed to be formed according to the usages of the world; he has reached that age when a man knows himself, and looks out for a career.

It is needless to dwell on the course of instruction, which is now nearly the same in all the great military schools of Europe. There are thirty-five professors, many of them eminent in their respective departments. One leading object, both of instruction and discipline, is to cultivate the habit of self-improvement and self-government. Physical sports are practiced and encouraged, and the cadets frequently challenge the officers of the garrison to a match of cricket.

An examination takes place every six months, in which the progress of each cadet is ascertained and reported. Those who pass through the series in good standing are promoted to a commission; the most distinguished to the engineer corps, and the others to the artillery. The appointment of these young officers gives rise to an interesting ceremony. The Duke of Cambridge, with a numerous staff, visits Woolwich Academy twice a year. All the cadets are present in review in front of the monument. It is pleasing to see how admirably they go through the manœuvres. The duke then enters a hall where a *viva voce* examination takes place on the art of fortification. This over, the cadets form in square, and the duke then advances to the table where the prizes are laid out. These prizes consist of a sword of honor, telescopes, mathematical instruments, and books. The President of the Council of Education reads out the names of the cadets of the first class who are to receive commissions in the engineers and artillery. In conclusion, the Duke of Cambridge addresses some parental words to the young men who are about to leave the academy to enter the army. Such is a brief account of this academical festival, to which the brilliancy of the uniforms, the rank and names of the assistants, the happy emotions on the faces of the young men, impress a character of charm and solemnity.

MILITARY COLLEGE AT ADDISCOMBE.

Addiscombe was formerly the residence of the Earl of Liverpool, but was converted into a school at an expense of $40,000, by the East India Company. Within a few years it has passed into the hands of the Government. One of the first acts of the Secretary of War and Council of Military Education was to inaugurate a system of admission (which was open by patronage of members of the company) by competitive examination, and which has been attended with the happiest results. After passing a year at Addiscombe, the cadets enter according to merit (ascertained by examination) and either enter the engineers, artillery, or line service. The India service will always remain distinct and sought after; that life of adventures, encampments in the jungles, tiger hunts, the attraction of struggles against man and nature, the dazzling figures of a world shining in the east through the fogs of Great Britain, all this responds to one feature of the English character, the love of adventure.

ROYAL COLLEGE OF SANDHURST.

Here are two distinct institutions—the college, which is a preparatory school for infantry and cavalry officers, and the *senior department*, or staff school. The scholars of the last department, who have already gone through the competitive examination, are commissioned officers; they have even served a certain number of years in the army; some of them have gone through the Crimean war and the Indian campaign. In 1859, one of these officers had received eighteen

or nineteen wounds, which had deprived him of one of his eyes. I was surprised at finding among them candidates for staff appointments who could write and speak French in a manner that would have done honor to a French officer.

The English find it an advantage to admit young officers of talent and energy into the higher branches of the service. To the experience of their profession, their picked soldiers add knowledge already acquired, which a second course of education develops and consolidates. It must, however, be admitted that it requires a certain moral strength to return, after having held a command, to the benches of a school, to follow various studies, and to submit to strict examinations, which exclude all ideas of promotion and favor, fortune or birth.

In an economical point of view, these two institutions, Woolwich and Sandhurst, cover their own expenses without any cost to the State. This fact, which was by no means foreseen, is owing to two measures relatively of recent date—the gradual withdrawal of subsidies formerly granted by Parliament, and the accession of the sons of rich men not belonging to the army; these latter pay a high premium, and thus contribute towards the education of the other cadets, who, being sons of officers, enjoy certain immunities. In England, it is thought equitable that the services of the father should be counted in favor of the son; according to this principle, the debt contracted by the country towards military men is paid to their sons by civilians.

Young men who have not passed through Sandhurst may, nevertheless, be admitted as officers into the line or cavalry, but on the condition of undergoing an examination and *purchasing* their commissions. This purchasing of direct commissions is doubtless detrimental to Sandhurst College. The abolition of the system has often been mooted. The Duke of Cambridge approves of the abolition, as does the Minister of War, and wishes that no officer shall be admitted into the English army except from a military college.

COUNCIL OF MILITARY EDUCATION.

So far we only behold the members of a great system. There is unity in the Council of Military Education, which to a certain extent is the head of instruction. The influence of their council, which consists of eminent men, is felt in the different schools, introduces changes and useful reforms, directs the public examinations—in a word, gives the impulse to the military studies of the United Kingdom. The civil and religious element is represented therein by one of the most learned men of England (the Rev. Henry Mosley, canon.) The other members are generals and colonels belonging to different corps of the army.

Thus it will be seen that England enjoys a system of military education which will bear comparison with that of any other nation in Europe. The chief purposes of this system are a good general instruction up to the age of sixteen or nineteen years, then a short military instruction, then, after some years of service, a final course of studies in the senior department or staff college. It must not, however, be supposed that the present state of things, though happily modified by the recent principle of competition, is the extreme limit of progress. In the name of liberty, I am too anxious that Great Britain should maintain her position in the world, to pay a full compliment to her self-esteem and enslumber her aspirations for reform. She has done much in these latter times; but there is still much to be done, and she is aware of it, to raise the moral power of her officers to the level of modern times, where enlightenment pervades every class of society.

MODIFICATIONS IN 1871.

In 1867 a Royal Commission was appointed "to inquire into the Present state of Military Education and into the Training of Candidates for Commissions in the Army." The Report, with the minutes of evidence and illustrated documents, was quite voluminous, and has been followed with important changes in both the system of military instruction, and in the mode of making appointments and promotions in the army, that will be noted in detail in the following chapters, which are compiled from historical notices by the Secretary of the Commission, and recent Regulations for the government of the several schools and the examinations for appointment and promotions.

The most important measure affecting the British army, after repeated discussions of the principle, in the last and former Parliaments, and particularly in the last, on a bill of the Gladstone ministry, in which the votes of the Commons in favor was overruled by the Lords, was the abolition of the whole system of purchase and sale of commissions by Royal Warrant issued July 20. 1871. This radical change was followed (October 30) by a revision of the Queen's Regulations, in which original appointments and promotions in the military service are put on a new basis. Henceforth, commissions of the first grade are to be issued to sub-lieutenants, for any vacancy occurring:

1. To successful candidates, in the order of merit as ascertained by competitive examination in general subjects.

2. To graduates of the universities who shall pass a qualifying examination.

3. To Queen's Cadets, Indian Cadets, and Pages of Honor, who have passed successfully the final examination of the Military Academy, or its equivalent.

4. To non-commissioned officers who are recommended for promotion by their commanding officers. If more candidates apply than there are vacancies to be filled, appointment is decided by competition.

5. To a lieutenant of the militia, who shall pass the professional examination required.

Sub-lieutenants are eligible to promotion only after passing a professional examination, and only after twelve months' service with a regiment, under strict discipline, with liability to be removed for physical or moral unfitness. Within three years from the date of their commissions as lieutenants, officers may submit to an examination in respect to fitness for promotion to captaincies, and any officer failing to pass within three years, must retire from the army. Lieutenants are eligible to the rank of captain at any time after two years' service in the army, having passed the examination. A captain may be made a major after two years' service in the army; and a major is at any time eligible to a lieutenant-colonelcy, which means the command of a regiment.

Every promotion must now be made on the recommendation of the Commander-in-Chief, with the approval of the Secretary of State for War; and from the principles laid down in the Royal Warrant, as will be seen further on, every precaution is taken to insure a gradual advance by seniority, and a more rapid rise by meritorious service founded on intelligent and disinterested tests. By the new Warrant the Militia is brought into closer connection with the Regular Army. To the abolition of purchase, and promotion by professional preparation and service, may be added the autumn field manœuvres, inaugurated in 1871, with 30,000 men, and the localization of the Army, by assigning a corps with staff, train, men, &c., to territorial divisions of the country.

COUNCIL OF MILITARY EDUCATION.

HISTORICAL NOTICE.

In the debates which took place in Parliament during the Crimean war, in the year 1855, attention was frequently drawn to the necessity of improving the professional education of officers, and more particularly of providing means of instruction for, and requiring special qualifications from, those who were candidates for the staff. In the course of the same year a great alteration was made in the principles which had hitherto regulated preparatory instruction for the army, by abandoning, so far as the scientific corps were concerned, the system of juvenile military education, and throwing admission to the Artillery and Engineers open to public competition among candidates whose age would afford the presumption that their general education was already completed. At the beginning of 1856 three Commissioners, Lieut.-Colonel Yolland, R.E., Lieut.-Colonel Smythe, R.A., and the Rev. W. C. Lake, were appointed by Lord Panmure, then Secretary of State for War, "to consider the best mode of reorganizing the system for training officers for the scientific corps"; and for this purpose were directed to visit the military schools of France, Prussia, Austria, and Sardinia. The instructions issued to the Commissioners informed them that it was already decided that admission to the scientific corps should be obtained by open competition, and that the age of candidates admitted to the examination should be from 17 to 20.

While the Commissioners were still engaged in their inquiries, the question of military education was frequently brought before the notice of Parliament in the course of the session of 1856, more particularly by Mr. Sidney Herbert, who, in an elaborate speech on the 5th of June, explained to the House of Commons the details of a general scheme of education for officers of all branches of the service, the outline of which he had previously sketched out while Secretary at War in 1854, in a letter to the Commander-in-Chief.

The subject of military education was one which at this time engaged the serious attention both of the Government and the public. Toward the close of the year, Major-General Lefroy (then Colonel Lefroy, and employed at the War Office as artillery adviser to the Secretary of State) was directed by Lord Panmure to draw up a general scheme for the education of officers; and numerous plans, with a similar object, were about the same period proposed for the consideration of the Secretary of State.

The military educational establishments which existed in 1856 were as follows:

The Royal Military College at Sandhurst, comprising a senior and junior department.	Under the control of the Commander-in-Chief.
The Royal Military Academy at Woolwich.	Under the control of the Clerk of the Ordnance.
The Ordnance School at Carshalton, a preparatory establishment to the Academy.	
The Department of Artillery Studies at Woolwich.	
The Royal Engineer Establishment at Chatham.	
The East India Military College at Addiscombe.	Under the Court of Directors of the East India Company.
The School of Musketry at Hythe.	Under the control of the Commander-in-Chief.
The Royal Military Asylum at Chelsea, comprising a training school for army schoolmasters, and a model school for children.	Under the control of the Deputy Secretary at War.
The Royal Hibernian School at Dublin.	
Garrison and regimental schools for soldiers and children.	Under the control of the Chaplain-General.

Up to this period no systematic organization for the direction of military education had prevailed in this country; the various educational establishments were under the control of separate departments, and no single authority exercised any general supervision over them. The appointment of a Director-General of Military Education had been already advocated in Parliament by Mr. Sidney Herbert, and the institution of a special department to superintend the whole system of education for the army was one of the main features both of Colonel Lefroy's and of all the other schemes brought under the consideration of Lord Panmure at this period.

The Commissioners appointed in 1856, after having visited the military schools of the Continent, presented their Report in January, 1857. In this Report, although their instructions

had more particularly directed their attention to the training of officers for the scientific corps, they touched upon several points connected with the education of officers of the army generally. One of the changes most strongly recommended by them was the formation of a special Board of Military Education. "We consider it of the first importance," their Report says, "that military education in this country should be regarded as a whole, and that perfect unity of system and harmony in its working should be made to prevail. This, we conceive, can only be done by bringing military education generally under the control of one head, the Secretary of State for War; and to effect this, a Board or Section of Military Education should be formed, as part of the establishment of the War Office." The Report adds: "The creation of such a Section appears to us far more important than any other single object we can recommend." The Commissioners also stated that after careful consideration, they recommended the combined action of a Board in preference to the undivided authority of a single individual, on the ground of the variety of knowledge and experience required for the proper treatment of educational questions.

The appointment of the Council of Military Education was the first result of the recommendations of the Commissioners. Its institution was proposed in a letter from the Commander-in-Chief to the Secretary of State for War on the 6th of April, 1857, and as originally constituted, it consisted of the Commander-in-Chief as *ex officio* president, a Major-General as vice-president, and two field officers as members. The appointment of the Council, although the members commenced their duties at once, was not officially gazetted until June.

The functions of the Council, however, did not in the first instance extend to a general superintendence over the whole system of military education. Almost simultaneously with their institution an Inspector-General of Army Schools was appointed under the Secretary of State for War, to whom the management of all institutions connected with the education of soldiers and children, which had previously been in the hands of the Chaplain-General, was entrusted. Nor was the supervision of the Council even over the education of officers at first general, as the Royal Military Academy at Woolwich remained under the management of the War Office (under which department it had been placed on the abolition of the

office of Master-General of the Ordnance), and the examinations for admission to it were conducted by a separate Board of Examiners, under the superintendence of Canon Moseley.

The instructions issued to the Council on their first appointment directed their attention more especially to the organization of a Staff College, the revision of the system of examinations for direct appointments to the army, the amalgamation of Woolwich and Sandhurst, and the professional instruction and examination of officers after entering the service. On all these questions they submitted reports in the course of the year, and at the beginning of 1858 they commenced to conduct the examinations in connection with the Staff College and the Cadet College at Sandhurst, although these establishments were not formally put under their authority until, by a Royal Warrant of the 1st of October, 1858, the Council were appointed Visitors of the Royal Military College. The examinations of officers for direct appointments to the staff, which had been instituted in 1857, were also placed under the superintendence of the Council in 1858; but at a later period, the portion of these examinations which has more especial reference to matters of drill and regimental duty was, on the recommendation of the Council themselves, removed from their control, with the view of its being conducted by a Board of Officers appointed by the Adjutant-General.

At the beginning of the year 1858, the office of Secretary to the Council of Military Education was created, and in June of the same year an augmentation of their number took place by the addition of two new members,—one a field officer, the other a civilian, the Rev. Canon Moseley. The constitution of the Council as then fixed continues to the present day, and consists of the Commander-in-Chief as *ex officio* president, a vice-president, and four members, one being a civilian.

The appointment of a civilian as a member of the central Board of Military Education had been recommended by the Commissioners of 1856, on the ground of the close connection between military and civil educational questions. The decision to carry out this recommendation, simultaneously with an augmentation in the strength of the Council, appears to have been connected with the determination arrived at, to place the superintendence of the Academy at Woolwich—the competitive examinations for admission to which had hitherto been conducted by Canon Moseley—in the hands of the Council.

They were formally appointed Visitors of the Academy in August, 1858, their control over the education of the officers of the army being now made almost entirely general. The powers of the Council, however, in regard to Woolwich appear, probably from the fact of their not being defined by Royal Warrant, to be theoretically somewhat less extensive than those possessed by them over Sandhurst, as the recommendation of the appointment of professors, which in the case of the latter college is formally vested in the Council, is at the Academy left to the Lieutenant-Governor.

In October, 1859, the Indian Military College at Addiscombe was placed under the supervision of the Council, and the examinations for admission to it were conducted by them until the close of the establishment in 1861.

In 1860, the superintendence of army schools, garrison libraries, recreation rooms, the Royal Military Asylum at Chelsea, and the Royal Hibernian School at Dublin, were transferred from the Secretary of State for War to the Council.

In 1864, the Advanced Class of Artillery Officers, on its institution, was placed under the control of the Council. Since this date the whole system of army education has been superintended by that body, with the exception of the examinations of officers for promotion, the School of Musketry at Hythe, and the more peculiarly regimental institutions which exist in the Department of Artillery Studies, the School of Gunnery at Shoeburyness, and the School of Military Engineering at Chatham, for the special instruction of officers of the scientific corps. The Survey Class at Aldershot, though not formally is indirectly subject to their supervision.

1. ORGANIZATION AND DUTIES IN 1869.

The Council of Military Education consists of the Duke of Cambridge, Field Marshal Commanding-in-Chief, *President;* Major-General W. C. E. Napier, *Vice-President;* Major-General Sir Fred. Abbott, of the Royal Engineers; Col. Pocklington and Col. Hamley, of the Royal Artillery; Rev. Canon Moseley, civilian; and Capt. Greentree, *Secretary.*

Military Schools and Examinations.

1. To recommend to the Commander-in-Chief, and the Secretary of War, gentlemen for the appointment of examiners in the army examinations.
2. To recommend professors and instructors for the Advanced Class of Artillery Officers, the Staff College, the Royal Military Academy, and the Royal Military College.

3. To examine, by means of their staff of examiners, officers for direct appointment to the staff, chiefly the personal staff, and aids-de-camp and assistant military secretaries.

4. To examine officers of artillery for admission to the Advanced Class, and for certificates on quitting it.

5. To examine officers for admission to the Staff College, probationarily after a year's residence, and for qualification for the general staff on quitting the College.

6. To examine candidates for admission to the Royal Military Academy at Woolwich, and for qualification for commissions in the Royal Artillery and in the Royal Engineers on quitting that establishment.

7. To examine candidates for admission to the Royal Military College at Sandhurst, and for qualification for commissions in the army on their quitting the College.

8. To examine candidates for direct commissions in the cavalry, guards, and line.

9. To visit the several military colleges whenever they consider it desirable.

10. To report to the Commander-in-Chief on all questions connected with the education of candidates for the army, or with the educational departments of the several military schools.

Army Schools, Regimental and Garrison Libraries and Reading Rooms.

1. To receive and consider all applications for training schoolmasters or schoolmistresses; the usual course of procedure in these cases is annexed.

2. The appointment of trained schoolmasters and schoolmistresses, according to the regulations.

3. The appointment of acting schoolmasters and schoolmistresses, when trained masters and mistresses cannot be provided.

4. The appointment of civilian schoolmasters in embodied regiments of militia under special regulations as annexed.

5. The transfers of schoolmasters and schoolmistresses from one regiment or garrison school to another, as circumstances may require.

6. Promotion of schoolmasters and schoolmistresses from one class to another according to the regulations.

7. To receive and consider all communications from commanding officers on matters relating to the appointment of schoolmasters and schoolmistresses their discipline, application for leave to marry, furlough, etc.

8. To receive the monthly report of schools, prescribed by Article 16 of the Schools Regulations, and to consider the same, and take such proceedings thereon as may appear necessary.

9. The periodical inspection of all military schools, and of the Royal Military Asylum, Chelsea, and the Royal Hibernian School, Dublin.

10. To provide for and superintend the half yearly examination at the Royal Military Asylum, Chelsea.

11. The supply of suitable apparatus for the illustration of lectures for the instruction and entertainment of soldiers, according to the rules laid down by the Secretary of State.

12. The general supervision of regimental and garrison libraries and reading rooms.

13. To consider applications for, and appoint librarians at rates of pay previously authorized by the Secretary of State.

14. To supply games, and other authorized articles for reading rooms, according to the rules annexed.

15. To receive the quarterly reports of the state of barrack libraries in duplicate, and to consider any recommendation which may be made therein; one copy to be forwarded to the Secretary of State for War, with the recommendations of the Council recorded thereon, should any be necessary.

16. To make out requisitions upon the War Office for additions to libraries, when necessary, within the annual amount granted by Parliament.

17. To receive and consider the half yearly reports of artillery and engineer libraries in duplicate, in aid of which a grant of money will be made annually to each brigade of artillery and company of engineers by the Secretary of State, on the recommendation of the Council of Military Education; one copy to be forwarded to the Secretary of State, with any remarks thereon which may appear called for, the other to be retained by the Council.

18. Hospital libraries and the schools and libraries of disembodied regiments of militia will remain under the Secretary of State for War.

19. Upon all matters connected with either schools or libraries, not specified above, and which may involve expense, reference should be made to the Secretary of State for War, previously to any decision being arrived at.

EXAMINATIONS FOR COMMISSIONS AND PROMOTIONS.

I. EXAMINATIONS FOR DIRECT COMMISSIONS.

HISTORICAL NOTICE.

Previously to the year 1849, no educational qualifications were required as a condition of obtaining a commission, except from officers appointed to the scientific corps—admission to which could only be obtained by passing through the Royal Military Academy at Woolwich—and from the small proportion of officers, scarcely amounting, at that time, to one sixth of the whole number annually obtaining commissions, who entered the other branches of the service from the Royal Military College at Sandhurst. Examinations for admission to the army generally were first instituted by the Duke of Wellington, when Commander-in-Chief, in 1849. The examination, in addition to general subjects of elementary education, included the professional subject of fortification, in which the candidate was required to have read some easy work on the subject, and to have received some instruction in drawing. This requirement was subsequently somewhat modified; and the knowledge of fortification afterward exacted from a candidate was, "to be able to trace upon paper, in presence of the examiners, a front of fortification according to Vauban's first system, and also the profile of a rampart and parapet." In other subjects, modifications were also introduced; but the general character of the examinations remained much the same as originally established, and the regulations introduced by the Duke of Wellington, in 1849, continued substantially in force, until the general revision of the system of military education, which took place in 1857. It appears, however, from the evidence given by Lord Panmure, before the Royal Commission on the Purchase System, that, during the Crimean war, the stringency of the examinations was very much relaxed.

The examinations were held at Sandhurst by the professors of the College, in the presence of the Lieutenant-Governor, and were conducted to a great extent *vivâ voce*. The Select Committee of the House of Commons on Sandhurst (1855) did not make any recommendation in regard to these examinations,

but stated in their report that in the only branch of the examination which was of a military character, namely, fortification, the knowledge required would easily be mastered in a week. The character of the examination, however, appears to have been very generally regarded with dissatisfaction. Mr. Sidney Herbert, when Secretary at War, in 1854, criticised it severely, as being "too technical, too limited, and within its limits too severe," and as leading necessarily to a candidate cramming up a few books which happened to be in use at Sandhurst, without affording any test of general education. He contemplated at that time a revision of the examinations, and the institution of a special board of examiners, in place of the Sandhurst professors, for the purpose of conducting them; and the Treasury, in connection with this subject, suggested that the machinery proposed for the object in view should be combined, as far as practicable, with that about to be established for examining candidates for the Civil Service.

The outbreak of the Crimean war prevented Mr. Sidney Herbert's proposals, which were connected with a general plan for the instruction of officers, from being carried into effect; and in 1856, Lord Panmure, before the Purchase System Commission, spoke of the defects of the existing examinations in nearly the same terms as those used by Mr. Herbert in 1854. After stating that they led to a system of cramming up particular books, he laid down the principle that the examination "should be such as young men may be supposed capable of passing without having any particular professional education. It ought to be upon general subjects, such as a young man ought to become acquainted with during his passage through any high educational establishment in this country."

The various schemes for the reorganization of military education brought under the notice of Lord Panmure, at the end of 1856, proposed improvements in the system of examinations for admission to the army; and nearly all the authorities consulted on the subject at that time appear to have concurred in the opinion that the examinations should be strictly non-professional, and should be confined to requiring proof on the part of the candidates of a knowledge of the ordinary subjects of liberal education. The commissioners appointed in the same year to consider the training of officers for the scientific corps also recommended that the examination of candidates

for commissions, who did not pass through a military college, should be of a general, and not of a special, character.

The Council of Military Education, on their appointment, in April, 1857, were instructed "to revise the whole system of examination for direct appointments to the army," which is at present very defective; and this subject was, in fact, the first of those referred to in their instructions which they were directed to take into consideration. After consultation with the head masters of some of the chief public schools of the country, with the view of ascertaining the amount of knowledge which might fairly be expected from young men of 17, the Council proposed a scheme of examination based on the fundamental principle that the examination should be entirely non-professional, and confined to subjects which form the course of ordinary liberal education at civil schools. Regulations founded upon the proposal of the Council were issued on the 1st of August, 1857, and it was announced that they would come into operation at the beginning of 1858. These regulations were subsequently modified in some of their details, even before the first examination was held under the new system; further modifications have been from time to time introduced in them, without, however, affecting their general character; and the scheme proposed by the Council of 1857 has, in its main principles, formed the basis of all the regulations under which examinations for direct commissions have been held to the present time.

It appears, however, from the evidence given before the Commission of 1869, that it has been found necessary, from time to time, to diminish the difficulty of the examinations, owing to the number of failures among the candidates, and that the present standard is considerably lower than that originally established. An acquaintance with French, English history and geography, and drawing, was at first an indispensable condition of qualification, but is now no longer required; the obligatory subjects of examination have thus been reduced from five to two—mathematics and English—while, at the same time, the amount of mathematical knowledge formerly exacted has been reduced.

The first examination under the new system took place in February, 1858. Even before this, at the end of 1857, the place of examination had been transferred from Sandhurst to

London, and the method of conducting the examinations by printed papers, instead of by *vivâ voce*, had been adopted. The examinations have, ever since that period, been conducted by examiners appointed by the Council of Military Education, and have, as a rule, been held half yearly. By a regulation which has been for some years in force, candidates for direct commissions are also permitted to be examined at foreign stations. The examination is, in this case, conducted in the presence of a board appointed by the officer commanding the station; but the method of examination is, in all other respects, identical with that adopted at home. The examination papers are forwarded by, and the candidates' replies are returned to, the Council of Military Education.

The plan proposed by the Council was intended to regulate admission to the army in ordinary times of peace; but almost immediately after it had been formally approved, and before it had actually come into operation, the pressure occasioned by the outbreak of the Indian Mutiny led to an abnormal condition of circumstances. In September, 1857, a circular was issued, announcing that commissions would be given without examination on the condition of the applicant raising a certain number of recruits. In March, however, of the following year, this temporary measure was abolished, the pressure for troops being no longer such as to render its continuance necessary. Since that period no candidates, with the exception of graduates of the universities, have obtained commissions without passing the regular examination.

Before 1862, candidates were eligible for commissions without purchase, on passing the examination for direct appointments. Since that year, however, all free commissions have been reserved for cadets at Sandhurst, and those who pass the direct examination have only obtained commissions by purchase.

REGULATIONS IN FORCE IN 1869.

I. The examinations of candidates for direct commissions will be held in London at such periods as the exigencies of the service may require, and be conducted under the direction of the Council of Military Education by examiners appointed for the purpose. The number of candidates summoned to attend each examination will be limited to the requirements of the service.

II. The age of candidates examined for direct appointments will be, until further notice, from 17 to 20 years for the infantry, from 17 to 22 years for the cavalry, and from 17 to 26 years for colonial corps.

III. The candidate will be examined by a medical board, to ascertain that he is in every point of view, as regards his physical constitution, fit for military service.

He will be required to produce the following certificates, which must be forwarded to the Council of Military Education, 13 Great George street, S. W., as soon as possible after the receipt of the Military Secretary's order to attend for examination:

(*a.*) A certificate of baptism, or other satisfactory proof of his age.

(*b.*) A certificate from a minister of the church or of the denomination to which he belongs, that he has been duly instructed in the principles of religion.

(*c.*) A certificate of good moral character, signed by a clergyman of the parish to which he belongs, or by the tutor or head of the school or college at which he has received his education, for at least the two preceding years; or such other proof of good moral character as will be satisfactory to the Commander-in-Chief.

(*d.*) A statement of the subjects in which he wishes to be examined.

IV. The following will be the subjects of examination, but no candidate will be allowed to be examined in more than *five* of these subjects.

	Marks.
The classics { Latin,	2,000
The classics { Greek,	1,600
Mathematics, pure and mixed,	3,600
English language,	1,200
Modern languages (not including provincial dialects) each,	1,200
History, ancient and modern, with geography,	1,200
Natural sciences, *i.e.*, mineralogy and geology,	1,200
Experimental sciences, *i.e.*, chemistry, heat, electricity, including magnetism,	1,200
Drawing,	600

V. Of the foregoing subjects, the elementary branches of mathematics and the English language, to the extent stated in the following paragraphs, will be considered obligatory:

1. In mathematics, 1,200 marks will be given to the following obligatory portions, viz., arithmetic, including vulgar and decimal fractions, proportion, extraction of the square root, and simple interest.

Algebra, including fractions, simple equations, and questions producing them: Euclid, the first three books.

Of the 1,200 marks allotted to the foregoing portions of mathematics, 400 will be required for qualification, and of these at least 200 must be obtained in arithmetic.

2. In the English language, the candidate will be required to write correctly and in a good legible hand from dictation, and to compose grammatically. He will be required to obtain at least 200 marks in this subject.

3. Out of the remaining subjects the candidate may select any three.

4. No candidate will be allowed to count the marks gained in any one of the three voluntary subjects, unless amounting to one-sixth of the whole number of marks allotted to that subject; and for qualification, he will be required to obtain on his five subjects a total of 1,500 marks.

5. In the examination in classics, passages will be given for translation from the books usually read at schools; grammatical questions will be set, and English passages also given for translation into the Latin and Greek languages.

VI. The result of each examination will be reported to the Commander-in-Chief, and the names of any candidates who distinguish themselves will be specially brought to his notice.

VII. An unsuccessful candidate will not be debarred from applying to the Commander-in-Chief for permission to attend a future examination. No candidate, however, will be allowed more than three trials.

Should a candidate obtain only between 700 and 1,200 marks, he will not be allowed to present himself for reëxamination for at least six months. If he obtains less than 700 marks, a period of at least twelve months must elapse before he can be allowed to present himself again.

In all cases permission to be reëxamined must depend upon the number of applicants on the list.

In subsequent examinations no credit will be given for the marks gained by a candidate on former occasions.

In the event of a candidate not appearing for examination at the time appointed, such candidate will not be permitted to attend on the next occasion, and he will render himself liable to have his name either erased entirely or placed at the bottom of the list of those noted for examination.

VIII. A student at either of the Universities of Oxford, Cambridge, Dublin, London, St. Andrew's, Glasgow, Aberdeen, Edinburgh, or Queen's University, Ireland, who shall have passed the examination necessary for taking a degree in arts, is qualified for a commission by purchase without being required to pass the foregoing examination, provided he is within the limits of 17 and 23 years of age if for the infantry, 17 and 25 years if for the cavalry, and of 17 and 28 years for colonial corps, and can produce the certificates marked (*a*), (*b*), and (*c*).

Such candidate must furnish a certificate of having graduated, or of having passed the examinations, signed by the Registrar of the University, and showing the date on which the examination took place.

On his application being approved, the candidate will receive an order to be medically examined as to his physical fitness for the service.

The candidate will address his application, accompanied by the necessary certificates, to the Military Secretary, Horse Guards.

III. PUBLIC SCHOOL EDUCATION AS PREPARATORY TO MILITARY EXAMINATIONS.

A.—GENERAL NOTICE.

In connection with the Modern Departments, at some public schools, technical instruction in military subjects is actually at present given. This, for instance, is the case at Cheltenham College, the Modern Department at which appears, in fact, to have been originally instituted with the express object of affording means of special military education, and at the present day is officially called the "Military and Civil Department." At one time, also, even at some schools in which Modern Departments did not exist, classes were formed in which instruction in military subjects was given to boys intended for the army. Both at Eton and at Harrow such classes existed, and fortification and military drawing were taught in them. The object of the formation of these classes appears in both cases to have been to enable boys to go up straight from school to the examinations for admission to the army, without the necessity of having recourse to private tuition. At the time of their institution a knowledge of fortification was required in the examination for direct commissions, and a candidate was therefore unable to present himself for this examination without some special preparation. At the commencement of 1858, however, the direct commission examinations were entirely remodelled; the small amount of fortification previously required was at that time excluded from the subjects of examination, which have ever since been of a non-professional character, and more or less such as enter into the course of ordinary liberal education. With the exclusion of technical subjects from the military examinations, the necessity for any special instruction in such subjects in

candidates for admission to the army ceased. The military class at Harrow seems to have died out within a few years of its establishment; it has not been in existence during the last ten years and more. At Eton, though the corresponding class is still maintained, the teaching of technical military subjects in it has been abandoned. Even in the Modern Department at Cheltenham the instruction appears of late years to have become of a less decidedly military character than it originally was; and fortification, which was at one time taught at Wellington College, no longer enters into the course of instruction there. In the Modern Side, which has within the present year been established at Harrow, though partially intended, among other purposes, to assist the education of boys intended for the army, no attempt is made to give special military instruction.

The question of the possibility of affording an adequate military education at civil schools was fully discussed by the Commissioners appointed in 1856 to consider the training of officers for the scientific corps.

Having arrived at the conclusion that professional military education as hitherto given in this country has been begun at too early an age, we are met by what may be called the extreme opposite view, which would suggest the desirableness of giving up altogether education in military colleges previously to entering the army, or to entering a purely practical class or college for the special corps of Artillery and Engineers. An opinion appears to exist that the ordinary schools of the country are the best means of giving nearly the whole teaching of general and even military science which is desirable for all classes of officers before entering the army. It seems to be thought that not only modern languages and mathematics, but military history and topography are likely to be taught in such schools sufficiently for the highest military purposes, and that even young men intended for the special arms of the service may, on joining a military academy, be absolved, or almost entirely absolved, from any other studies than those included under the expression "*a purely practical course.*"

The Commissioners expressed their unhesitating dissent from this view. After pointing out the difficulties of giving at ordinary schools a complete preparation even in studies of a general preparatory character, such as modern languages and mathematics, and the still greater difficulties of teaching special subjects, like military history and topography, the Report proceeds:

Agreeing, therefore, as to the fact of a "sound general education being given by public schools," we are unable to draw from it the conclusion that they will "give a specific military education." They may indeed assist our military education, in a manner which the true sense of the term "sound general education" expresses, by encouraging preliminary tastes and studies, such as general history, mathematics, and modern languages, English included, to a greater extent than they do at present. But if there is such a thing as a science of war at all, it stands to reason that it can only be taught fully in cases where young officers have the passion and the capacity to begin it early, by its own teachers, and in its own place. The teachers should be

practical men, as well as men of military science; the place a military college. And the great schools of the country will perform the same service to such an academy for young scientific officers as they do for places which give a specific education for other professions; they will *prepare for it*, but disclaim any attempt to *complete it*.

The Report of the Public Schools Commission does not appear to have made any direct reference to the question of the possibility of giving technical military instruction at civil schools; but the disinclination shown by the Commissioners to recommend even the general institution of "Modern Departments" would lead to the conclusion that they were not disposed to view with favor the introduction of any system of special instruction into the ordinary school course.

The question has been dealt with at considerable length in the evidence taken before the present Commission. In addition to the evidence given by Dr. Barry, Mr. Southwood, Dr. Benson, and Dr. Temple, to which particular reference is made in the Report, opinions on the subject were expressed by several military witnesses. Major-General Sir P. Herbert considers that all which is learnt at Sandhurst—all the knowledge requisite for a line officer—might equally well be acquired at a public school, if proper arrangements were made for teaching it. In his opinion fortification (including the practical construction of field-works), military drawing and surveying, military history and drill, could all be taught by military instructors at public schools without difficulty, and without interference with the subjects of general education. Major-General White considers that military history, modern languages, and drawing might be taught with advantage at public schools to boys intended for the army, although it would be difficult to teach the practical work of field fortification, artillery, and surveying. Colonel Baker appears to be of opinion that at the Universities, certainly, a special preliminary education might be given to candidates for the army, on a system similar to that which it was at one time proposed to introduce at Cambridge, but which does not appear to have ever been actually adopted. At the same time, though this instruction would be of a special character, Colonel Baker does not seem to contemplate its embracing strictly technical military subjects. On the other hand, His Royal Highness the Duke of Cambridge is of opinion that special military classes at public schools would fail; Major-General Sir F.

Abbott thinks it unnecessary to establish such classes; Colonel Hort is decidedly opposed to an attempt to give military instruction at any but a military college, on the ground that it could not be so effectively given at a civil establishment, and would, moreover, interfere with the acquisition of a general education; and Lieut.-General Sir D. Cameron considers that it would be impossible for public schools to give a thorough or perfect knowledge of the practical subjects taught at Sandhurst, such as fortification, artillery, military drawing, and surveying.

In connection with the same subject suggestions have been made by some witnesses that the Government should assign a certain number of free commissions annually, as prizes to be competed for, either at particular public schools, or more generally amongst candidates educated at such schools. The institution of military exhibitions or scholarships at civil schools, and of military degrees at the Universities, has been also suggested. By some witnesses these proposals are advocated with the special view of inducing public schools to adopt a system of military instruction; by others with the more general object of holding out increased encouragement to enter the service to candidates who have had the advantage of a public school education.

Although the question of giving military instruction at public schools was not specially discussed by the Public School Commissioners, their attention was directed to the results of public school education in preparing candidates for the military examinations. Their Report speaks as follows in reference to this subject:

The number of public-school boys who enter the army is not large. Of 1,976 candidates for direct commissions within three years, 122 only had been at any of these schools. Of these 102 succeeded and 20 failed. It will be observed, on reference to the returns, that this proportion of failures is considerably below the average; the public school men, therefore, were better prepared than the general run of candidates. Of 96 who passed at their first examination, 38 came immediately from school, 58 had had intermediate tuition. Of the 20 who failed, 14 had had such tuition.

The public-school candidates for Sandhurst during the same period were 23 out of 375; the proportion who succeeded being here also above the average. Of 18 who succeeded, 11 came straight from school; of five who failed, only one.

The scheme of examinations for direct commissions, framed to meet the suggestions of the Head Masters of public schools, is simple and easy, and requires nothing that is beyond the reach of any boy of moderate industry and ordinary capacity; and it is clear that no boy, who will give himself a little trouble, needs to forego the wholesome influences of a great school for the sake of being "crammed" in the house of a tutor. The Sandhurst examination is also evidently within the reach of the schools.

The qualifying examination for Woolwich appears, before 1862, to have required an amount of mathematical knowledge difficult of attainment for a boy educated at a public school; but it underwent in that year some changes which have made it easier for candidates who have not received a special training. The obligatory mathematics do not now go beyond plane trigonometry; and a candidate need not obtain in them, to qualify, more than 700 marks out of 3,500; with this minimum, and with a fair proficiency in Latin, Greek, French, and geometrical drawing, he is entitled to enter into the competition. This standard is certainly not so high as to be inaccessible to a boy educated at a good public school, and from a table showing the working of the scheme at the examination of January, 1863, it appears that of the 20 successful competitors, 11 distinguished themselves in classics; the other marks were chiefly gained in mathematics and French. In three years, previous to this change, 35 public-school candidates passed and 49 failed to pass the qualifying examination, the totals being 545 and 689. Of the whole 84, two only went direct from the schools, and these failed.

In another passage the Commissioners say: "The main studies of the public schools being classical, it is obvious that, unless a due amount of weight is given to the classics in the Woolwich examinations, boys from those schools will not stand a fair chance in the competition. On the other hand, as it is of importance that the examinations should comprise other subjects besides classics, it is also obvious that unless the public schools provide a due amount of instruction in those other subjects, the candidates whom they send up must compete at a disadvantage. It is certain that there has hitherto been a want of adjustment between the Woolwich standard and the teaching of the public schools. The fault, we think, lies chiefly, though not wholly, in the deficiencies in the course of education pursued at the latter; and we are convinced that when these deficiencies have been supplied the difficulty which is now complained of will speedily disappear. But it is also to be observed, with respect to the Woolwich examinations themselves, that the scale of marks has lately (as we have already stated) undergone an alteration, which diminishes the amount of mathematical attainment required, and allows greater weight to classical scholarship. It appears probable that the Modern Departments at Cheltenham and Marlborough would not have been what they are had the old Woolwich standard, which is stated to have influenced them so strongly, been the same as the present; and probable, also, that they will hereafter feel the effects of the change which has been made in it.

III. EXAMINATIONS FOR PROMOTIONS.

HISTORICAL NOTICE.

Examinations for promotion were for the first time instituted shortly after the introduction of examinations for admission to the army, by the Duke of Wellington when Commander-in-Chief, in the year 1850. A circular memorandum, published on the 14th of May of that year, announced that all officers would in future be subjected to an examination previously to promotion to the respective ranks of lieutenant and captain. The first examination was to be confined to subjects connected with the rudiments of drill, regimental duties, interior economy, and the Mutiny Act and Articles of War. The second examination for the rank of captain was in addition to extend to more general subjects, and to include geography, ancient and modern history, mathematics, and field and permanent fortification; but the examination in these subjects was not intended to affect lieutenants who had entered the service previously to 1849.

The examination for promotion to the rank of lieutenant was to be conducted regimentally by the commanding officer and the two next senior officers of the candidate's regiment. The purely professional portion of the second examination, for the rank of captain, was to be conducted in the same manner; with regard to the mode of testing the candidates' qualifications in the more general subjects required in this examination, it was stated that such orders would be given in each individual case as the Commander-in-Chief might think proper and necessary.

These regulations continued in force up to the time of the institution of the Council of Military Education in 1857, although it appears, both from official statements made by the Secretary at War, and from numerous expressions of opinion in Parliament between the years 1854 and 1857, that, at least so far as regarded the second examination for the rank of captain, little attempt was made, even nominally, to enforce the regulations. Mr. Sidney Herbert proposed, in 1854, in connection with his general scheme of military education, to remodel the examinations and to institute a special machinery for conducting them; and though no actual steps were taken to carry out his proposal, the necessity of making the examinations real and genuine tests of professional knowledge, and of enforcing strict qualifications for promotion, was frequently recognized in the numerous discussions which took place in Parliament on the subject of military education during the course of the Crimean War.

The Council of Military Education, on their appointment in 1857, were directed to consider the question of the professional examination of officers for promotion up to the rank of captain, and in the course of the year submitted a proposal on this subject, in connection with a scheme for providing instruction for officers after entering the service.

New regulations on the subject were issued on the 19th of July, 1858, which, while introducing little change in regard to the examination of cornets and ensigns, rendered a knowledge of mathematics, history, and fortification no longer requisite in the second examination for the rank of captain. Geography, on the other hand, was still retained among the subjects, and, as a condition of promotion to a captaincy, a lieutenant was required "to be able to state the general divisions

of the world, the name of the capital of each nation in Europe, and the principal rivers, seaports, and military posts in Great Britain, Ireland, and Her Majesty's Dominions in every part of the world." The examinations of cornets and ensigns still continued to be conducted regimentally; that of lieutenants, so far as related to matters of regimental economy, detail, or discipline, was to be made by boards of officers appointed by the commanding officer at the station, consisting, when possible, of three senior officers not of the same corps as the candidate.

In November, 1858, revised regulations were issued, which, in accordance with the recommendations of the Council of Military Education, made considerable changes in the examinations, and placed them on their present basis. The subjects of regimental and ordinary duties on which candidates were to be examined were more minutely detailed than heretofore; the examinations were made entirely professional, geography being excluded from the second examination, and at the same time it was announced that lieutenants would be required to show a sufficient knowledge of reconnaissance and of field fortification. But the most important change made at this time was in regard to the mode of conducting the examinations, which were no longer to be carried on regimentally, but by a board appointed by the commanding officer of the district, consisting (if possible) of three field officers,—with the additional provision that in no case in which it could possibly be avoided, an officer of the same regiment as the candidate was to be a member of the board. Cornets and ensigns were to be required to pass the examination before completing eight months' service; and, in order to give additional stringency to the regulations, it was announced that the Commander-in-Chief would "not hesitate to promote (either regimentally or from other corps) officers who may have passed the required examination, in place of the idle and incompetent."

REGULATIONS IN FORCE IN 1869.

Infantry and Cavalry.

159. Before officers are recommended for promotion to the rank of lieutenant, the commanding officer is to apply to the senior officer of the district or station for a board to examine and report upon their qualifications as under:

(*a.*) They must have a thorough knowledge, and must give an account, of the duties they have to perform as regimental orderly officers, as officers commanding guards, or as subaltern officers of guards under officers of superior rank.

(*b.*) They must have a thorough knowledge of, and be able to put a company through the various exercises and evolutions prescribed in the first two parts of the "Field Exercises of the Infantry;" and they must be acquainted with the rifle drill and practice, and the theoretical principles of musketry, as defined in the authorized book of instruction.

(*c.*) They must know exactly the place of all the company officers in every situation of the battalion, and be able to command a company in battalion exercise.

(*d.*) They must be acquainted with such parts of the Queen's Regulations and Orders for the Army as relate to the duties and conduct of a subaltern officer, and with the Mutiny Act and Articles of War, so far as is necessary for the performance of their duties as members of a court-martial.

(*e.*) They must be acquainted with the regulations of the army in regard to the pay and messing of the troops, the supply of clothing and necessaries, and all details regarding the weight of, and mode of carrying, the various articles of the soldier's kit, arms, accoutrements, and ammunition.

160. In addition to such portions of the foregoing as may apply to the cavalry service, it is necessary in the case of cornets recommended for promotion to the rank of lieutenant,—

(*a.*) That they shall have learnt their foot drill and sword exercise, and have been instructed in the single and double ride.

(*b.*) That they shall be able to put a troop through the carbine, lance, and sword exercise, and to exercise both a squad and troop in the drill and evolutions prescribed in the Cavalry Exercise Book.

(*c.*) That they shall be able to command a troop in squadron exercise.

(*d.*) That they shall have made themselves masters of the detail of saddlery, the mode of fitting the saddle, bridle, etc., and of the whole equipment of the cavalry soldier and his horse.

161. Lieutenants in the Cavalry and Infantry will, in addition to the foregoing, before they are recommended for promotion to the rank of captain, be required to show that they are further duly qualified as follows:

(*a.*) They must have a thorough knowledge of the provisions of the Mutiny Act and Articles of War, and of the forms and proceedings of courts-martial, and must give evidence of having studied some of the standard works on military law.

(*b.*) They must understand perfectly the evolutions of a regiment of cavalry or a battalion of infantry, as laid down in the regulations for those services respectively.

(*c.*) They must be acquainted with the light infantry drill, duties of outposts, patrols, escorts, advanced and rear guards.

(*d.*) They must perfectly understand the interior economy of a troop or company, and the established system of keeping their accounts.

(*e.*) They must be thoroughly acquainted with the Queen's and War Office Regulations applicable to their own branch of the service.

(*f.*) They must be competent to take charge of a troop, company, or detachment, in every position in which it may be placed.

(*g.*) And they will be required to show that they have a sufficient knowledge of field fortification and reconnaissance.

162. The board of examination is to consist, if possible, of three field officers; but on no occasion, when it can be avoided, is any officer of the same regiment as the candidate to be a member. In all cases the board will ascertain by practical examination, as well as by verbal and written answers to questions, whether the officer is instructed in the subjects specified in the preceding paragraphs. The questions are to be written on half margin, and the replies written opposite to them. The board will mark in red ink its correction of any mistakes in the answers, and will certify in each case that "the candidate has not received any assistance from books or other sources." The report of the board to be on a separate sheet, and when officers of different regiments are examined by the same board, the report in connection with each regiment is to be made separately.

163. The general officer commanding will forward the report of the board, and the written questions and replies, to the adjutant-general, accompanied by his own observations thereon, regarding the nature of the examination, the correctness of the answers, and the eligibility of the officer examined.

164. Every cornet or ensign is to be examined on the different points herein specified, before he has completed one year's service; and should he fail to qualify himself for promotion within that period, his commanding officer must report, through the general officer commanding, for the information of the Commander-in-Chief, whether it is owing to a want of diligence and attention on the part of the officer, or to sickness, or other circumstances over which he could have had no control.

165. No officer will be recommended for promotion to the rank either of lieutenant or captain unless his examination papers and certificate of qualification have been received by the Military Secretary; but the Commander-in-Chief will, in all cases, select the senior officer who may have qualified for promotion to the higher grade.

Artillery.

166. The examination of lieutenants of artillery for the rank of captain will include all the subjects required from officers of the line of corresponding rank, except that a general knowledge only of the evolutions of cavalry and infantry will suffice. In addition to the foregoing, lieutenants of artillery are to be examined as to their acquaintance with the more special duties of their arm of the service. The following will serve as a guide:

(*a.*) Field-gun drill. Exercise of heavy guns on ground and traversing platforms, mortar drill, rocket drill, Armstrong-gun drill, practice with hot shot and molten iron shells, gun and transporting carriage drill.

(*b.*) General duties of the men, and principles involved in mounting and dismounting ordnance generally, in placing guns on towers, in embarking and disembarking ordnance, and in moving ordnance up steep inclines; also the tackle, etc., required in the above operations.

(*c.*) Different pieces of ordnance in use throughout the service at the time of examination, their weight and calibre, and special purpose.

(*d.*) Ammunition employed with ordnance generally; ammunition employed with Armstrong guns; general construction of a Congreve rocket, and the principle of its motion; manufacture and action of fuzes and tubes; the advantages of the rifle action, and the principle upon which it depends; essential points with regard to rifling ordnance; general principles of breaching; position and employment of artillery in the field; considerations which regulate the rapidity of artillery fire; principles connected with the construction of artillery carriages; general knowledge of laboratory duties.

(*e.*) Embarking and disembarking horses; management of horses on board ship.

(*f.*) To be able to define technical artillery terms, etc., in such a way as to make them understood by the non-commissioned officers and men under their command, such as,—1, point blank; 2, point blank range; 3, dispart; 4, chambers; 5, preponderance; 6, different kinds of artillery fire; 7, how elevation gives an increase of range; 8, windage; 9, deviation, etc., etc.

(*g.*) Subalterns who have been one year or more in the horse brigade, or in a field battery, will be required, in addition to the foregoing subjects, to be thoroughly acquainted with stable duties, and horse artillery or field battery movements and details. All must have a general knowledge of these subjects.

167. Every officer, on becoming the thirtieth on the list of lieutenants, must be prepared to undergo the required examination. Any officer, after four years' service, may apply for such examination at an earlier period.

168. Instructions will, from time to time, be issued to the general or other officer commanding districts or stations, to assemble a board, to consist of three officers, viz., a field officer (of the artillery, if possible), an officer of the staff, and a captain of artillery, or an officer of that corps who may already have passed the examination. Either the gunnery instructor or the fire-master should, when practicable, be selected for this duty. If it be impossible to obtain a staff officer, a captain of the line should be substituted; if a second officer of artillery cannot be had, an officer of engineers should be substituted; but either the president or one member must be of the artillery.

169. That portion of the examination which can be best replied to in writing will be conducted by means of questions prepared by the deputy adjutant-general of artillery, and forwarded to the general officer commanding the district. The *viva voce* and practical examination will be conducted by the board of officers, who will satisfy themselves that the officer under examination not only possesses the requisite knowledge himself, but that he is able to impart that knowledge in a clear and satisfactory manner.

170. The board will then forward, through the general officer, its report, together with the written answers, to the adjutant-general of the forces; and, in returning to him the written answers, the president of the board will certify that they are the *bonâ fide* performances of the candidates, without assistance. The written papers will then be examined by the deputy adjutant-general of artillery, and the result, together with the opinion of the board, reported to the Commander-in-Chief.

ROYAL WARRANT OF OCTOBER 30, 1871.

In pursuance of the abolition of the whole system of purchase, sale, or exchange for money, of commissions in the army, by Royal Warrant, dated July 20, 1871, certain changes in respect to first appointments, regimental promotion, and exchanges, became necessary, and were provided for in the Royal Warrant issued October 30, 1871, which became operative on the first day of November following. By these regulations, the first step in official rank is that of Sub-Lieutenant; the rank of Cornet and Ensign being no longer recognized. As a general rule, the final appointments will be given only to successful candidates at a competitive examination. These will be probationary, and revocable in case the unfitness of the incumbents shall be demonstrated by practical trial in their work From the Memorandum of the Secretary of War (Edward Cardwell), which accompanies the Warrant, we cite the following as defining the present system of original appointments and promotion

Commissions as Lieutenants will be given to all Cornets and Ensigns appointed before the 26th of August, 1871, and to Cornets and Ensigns appointed since that date from the A List at Sandhurst, their commissions to date from the first of November.

Commissions as Sub-Lieutenants will be given to:

(*a.*) All other Cornets and Ensigns appointed after the 26th of August, 1871, the rank of Cornet and Ensign being abolished.

(*b.*) Candidates who have passed the examination for Direct Commissions, in their turn as vacancies occur.

(*c.*) Candidates for commissions in the Household Cavalry and Foot Guards who are nominated to fill the vacancies which occur in those regiments, before the date of the first competitive examination for Sub-Lieutenancies, and who pass a qualifying examination.

(*d.*) Candidates from the Universities now on the Commander-in-Chief's list.

Sub-Lieutenants will be attached for a year to regiments at home. They will then be required to go through a course of instruction, and on passing a practical professional examination, be commissioned to regiments as Lieutenants. They will be under strict discipline, and will be liable to be removed for unfitness, either moral or physical, and for misconduct. Those unsuited to the Cavalry may be transferred to the Infantry.

In dating their commissions they will be allowed a portion, not exceeding one year, of their services as Sub-Lieutenants; the time allowed being determined by the class of certificate they receive after their year's regimental training, their conduct while under instruction, and their position at the final examination. Their service for retirement will reckon from the date of their commissions as Lieutenants.

Candidates who have passed the examination for direct commissions, and have also passed satisfactorily through a year's course of study at the Royal Military College before being appointed to be Sub-Lieutenants, and Sandhurst Cadets from the B List will be commissioned to regiments as Lieutenants on serving satisfactorily for twelve months with a regiment as Sub-Lieutenants.

There are now a large number of supernumerary officers, and also a large number of candidates who have passed for commissions.

The absorption of supernumerary officers will probably be completed, and the candidates who have passed for commissions have received their ap-

pointments in about two years from the present time, and personal appointments in the Army will then only be given as follows:

(*a.*) To successful candidates at a competitive examination.

(*b.*) To non-commissioned officers recommended for promotion by the Field-Marshal Commanding-in-Chief.

(*c.*) To candidates from the Universities.

(*d.*) To Queen's Cadets, Indian Cadets, and Pages of Honor.

(*e.*) To Lieutenants of Militia.

The competitive examination will be carried out by the Civil Service Commissioners; the standard of qualification being that recommended by the Royal Commission on Military Education. Ample notice will be given of the first examination, and there will be no advantage in any applications being made for admission to be examined before the publication of such notice.

Non-commissioned officers, on being selected for promotion, will pass an examination in certain professional subjects; and then, after twelve months' satisfactory service as Sub-Lieutenants, will receive commissions as Lieutenants

A certain number of Sub-Lieutenancies a year will be allotted to candidates who have passed the University examination specified in the Regulations. If they also pass the examination for the degree of B.A., they will be allowed two years' extension of the limit of age. University candidates will be required to give at least six months' notice of their desire to be admitted into the Army. If in any year there should be more candidates than appointments, the requisite number will be chosen by competition between the candidates; after their appointment they will go through the same course as other Sub-Lieutenants.

There will be no vacancies for two years for any candidates from the Universities whose names are not now on the Commander-in-Chief's list.

Queen's and Indian Cadets and Queen's Pages will be required to pass a qualifying examination, which for the present will be the same as that recommended by the Royal Commission on Military Education. The nominations will remain as heretofore. When appointed, Cadets and Pages will go through the same course as other Sub-Lieutenants.

First appointments as Subalterns in the Militia will be made on the recommendation of the Lieutenants of counties. Candidates, before receiving their Commissions as Lieutenants in the Militia, will be required to pass a qualifying examination in general subjects equal to the standard fixed as necessary for a candidate for a Sub-Lieutenancy. They will next be required to be attached to a regiment of the Line for three months, or such time as may be necessary to teach them their drill. After serving with their Militia regiments for two annual trainings, they will be eligible for the appointment of Lieutenants in the Army. In order to obtain such an appointment they must be recommended by the commanding officer of their Militia regiment, his recommendation being confirmed by the general officer commanding the district, and they will be required to pass an examination in professional subjects of the same kind as that which will be required of a Sub-Lieutenant before he receives his commission as Lieutenant.

The limits of age, except for non-commissioned officers, will be fixed at from seventeen to twenty for Sub-Lieutenants, the limit being raised to twenty-two in the case of candidates who have passed their examination for the degree of B.A. at the Universities, and from nineteen to twenty-two for Lieutenants from the Militia.

In addition to the examinations hitherto required from regimental officers, those who are promoted to the rank of Captain after the 1st of November will, before being promoted to the rank of Major, be required to pass a professional examination.

The General Order promulgating the Royal Warrant and the Memorandum of Secretary Caldwell contains the following paragraph:

His Royal Highness the Field-Marshal Commanding-in-Chief, in promulgating these regulations to the Army, would desire to impress upon each individual officer, and especially upon those of junior standing who have still a name to make in the service, that they must more than ever rely upon their own exertions, upon their professional knowledge and ability, upon their general character and conduct as officers, and the opinion with which they impress their military superiors, for advancement in the service.

Examiners Employed by Council of Military Education.

Mathematics.—Rev. Canon Heaviside, Norwich; Rev. W. N. Griffin, late Fellow and Tutor, St. John's, Cambridge.
Classics.—Rev. Osborne Gordon, D.D., late of Christ Church College, Oxford; Prof. Rawlinson, Camden Professor of Ancient History, Oxford.
English.—G. W. Dasent, D.C.L.; W. Stebbing, M.A., Fellow of Worcester College, Oxford.
French.—M. Esquiros; M. Savoye.
German.—Prof. Max Müller, Prof. of European Languages, Oxford; C. Schöll, Ph.D.
Hindustani.—Prof. J. Dowson; Rev. W. D. Mallagan, M.A.
Experimental Sciences.—Prof. Liveing, M.A., Prof. of Chemistry, Cambridge; Prof. Abel, Chemist to War Office.
Natural Sciences.—Prof. Morris, F.G.S.; H. W. Bristow, F.R.S.
Drawing.—Lt. Col. H. Scott, R.E.; Rev. W. Kingsley, late Fellow and Tutor, Cambridge.
Italian.—C. De Tivoli.
Spanish.—Señor Vives.
Portuguese.—Le Chevalier da Costa Ricci.
Dutch.—Rev. Dr. Gehle.
Modern Greek.—Rev. N. Morphinos.
Danish.—Rev. J. Plenge.
Military History.—Major G. P. Colley.
Fortification and Practical Gunnery.—Lt.-Col. Hutchinson, R.E.; Major Milman, R.A.
Military Administration.—Major M. Petrie.
Persian.—Col. Ouseley.
Military Legislation.—Col. J. H. Laye, D.J.A.
Artillery.—Major C. F. Yonng.

In the evidence before the Military Education Committee, of July 13, 1869, the Secretary of the Civil Service Commission expressed the opinion that the entrance examination, both to Sandhurst and Woolwich, on subjects purely civil, might be conducted by the latter; and that the same and other subjects, in their scientific value, both in all qualifying and competitive examinations for direct commission and promotion, could be conducted by the same examiners, thereby securing economy, more uniformity in the methods and tests, and more satisfactory results. The staff of examiners should be composed of changing as well as of permanent members, and when the service is professional, an expert should be called in. The entire work of the Civil Service Commission, including the India Service, is done by one Commissioner, the Secretary, and his permanent examiners, with occasional assistants.

Expenses of Council of Military Education.

Year.	£	*s.*	*d.*
1858–59,	6,325	3	1
1859–60,	6,956	7	7
1860–61,	7,757	12	1
1861–62,	7,789	14	3
1862–63,	7,681	17	6
1863–64,	7,529	11	10
1864–65,	7,976	17	5
1865–66,	7,884	2	8
1866–67,	7,353	16	5

ROYAL MILITARY COLLEGE AT SANDHURST.

I. HISTORICAL NOTICE.

THE ROYAL MILITARY COLLEGE AT SANDHURST was instituted in 1799, on the persistent representations of its necessity and advantages, by General Le Marchant, an eminent and distinguished officer, who met his death in actual service on the plains of Salamanca, in 1812. The report of the Parliamentary Commissioners of 1855 and 1870 give the following particulars of the history and present condition:

It commenced as a place of instruction for officers, in 1799. In 1801, the Junior Department was organized. The united departments took the name of the Royal Military College, and his Majesty George the Third was pleased by Royal Warrant to appoint a Supreme Board of Commissioners for the purpose of managing all the affairs of the College.

An establishment and a course of study were recommended by this Board, and adopted in a Royal Warrant, passed in the same year, 1801. From this date warrants were issued from time to time until the warrant of 1808, which cancels all former warrants, and still regulates the College.

By this warrant, a Board of Commissioners was appointed, consisting of the Commander-in-Chief, the Secretary at War, the Master-General of the Ordnance, the Quartermaster-General, the Adjutant-General, the Governor, and the Deputy-Governor of the College,—all for the time being. Certain other officers were added to these *ex officio* members. In the Board so constituted were vested the control, direction, and management of all the affairs of the College. The College was to be under the immediate command of the Governor and Deputy-Governor, to be divided into a senior and junior department, each to have its own course of study, under its own staff.

A collegiate board was created to take cognizance of all matters relating to the interior economy of both departments. This board consisted of the Governor, the Deputy-Governor, and three other resident military authorities.

The Royal Warrant of the 27th May, 1808, for regulating all matters relative to the Royal Military College, states the objects of the two departments of the College, as follows:

The Senior Department of the Royal Military College is established for the purpose of instructing officers in the scientific parts of their profession, with a view of enabling them the better to discharge their duty when acting in command of regiments (the situation in which they can best recommend themselves to Us, and be entitled to hope for advancement in the higher stations of Our service), and, at the same time, of qualifying them for being employed in the Quartermaster-General's and Adjutant-General's Departments.

The Junior Department of the Royal Military College is appropriated to the instruction of those who, from early life, are intended for the military profession, and who, by this means, may be grounded in science previously to their obtaining commissions in Our army.

This department of the College is also intended to afford a provision for the sons of meritorious officers, who have fallen or been disabled in the service of their country, and the means of education to the sons of those officers who belong to Our regular service.

The first of the departments organized was thus the Senior Department, which was established at High Wycombe, in 1799, although it would seem that classes for the military instruction of officers had been in existence previous to that year. The origin of the Senior Department is thus described in the evidence given by Sir Howard Douglas before the Select Committee on Sandhurst:

General Jarry, who was the first Commandant of the Senior Department, was a Frenchman, highly educated in France, who entered the service of Prussia a short time before the commencement of the Seven Years' War, and was on the personal staff of Frederic the Second through the whole of that war. He returned to France, and became afterward one of the generals of the French army; and, in the year 1795, defected from the French army, and came to London, where he soon became very generally known as a man of eminent talent, perfectly master of the science and the practice of his profession, and, from his having served so long about the person and on the staff of Frederic the Second, full of the most interesting anecdotes and instructive details connected with that war. General Le Marchant, having formed an acquaintance with General Jarry, in London, it occurred to him that, if General Jarry could be engaged to give lectures to a certain number of young officers who might be disposed to go and reside where the general might attend, it would be very advantageous to the service. General Jarry was so engaged. A house was taken at High Wycombe; a considerable number of the rising young officers of the day became his students,—Sir George Murray, Sir Henry Bunbury, Sir Richard Bourke, General Richardson, and a great many others. General Jarry soon found that the rudiments of military science in the British army were not sufficiently known to enable all the students to profit by his instruction, and recommended that mathematical, and fortification, and other classes, should be established; and, accordingly, Mr. Dalby, a mathematical professor, M. St. Denis, professor of fortification, and M. Polchet, of the Polytechnic School, were engaged; and in this way the Senior Department was established.

General Jarry became commandant of the establishment on its institution, and, in 1804, Sir Howard Douglas himself was appointed to assist General Jarry, as superintendent.

The formation of the Junior Department had probably been determined upon from the time when the Senior Department was established. It was actually organized in 1801, when it was established at Great Marlow, and, in the year 1803, consisted of 200 cadets; the Senior Department being, at the

same time, composed of 30 students. Each department had at this time its own commandant, superintendent, and special staff of instructors (7 for the Senior, and 19 for the Junior Department); while there was, in addition, a general staff, consisting of a governor, lieutenant-governor, and other officials, for the two departments, which, although in separate localities, together constituted the Royal Military College.

The Royal Warrant of 27th May, 1808, fixed the establishment on a still larger scale, as follows:

1 Governor, 1 Lieutenant-Governor, 1 Inspector-General of Instruction.
Senior Department.—1 Commandant, 1 Adjutant, 30 Students.
Junior Department.—1 Commandant, 1 Major, 4 Captains of Companies, 412 Gentlemen Cadets.
Staff.—1 Chaplain and Librarian and Superintendent of Religions and Classical Instruction, 1 Agent, 1 Secretary to the Board of Commissioners, 1 Paymaster, 1 Quartermaster, 1 Surgeon, 1 Assistant Surgeon.

The number of professors is not fixed by the warrant, but, in 1810, 5 were employed at the Senior, and 32 at the Junior Department. In 1815, the number of professors was 6 at the former, and 36 at the latter.

The establishment, with slight modifications, continued as above throughout the period of the war which terminated in 1815; but shortly after the conclusion of peace reductions began, in consequence of the recommendations made in the report of the Finance Committee of 1817, and at the same time the course of instruction in the Junior Department was made of a much less military character than it had originally been.

The Senior Department was, as has been stated, originally established at High Wycombe, and the Junior Department, as there was not sufficient accommodation for it at the same place, was, on its institution, placed at Great Marlow. It is probable, however, that it was intended from the first that the Military College should be at Sandhurst, and it appears that, as early as 1801, the greater part of the estate at Sandhurst had been purchased. Owing, however, to doubts having subsequently arisen as to the eligibility of Sandhurst as a site for the college, the works there do not appear to have been commenced until 1809; and it was eventually determined that the Junior Department alone should be placed there, the Senior Department being accommodated at Farnham. In 1812, the Senior Department went to the quarters prepared for them at

the latter place, and about the same time the Junior Department was removed to Sandhurst. In 1820, in consequence of the space left vacant by the reductions which had then been made in the Junior Department, the Senior Department was transferred to Sandhurst; its separate military staff was at the same time abolished, the number of students at it was reduced to 15, and the number of instructors to 2. It continued in this state down to the time of its conversion into the Staff College, which took place in January, 1858. The Junior Department was also, by successive reductions, brought, in 1832, to the state in which it stood in 1855, at the time of the appointment of the Select Committee of the House of Commons, the number of cadets having been reduced to 180, divided into two companies. In the year 1832, also, the Parliamentary votes in aid of the College, which, in 1815, had amounted, for the Junior Department alone, to £34,000, entirely ceased, and, from this time up to 1855, the College was not only self-supporting, but, in some years, actually paid money into the Exchequer.

In the year 1855, in consequence of attention having frequently been drawn in Parliament to the state of Sandhurst, a Select Committee of the House of Commons was appointed to inquire into the condition of the Royal Military College. The establishment of the College was, at that time, as follows:

1 Governor, 1 Lieutenant-Governor.

Senior Department.—2 Instructors, 15 Students.

Junior Department.—1 Major and Superintendent of Studies, 2 Captains of Companies, 180 Gentlemen Cadets, 1 Chaplain, 1 Secretary to the Board of Commissioners, 1 Paymaster and Quartermaster, 1 Surgeon, 1 Assistant Surgeon, 1 Riding Master, 16 Instructors.

This continued without material alteration to be the establishment until 1858.

The instructors undertook the following branches:

(*A.*) *Senior Department.*—1. Mathematics and Fortification. 1. Military Surveying.

(*B.*) *Junior Department.*—3. Mathematics. 2. Fortification. 3. Military Drawing and Surveying. 1. Landscape Drawing. 2. History, Geography, and Latin. 3. French, 2. German. [The seniors in these branches also gave instruction to the Senior Department.]

The Chaplain also gave instruction in History.

The title of Major and Superintendent of Studies dates from the year 1842. For some years previously, the offices of Adju-

tant, Paymaster, and Superintendent of Studies, had been combined in the person of one officer, Major Proctor. On his retirement, in 1842, Lieut.-Colonel Prosser was appointed Major and Superintendent of Studies—an office which has been retained to the present day—and the appointment of Adjutant was abolished.

At the time of the inquiry by the Select Committee of the House of Commons (1855), the Junior Department of the College was a school for boys. The limits of age for admission were from 13 to 15. Candidates were admitted by application to the Governor, on passing a qualifying examination, before the professors of the college, in elementary subjects of ordinary education. The maximum term of residence was four years, the average period being three years. The course of study was intended to complete the general education of the youth, in addition to giving him military instruction, and included history, geography, and Latin, as well as more professional subjects.

The system of instruction which prevailed at the College at that time is described as follows by Mr. Twisden, now professor of mathematics at the Staff College:

The instruction and examinations in the Junior Department were, in the year 1855, conducted on the following system: There was a division of the department into upper and lower school; but, practically, the division was of little importance. The most important division was made by the line which, in each separate branch of instruction, divided the cadets in the Board class from those not in the Board class.

A cadet was in a Board class who was actually preparing for the public examination, which took place before the "*Board* of Commissioners for Regulating the Affairs of the Institution." The Board was, however, in most cases, represented by not more than one or two of its members. In any given subject, a cadet had to pass through certain grades of elementary instruction before he could be placed in a Board class. Moreover, he was only moved from one grade of elementary instruction to another on passing examinations, which were held monthly by the senior instructors in the several subjects. The junior instructors reported those of their cadets whom they regarded as ready for promotion, and the senior ascertained that the proper degree of proficiency was obtained. Thus, in mathematics, a cadet had to pass examinations in Fractions and Decimals, mixed numbers, Rule of Three, Interest, and Square Root, Algebra up to the end of Quadratic Equations, and logarithms,—four successive examinations in all. He had then to spend a half year in the study of Euclid's Geometry before admission to the Board class. It will be understood that all the cadets were not examined monthly, but only such as were reported as fit for examination; so that any one cadet might pass a long time without examination, or he might be examined for several successive grades in one subject, and not undergo any examination in another. There was, in fact,

scarcely any mutual dependence of one branch of instruction upon another. I believe the only exceptions to this were, that a cadet was required to have passed his examination in algebra before getting into the lowest fortification class, and to have gained a certain proficiency in military drawing before getting into the surveying class.

The Board class in each branch was taught by the senior instructor in that branch, except that the Board class of history was taught by the chaplain. When a cadet had passed an examination in any subject before the Board, he was said to have taken up a step. The steps which it was possible for him to take up were as follows, and I have arranged them in three groups, for conveniences of reference:

A.—(1.) Euclid's Geometry. (2.) Fortification. (3.) Surveying.
B.—(4.) Trigonometry and Mensuration. (5.) Attack and Defence of Fortification. (6.) History and Geography. (7.) Latin. (8.) French. (9.) German.
C.—(10.) Elements of Mechanics. (11.) Elements of Coördinate Geometry and Differential Calculus.

To gain a commission without purchase, it was necessary to take up the three steps in the group A, and any three in the group B,—six in all. But if a cadet took up more than six steps, the fact was mentioned in the certificate given him on leaving the College. For gaining this honorary distinction, the steps marked in group C were allowed to count; but I believe not otherwise. I may mention that, in many cases, more than six steps were taken up.

The process of examination before the Board was this: About seven weeks before the end of the half year, the senior instructor in each branch reported the cadets in his branch whom he thought capable of taking a step. Thus the senior instructor or professor of mathematics reported those cadets in the Euclid Board class whom he judged capable of taking up the step. Shortly after, these cadets were examined before the Lieutenant-Governor; about a week before the end of the half year, they were examined again, on this occasion, before the Governor; lastly, they were examined publicly before the *Board*. Failure was possible in either of these examinations, and not unfrequently occurred at the preliminary examinations, and sometimes, though rarely, at the Board examination. The effect of failure was, that the cadet could not pass his step without going through his examinations at the end of the next half year.

The examinations were conducted entirely *vivâ voce*. The Governor's and Lieutenant-Governor's examinations were searching; they sometimes lasted from six to seven hours; but, of course, the cadets, severally, were under examination only during a part of that time. The Board examination, though less searching, was a real examination. A cadet under examination had not the least notion of what was going to be asked, except that it was fairly within the subject of the step.

The system thus briefly described was invented by Major Proctor, who was at first *Adjutant*, and, afterward, Superintendent of Studies. It was in operation, at all events, as early as the year 1818. It was open to several objections; but it possessed this capital advantage, that it was calculated to bring, and, in point of fact, brought a large majority of the cadets up to a certain moderately high standard of proficiency. The instructors were under no temptation to take great pains with a few clever boys, and to neglect the rest; they were nearly sure to assist every cadet showing the least inclination to work, and to assist those most who were in need of assistance.

On the other hand, the system failed to supply a cadet of superior ability with a motive to attain a high degree of proficiency in any given subject. The

utmost attained was, that cadets of more than ordinary ability were encouraged to attain the standard of proficiency in more than the necessary six subjects. The system was also open to the serious objection that, under it, the cleverest cadets got through their course quickly. This was bad for them, for it had the effect of bringing their school-education to an early end; and it was bad for the institution, because the eldest cadets were not the most intelligent.

I must be allowed to add, that my experience of the examinations by *viva voce* has given me a very lively sense of the value of that kind of examination; and, though it is not adapted for all subjects, and, where many have to be examined, takes too much time, yet it might be used under many circumstances with very great advantage, and I regard its total disuse since the year 1858 as a very serious error.

I have mentioned above the fact of the Junior Department being divided into an under and upper school. I may add that there were six classes,—three in each school, and two removes in each class. I believe that this was the remains of an earlier organization, which, without being formally abrogated, was, by degrees, nearly obliterated by the introduction of the step system. The only thing that kept up the distinction between upper and lower school was, that a cadet, to be in a Board class, had to pass into upper school. The three classes in the upper school did not have a nominal existence in 1851.

With respect to the Senior Department, a somewhat different system was followed. The course was one of two years; but, in the case of officers who had been cadets, the course was one of a year and a half. There was an examination held at the end of each half year on the subject of the half year's course. The method of examination resembled that in use in the Junior Department. The subjects comprised in the course are mentioned in a paper printed on page 215 of the evidence taken before the Select Committee of the House of Commons on Sandhurst (1855).

In certain respects, officers might do more than the prescribed course, and obtain honorary mention, *e. g.*, they might do extra plans; they might take up a certain amount of analytical mathematics, with a portion of Poisson's "Traité de Mécaniqne," and of Laplace's "Mécanique Céleste." I have by me the synopsis of the ordinary course of mathematics in use before the year 1858; but, as the heads of it are given in the paper above referred to, it is unnecessary to give any details about it.

The Report of the Select Committee of 1855 contained various suggestions for the improvement of both departments of the College, but did not propose to alter the character of the Junior Department as a place of juvenile education. The only practical results of the report were, the establishment of Queen's cadetships, and the revision of the rates of payment required from all classes of cadets. The institution of Queen's cadetships was determined upon by the Government in 1856, but the other alteration was not immediately carried out, and no modification of importance in the constitution of the College ensued from the recommendations of the Committee. It was not until the general reorganization of the system of military education which took place in 1857 that any important change was made in regard to the Military College.

It appears to have been decided at the end of 1856 by Lord Panmure, then Secretary of State for War, that an amalgamation of the Junior Department of Sandhurst with the lower classes of Woolwich should be effected. The Council of Military Education, on their appointment, in April, 1857, were directed to suggest the mode in which this amalgamation could be carried out, taking, as their starting point, the principle that Sandhurst was to be converted from a school for boys into a college for young men, with the age of admission ranging from 16 to 18.

The proposed plan having been approved, an announcement was made, in December, 1857, that the education of candidates for all arms of the service, who did not obtain commissions by direct appointments, would be given at Sandhurst; that entrance would be obtained by competitive examination, open to candidates between the ages of 16 and 18; that the period of study would be two years, and would be terminated by a competitive examination, the most successful candidates in which would be permitted to select the Engineers or Artillery, according to the number of vacancies in those corps, or would receive commissions without purchase in the Cavalry, Guards, or Line. Those who selected the Ordnance corps were to be removed to the school of application at Woolwich.

Almost simultaneously with this notification, appeared a General Order, announcing the conversion of the Senior Department into the Staff College, which was then placed under a separate commandant and staff of instructors,—the Junior Department being henceforward called the Cadet College.

An examination for admission to Sandhurst, under the regulations described above, took place in January, 1858, when 24 candidates were admitted to the College. On the 26th of April, however, a resolution was passed by the House of Commons, on the motion of Mr. Monsell, in consequence of which the plan for the amalgamation of Woolwich and Sandhurst was necessarily abandoned; and, in May, 1858, revised regulations were issued, which again placed Sandhurst on the footing of an entirely distinct establishment from Woolwich. In these regulations, however, a new provision was introduced, by which a cadet at the Military College was, if otherwise eligible, permitted to compete at the examination for admission to Woolwich, without his position at Sandhurst being affected by failure in this examination. This regulation has been retained.

The large increase in the numbers of the College which was contemplated by the amalgamation scheme was not carried out, the establishment still remaining at 180 cadets, divided into two companies. At the same time, the other alterations recommended by the Council in the constitution and course of study of the College were brought into effect. Since this period the system of juvenile military instruction, which had been already abandoned at Woolwich, has been discontinued at Sandhurst. The establishment was converted from a school for boys into a college for young men, the minimum age for admission being placed at 16; while the course of instruction—the length of which was fixed at two years—was made almost entirely professional. The principle of competition was adopted as the condition of admission, although not to so full an extent as at Woolwich, the candidate for Sandhurst being required to apply to the Commander-in-Chief, in order to have his name entered on the list of competitors. The entrance examinations for admission to the College, and the final examinations for commissions, were placed under the control of the Council of Military Education; and the whole method of instruction was revised, the old system of "steps" being abandoned.

For many years, up to this time, the College had been almost entirely self-supporting. The orphan-class of cadets, established by the Royal Warrant of 1808, who had received a gratuitous education, had, after successive reductions, been finally abolished in 1822; and, though the sons of officers were still educated at reduced rates, the system had been gradually introduced of affording them this advantage without expense to the public, by increasing the rates paid by the sons of private gentlemen. This system, which had been animadverted on by the Select Committee of the House of Commons, in 1855, was altered on the reorganization of the College, in 1858; the rates of payment from all classes were reduced, and the principle was, at least partially, adopted, of defraying, by a Parliamentary vote, the difference between the actual cost of the education of a cadet and the lower rates charged for the sons of officers. The first public announcement of the institution of Queen's cadetships, the holders of which were to receive a gratuitous education, was also made in 1858. Since this period, a large part of the expense of the College has been borne by the public.

Some addition to the instructional staff was made in the year 1858, in consequence of the general changes introduced at that time in the system and subjects of instruction; and, in the same year, the office of Adjutant—which had been abolished in the year 1842—was revived, in consequence of the strong representations of the Governor, Lt.-Gen. Sir H. D. Jones.

The next important change in the organization of the College was in 1862. After the abandonment of the scheme for the amalgamation of Woolwich and Sandhurst, the Council of Military Education turned their attention to the subject of enlarging the latter establishment, with the view of making it a general military college, through which all candidates for commissions in any branch of the service, except the Artillery and Engineers, should be required to pass. The general outline of a scheme having this object in view was submitted by the Council as early as July, 1858, to General Peel, then Secretary of State for War. It was still under consideration when General Peel left office, in the summer of 1859, and was again brought under the notice of his successor, Lord Herbert, in August of that year.

After some consideration, the general principle of the scheme was sanctioned by Lord Herbert, in December, 1859; but no immediate steps were taken for carrying the plan into operation. At the end of 1860, however, the Council were directed to draw up a detailed scheme of organization for the College, on the assumption that all candidates for commissions in the Cavalry, Guards, and Infantry, would be required to pass through a year's course of instruction there; a vote was also included in the estimates of 1861 for commencing the enlargement of the buildings, with the ultimate object of providing accommodation for 600 cadets. The details of the scheme were, after some correspondence, fully matured, and were on the point of being submitted to Her Majesty for approval, with the view of the new system coming into effect on the 1st of January, 1862. The plan, however, met with very great opposition, both in the House of Commons and from the authorities of the universities, who regarded it as necessarily leading to the exclusion of university men from the army. In consequence of this opposition, the Under-Secretary of State for War, toward the end of the session of 1861, announced, in the House of Commons, that the new system should not come into

operation until Parliament had had a further opportunity of expressing their opinion upon it. The original plan was also so far modified that the extension of the College was limited to providing accommodation first for 500, and then for 400 cadets, in the first instance; but the abolition of appointments to direct commissions, and the system of passing all candidates for commissions in the Line through the College, were still contemplated, though the commencement of the system was deferred until the 1st July, 1862.

The question was in this state at the time of the death of Lord Herbert, in August, 1861. Sir George Lewis, who succeeded him as Secretary of State for War, having, during the recess, reconsidered the question, announced, shortly after the commencement of the session of 1862, that it had been determined to abandon the idea of requiring all candidates for commissions in the Line to pass through the College, and that the system of appointments to direct commissions by purchase would be maintained. At the same time, it was proposed that *non-purchase* commissions should in future only be obtained by passing through Sandhurst, and that an enlargement of the College to 336 cadets should take place, to provide for the increased number of non-purchase commissions caused by the amalgamation of the Indian with the Imperial Army.

Even in this modified form, the plan for the extension of the College appears to have been viewed with considerable jealousy by the House of Commons. A vote adverse to it was actually at first carried; but the question having, in consequence of the representations of Sir George Lewis, been reconsidered, the plan proposed by the Government was at length agreed to. Regulations for the College on the new footing were issued on the 1st May, 1862. These regulations form the basis of the present system of the College.

One of the most important changes made at this time was the great increase in the number of free commissions placed at the disposal of the College. Under the old system which existed prior to 1858, while the institution was still a mere place of juvenile education, all cadets who passed in the six "steps," to which allusion has been made, received free commissions; but there was, strictly speaking, no competition for such commissions. After the alteration in the age of admission to the College, and the general revision of the course of

instruction which took place in 1858, a limited number of free commissions were bestowed upon those cadets who stood highest in the final examination. A large number of these appointments, however, still remained in the gift of the Commander-in-Chief, and were granted to candidates who passed the ordinary examination for direct commissions. Since 1862, all non-purchase commissions have been reserved for cadets at the Royal Military College, with the exception of a small number (not exceeding on an average 12 annually) bestowed upon non-commissioned officers promoted from the ranks, and upon gentlemen who have held the appointment of page to Her Majesty. The commissions given to the latter are exclusively in the Foot Guards, and their number seldom exceeds one in each year. The free commissions allotted to the College are thrown open to competition among the cadets, with the exception of those reserved for Queen's and Indian cadets. Both of these classes of cadets have, since the institution of Indian cadetships, which took place simultaneously with the change of the College system, in August, 1862, been entitled to receive free commissions on passing a qualifying examination at the end of their term of residence.

The course of study at the College was, at the same time, considerably modified, with the view of allowing its completion, under ordinary circumstances, in one year, instead of two years, as formerly,—the maximum term of residence being fixed at a year and a half. An attempt was also made to render the course more strictly professional, and better adapted to qualify a young officer for the performance of ordinary regimental duties immediately on joining his corps, by the introduction of instruction in military law, interior economy, etc.

The age of admission was fixed at 16 to 20 for candidates for the Infantry, and 16 to 22 for those for the Cavalry,—an extension of a year in these limits being for the first time introduced in favor of students at the universities. A further privilege held out to the latter class of candidates was that, while others could only obtain admission by competitive examination, the fact of having passed certain university examinations was of itself made a qualification for admission. These concessions, which, at first, were made to the Universities of Oxford, Cambridge, and Dublin, have been since extended to the other universities.

The number of cadets was never raised to the extent contemplated in the plan proposed by Sir George Lewis. It was originally intended that the College should accommodate 336 cadets, divided into four companies of 84 each; but the establishment was ultimately fixed at 250. This increase, however (the numbers having, previously to 1862, been 180), led to the addition, in August, 1862, of a third company to the two in which the cadets had been previously divided. An additional captain was appointed to command this company, and, at the same time, three subaltern officers (one to each company) were, for the first time, added to the strength of the establishment, to assist the captains in the charge of the companies. Simultaneously with this, an important alteration was made in the discipline of the College, by abolishing the system which had hitherto prevailed of employing the sergeants to assist in maintaining discipline by reporting the cadets for offences committed against the regulations.

The increase in the establishment also necessitated in this year an augmentation of the staff of instructors.

The establishment of the Royal Military College in 1863, after the change of system had come into effect, was as follows:

General Staff.—1 Governor, 1 Chaplain, 1 Paymaster, 1 Quartermaster, 1 Surgeon, 1 Assistant-Surgeon, 1 Riding Master.

Staff College.—1 Commandant, 1 Adjutant, 9 Professors, 30 Students.

Cadet College.—1 Lieutenant-Governor, 1 Major and Superintendent of Studies, 3 Captains of Companies, 3 Subalterns, 250 Gentlemen Cadets, 1 Adjutant, 40 Professors and Instructors, of whom two were employed also at the Staff College.

The organization of the College has undergone no material alteration since 1863, with the exception of the abolition of the office of Lieutenant-Governor, and the substitution for it of that of Commandant of the Cadet College. The change, though decided upon in 1862, was not carried out during the tenure of office of the officer who, at that time, held the appointment of Lieutenant-Governor, and did not actually take effect until 1864. The Lieutenant-Governor, though nominally the deputy of the Governor, had exercised no control over the Commandant of the Staff College from the time of the institution of the latter establishment, in 1858. His functions were limited to the Cadet College, of which he was virtually, though not nominally, the Commandant.

The establishment of cadets was raised in 1865 to 300, and

some slight alterations have, at various times, been made in the number of professors and instructors; but, in its general character, the establishment at the present time remains as it was in 1863.

The modifications which have since been made consist chiefly in the reduction of the higher limit of age for admission to 19 for all branches of the service (retaining, however, the former exception in favor of students from the universities); the discontinuance of the study of military law, etc.; and the extension of the ordinary course of residence from one year to a year and a half.

In regard to discipline, the system of assigning marks for good conduct, which was introduced by the regulations of 1862, has been discontinued, owing to practical difficulties which were found to occur in carrying out the system with uniformity. At the beginning of 1868, an alteration was introduced in the powers of the professorial staff with regard to the maintenance of discipline. Previously to this period they had exercised no disciplinary powers; they have since been required to take notice of all offences which come within their cognizance, either in or out of study, and have been empowered to place a cadet in arrest pending an inquiry into the offence. Even at the present time, however, the professors have no power of punishment, this power being confined to the military staff of the College.

According to the Royal Warrant of 1808, the four companies of cadets were placed upon the establishment of the army, and every one admitted to the College received a warrant of gentleman cadet, with the daily pay of 2*s.* 6*d.* Down to the year 1857, the regulations for admission to the College contained the provision that, "in conformity to the Royal Warrant, dated the 27th of May, 1808, all gentlemen cadets at the Royal Military College are subject to the Articles of War." This provision appears to have been omitted from all regulations published on the recommendation of the Council of Military Education since the reorganization of the College, which took place at the beginning of 1858. At the present time, a cadet, on admission, is required to sign a declaration "to conform, in every respect, to Her Majesty's Regulations, and to the rules and discipline of the service."

The Board of Commissioners, at the time of the report of

the Select Committee of the House of Commons, in 1855, still continued to administer all the affairs of the Royal Military College, in virtue of the wide powers vested in them by the Royal Warrant of 1808. For some years previously to this, however, the War Office had exercised considerable control over the financial acts of the Board. On the appointment of the Council of Military Education, in 1857, the latter body began to superintend the course of instruction at the College, their attention having been directed to this subject in the first instructions issued to them on their appointment. At the beginning of 1858, they commenced to conduct the examinations for admission, and, by a Royal Warrant of the 1st October, 1858, they were formally appointed Visitors of the College, and required to report to the Commander-in-Chief upon the instruction given at it. The power of recommending either the appointment or removal of the professors and instructors was, by the same warrant, placed in their hands.

The original warrant of 1808 has never been cancelled, and the powers vested by it in the Board of Commissioners still, therefore, nominally remain in force, except so far as by the warrant of 1858. Since this time, however, the connection of the Commissioners with the management of the College has been gradually diminished. In 1863, the office of Secretary to the Board was abolished, his financial duties being transferred to the Paymaster of the College, and the performance of his other duties being provided for in the Commander-in-Chief's office. The discipline of the College still remains nominally under the superintendence of the Commissioners; but, even in regard to this point, their interference, except when questions of considerable importance have arisen, appears to have been little called for. Their duties of late years seem to have been principally confined to business connected with the management of the College property, in regard to which, although the estate is now formally vested in the Secretary of State for War, the former powers of the Commissioners are reserved.

The attendance in the College, since its reorganization, has been as follows, viz.:

1855	180
1862	250
1865	300

Staff of Government and Instruction, 1871-2.

President.—Duke of Cambridge, Field Marshal.
Vice-President.—Rt. Hon. Edward Cardwell, Secretary of War.
Governor.—Lt.-Gen. Sir D. A. Cameron.
Assistant.—Col. J. E. Addison.
Paymaster.—Major Oliver Nicolls.
Chaplain.—Rev. E. J. Rogers, M.A.
Quartermaster.—John Davies.
Surgeon.—A. McLean, M.D.
Assistant Surgeon.—John Greig, M.D.
Riding-Master.—Capt. C. C. Brooke.

CADETS' COLLEGE.

Adjutant.—Major W. Patterson.
Captains of Companies of Gentlemen Cadets.—Lt.-Col. W. R. Farmar, Lt.-Col. Alfred P. Bowlby, Capt. H. E. Couper.

Staff of Instruction.

Mathematics and Arithmetic.—Rev. J. W. Vintner, Rev. Alfred Deek, G. Hester, J. P. Ketley.
Fortification.—Capt. G. Phillips, Lt. E. D. C. O'Brien, Capt. H. L. Mitchell.
Military Surveying.—Capt. W. Paterson.
Military History.—Capt. E. M. Jones.
Military Drawing.—Capt. E. A. Anderson, Capt. C. W. Fothergill, Capt. R. L. Leir.
Landscape Drawing.—Robert Harley.
French Language.—J. Balagué.
Geology.—T. R. Jones.
Chemistry.—Edm. Atkinson, Ph.D.

STAFF COLLEGE.

Commandant.—Col. E. B. Hamley, C.B.
Adjutant.—Major A. S. Jones.

Professors and Instructors.

Mathematics.—Rev. J. F. Twisden, T. Savage.
Military History.—Major C. Adams.
Fortification and Artillery.—Capt. H. Schaw.
Military Topography.—Major S. B. Farrell, Royal Engineers.
Military Administration.—Capt. W. Walker.
French.—A. A. De Charente.
German.—Dr. Overbeck.
Hindustani.—J. Dowson.
Military Drawing.—Capt. E. A. Anderson.

QUEEN'S AND INDIAN CADETSHIPS.

THE creation of Queen's cadetships originated in the recommendations of the select Committee of the House of Commons on Sandhurst. At the time the Committee reported (in the year 1855) the age of admission to Sandhurst was from 13 to 15; in the following year, however, at the time the recommendations of the Committee were adopted by the Government, it was in contemplation to raise the minimum age for admission to the College to 16; and it was consequently decided that, in order to meet the case of those who under the former regulations would have been admitted as Queen's cadets at a younger age, a special allowance of 40*l.* a year might, at the discretion of the Secretary of State, be granted to a candidate qualified for a Queen's cadetship, at the age of 13, to assist him in his preparatory education, until he attained the age at which he would be eligible for admission to the College. This arrangement was sanctioned by the Treasury in 1856, and at first the results of the recommendations of the Select Committee seem to have been confined to granting candidates the special allowance in aid of their preparatory education, as no cadet entered until 1860.

The first public announcement of the institution of Queen's cadetships, and of the regulations under which they were to be granted, was made by a General Order, dated Horse Guards, 5th January, 1858. It had by this time been finally determined to fix the ordinary minimum age for admission to Sandhurst at 16; but an exception was made in favor of the Queen's cadets, who were to be admitted one year younger,—at the age of 15. The following were among the regulations:

These cadetships, of which there are twenty in all, are confined to the sons of officers of the army, Royal navy, and Royal marines, who have fallen in action, or have died of wounds received in action, or of diseases contracted on active service, and who have left their families in reduced circumstances.

Gentlemen cadets on this class are educated gratuitously.

The nominations, with the concurrence of the Secretary of State for War, are made by the Commander-in-Chief for the army, in the proportion of 15 cadetships, and by the First Lord of the Admiralty for the navy and marines, in that of five cadetships,—to whom applications are to be made.

No candidate can be admitted under the age of 15, nor above that of 17.

In a case where the services of the father and the circumstances of the family are deemed such as to constitute a claim, a candidate ineligible for immediate admission, on account of his not having attained the proper age, but being a promising youth, may, at the discretion of the Secretary of State for War, be allowed an addition to the compassionate allowance, with the especial view of promoting his education, until he is eligible for admission.

The regulations under which Queen's cadets are at present nominated are similar to the above, with the exception that

the wording of the phrase "diseases contracted on *active service*" has been altered to "diseases contracted on *service abroad*," and that Queen's cadets, like other candidates, are not now admitted until the age of 16. An addition to the "Compassionate Allowance," not exceeding 40*l.* a year, may at the same time be granted to a candidate after the age of 13, in order to assist him in his education until he becomes eligible for admission to the College. The number of Queen's cadetships (20) includes both those who have entered, and those to whom the educational allowance is granted previously to their admission.

From the first institution of Queen's cadetships, the candidates nominated to them have been admitted to the College on passing a qualifying examination, and have received a gratuitous education; they were, however, originally required to compete for commissions without purchase, with other candidates, at the end of the College course. The privilege of obtaining a free commission on passing merely a qualifying examination was not extended to them until the institution of the Indian cadetships in 1862. As it was found necessary to exempt the Indian cadets from competition with other candidates for commissions without purchase, a similar privilege was extended to the Queen's cadets. Both classes of cadets, in addition to their free education and maintenance, receive clothing and pocket money.

The institution of Indian cadetships at Sandhurst took place in consequence of the transfer of the government of India from the East India Company to the Crown, and the subsequent amalgamation of the Indian and Imperial forces.

The notice of the admission of Indian cadets to the establishment appears for the first time in the College regulations of 1st May, 1862. Their number, like that of the Queen's cadets, is limited to 20. They are nominated, under the provisions of Acts 21 & 22 Vict. cap. 106, s. 35, and 23 & 24 Vict. cap. 100, by the Secretary of State for India in Council, from the sons "of persons who have served in India in the military or civil services of Her Majesty or the East India Company." The restrictions, however, regarding the death of the father and the circumstances of the family, which apply to a candidate for a Queen's cadetship, do not limit the nomination of Indian cadets. The expense of the education and maintenance of the latter is borne by Indian revenues.

REGULATIONS FOR ADMISSION, CLOTHING, BOOKS, PAYMENTS, ETC., 1867.

1. Candidates for vacancies at the Royal Military College, Sandhurst, will be required to undergo an examination under the superintendence of the Council of Military Education. Examinations for this purpose will be held in June and December of each year, at the Royal Hospital, Chelsea.

2. Twenty Queen's cadets will be borne on the establishment, being the sons of officers who have fallen in action, or have died of wounds received in action, or of diseases contracted on service abroad; and who have left their families in reduced circumstances. Fifteen will be sons of officers of the army, and five will be sons of officers of the Royal Navy and Royal Marines.

There will be, in addition, twenty Indian cadetships, for nomination to which the sons of persons will be selected who have served in India in the military or civil services of Her Majesty, or of the East India Company.

3. Candidates, whether for the infantry or the cavalry, must be between 16 and 19 years of age at the commencement of the term immediately succeeding their admission examination.

Terms commence on the 1st February and 1st August.

Students from the Universities will be admissible at the ages stated in Art. 11 of these regulations.

4. Every candidate for admission must apply (if under age, through his parent or guardian) to the Commander-in-Chief, to have his name entered on the list of candidates.

5. He must transmit with his application the following documents, viz.: (*a*) An extract from the register of his baptism, or, in default of that, a declaration before a magistrate, made by one of his parents, giving his exact age. (*b*) A certificate, from the minister of the Church or denomination to which he belongs, of his having been duly instructed in the principles of the Christian religion.

6. His name having been placed upon the list of candidates, it will be open to him to offer himself at any of the half-yearly examinations which may occur while he is within the prescribed limits of age. If unsuccessful in obtaining one of the vacancies at the college, he will be allowed to present himself at any subsequent examination until he has exceeded the maximum age. After he has exceeded the maximum age, he can only be admitted into the army on obtaining a direct commission by purchase, in the usual manner, after passing a qualifying examination.

7. He will be examined by a medical officer, who will ascertain whether he is free from all bodily and organic defects, and whether, as far as regards physical constitution, he is in every point of view fit for military service.

8. The following will be the subjects of examination, but no candidate will be allowed to be examined in more than *five* of these subjects:

	Marks.
Classics: Latin, 2,000; Greek, 1,600,	3,600
Mathematics,	3,600
English language,	1,200
Modern languages, each,	1,200
History, with geography,	1,200
Natural sciences (*i. e.*, mineralogy and geology),	1,200
Experimental sciences (chemistry, heat, and electricity),	1,200
Geometrical drawing,	600
Free-hand drawing,	600

Of the above subjects, the elementary portions of mathematics and the English language are obligatory on each candidate.

The following elementary branches will be included in the obligatory section of mathematics, viz.:

In arithmetic: vulgar and decimal fractions, proportion, extraction of the square root, and interest.

In algebra: fractions, simple equations, and questions producing them.

In Euclid: the first three books.

To these elementary branches 1,200 marks (out of the whole 3,600 for mathematics) will be allotted, and it will be necessary for qualification that at least 400 be obtained, of which 200 must be obtained in arithmetic.

In the English language 400 marks will be allotted to correct and legible writing from dictation, and to composition; and of these it will be necessary for qualification that 200 be obtained.

Out of the remaining subjects the candidate may select any three.

No candidate will be allowed to count the marks gained in any of the three voluntary subjects, unless amounting to one sixth of the whole number of marks allotted to that subject; and for qualification he will be required to obtain on his five subjects a total of 1,500 marks.

No marks will be allowed to count in any subject left optional to the candidate, unless he gain at least one sixth of the whole number allotted to that subject.

9. Every candidate will be required to forward to the Military Secretary, Horse Guards, one month before the examination, a statement of the subjects he desires to take up, as well as a certificate from the master or tutor under whom he has been educated, of his general moral conduct for at least the two preceding years. If a candidate has failed in a previous examination he will only be required to forward a list of the subjects he selects, and a certificate of conduct between the two examinations. These documents are under no circumstances to be transmitted before the date above specified.

10. After the examination the candidates will be reported to the Commander-in-Chief in the order of their merit, and will be appointed accordingly as far as vacancies will allow.

11. Candidates who have passed the examinations called "responsions" and "moderations" at the University of Oxford, or those called "previous examinations" at the Universities of Cambridge and Dublin, or the matriculation examination of the University of London; or any one of the three examinations required for the degree of M.A. at the Universities of St. Andrew's and Glasgow; or the "class examination of the second year" (Curriculum of Arts) at the University of Aberdeen; or the "preliminary examination" at the University of Edinburgh; or the "first University examination" of Queen's University, Ireland, will be considered as qualified for admission to the Royal Military College without further examination.

Candidates from the Universities must not be more than 21 years of age for the infantry, nor more than 23 years for the cavalry. They will be required to send to the Military Secretary, Horse Guards, two months before the commencement of the term at which they desire to enter, certificates from the responsible authorities of their college of general moral conduct during residence at the University, and of having passed the above-mentioned examinations, together with the certificate of age, as required by clause 5

Should the number of general candidates be considerably in excess of the number of vacancies at the college, a suitable portion of those vacancies will be offered to the University and to the competing candidates respectively.

12. Candidates for admission as Queen's cadets must apply for a nomination to the Commander-in-Chief, if the sons of officers in the army; or to the First Lord of the Admiralty, if the sons of officers in the Royal navy, or Royal marines. The above nominations will be made by the Commander-in-Chief or First Lord of the Admiralty, with the concurrence of the Secretary of State for War. The Secretary of State for India in Council will nominate to cadetships for the Indian services.

Provision of Necessaries, Books, Contributions, etc.

13. Every gentleman cadet will receive from the Military Secretary a list of the articles of clothing, books, and instruments with which he must provide himself before joining the college, and which he will be required to keep complete during his residence.

Any other books, instruments, or drawing implements that he may subsequently require for the prosecution of his studies, will be provided at the college, and charged to his account.

14. The amount of contribution for education, board, washing, and medical attendance, on account of each cadet, per annum, is as follows:

a. For sons of private gentlemen, - - - -	£100
b. For sons of admirals, and general officers having regiments or receiving Indian colonels' allowances, -	80
c. For sons of general officers, - - - -	70
d. For sons of captains and commanders of the Royal navy, and field officers of the army having substantive rank, - - - - - -	50
e. For sons of all officers of the royal navy and army under the above rank, - - - - -	40
f. For sons of officers of the royal navy and army who have died in the service, and whose families are proved to be left in pecuniary distress, - -	20

g. Queen's cadets and cadets nominated by the Secretary of State for India in Council, - - - Free.

15. General officers on the non-effective list will pay according to their last substantive rank.

Officers who have sold their commissions are, in this classification, reckoned as private gentlemen.

The cases of officers who have retired voluntarily upon half-pay previous to having served twenty-five years on full pay will be specially considered.

Officers who retire on half-pay after twenty-five years' service on full pay will be classified for payment with the rank in which they last served.

16. The orphans of officers whose claims do not come under classes *f*. and *g*, must contribute according to the substantive rank last held by their fathers.

17. For sons of officers who have retired on *full* pay, the payments will be according to the substantive rank last held by their fathers.

18. The sons of officers of civil departments having relative rank with officers of the army and navy, of the permanent militia staff, and of adjutants of the volunteer force, are admissible to the college on the same terms as those prescribed for the sons of army and navy officers of corresponding rank.

19. The sons of Indian naval and military officers not specially nominated by the Secretary of State for India will be admitted on the same terms as the sons of officers of the Queen's service.

20. Contributions for the sons of professors at the Staff and Cadet Colleges, at the Royal Military Academy, and at the late Indian Colleges, Addiscombe, will be - - - - - - - - - - £50

For the sons of masters at the above institutions, - - - 40

21. Any change which may take place by promotion or retirement in the rank of the father of a cadet must be immediately notified to the Military Secretary, in order that the contribution paid to the college on account of such cadet may be regulated accordingly.

22. *Previously* to the admission of a cadet (not a Queen's cadet) he, or if a minor, his parent or guardian, will be required to make the following payments, viz.:

1. His contribution for half a year.
2. The sum of 15*l*. for his first equipment of uniform clothing.
3. The sum of 10*s*. for the support of the company reading-rooms.
4. A deposit of 15*l*. on account, for contingent expenses.

23. The above sums are to be paid to the paymaster of the College.

24. For each succeeding half year the regulated contribution is in like manner to be paid in advance, to the paymaster of the college, to whom must also be remitted the sum of 5*l*. for the further provision of uniform clothing, and such sum as may be required to make up the contingent deposit to 15*l*. The amount of this balance will be shown by an account, rendered at the end of every half year, of the sums paid out of the deposit during the past term.

25. No cadet on whose behalf these regulations in regard to payments have not been complied with, will be received at the college.

26. No refund of contribution will be made for any portion of the half year in which the cadet may be removed from the establishment, without the special sanction of the Secretary of State for War.

27. No payments will be required from Queen's or Indian cadets.

28. If a cadet be rusticated during a term, his contribution for the half year will be forfeited.

29. If absent a whole term in consequence of rustication or sickness, a contribution of 10*l*. will be required for the privilege of his name being kept on the rolls of the establishment, and for a vacancy being guaranteed at the commencement of the next term.

30. If absent from sickness during any portion of a term, a refund of that portion applicable to subsistence will be permitted.

31. In the cases of cadets of the orphan class, whose annual contribution is only 20*l*., the amount to be paid when the absence extends over a whole term will be submitted to and determined by the Secretary of State.

32. Every gentleman cadet will be supplied with a weekly allowance of pocket money, at the discretion of the commandant of the college; but this allowance will not exceed 4*s*. 6*d*. a week for a gentleman cadet who is a responsible under officer, 4*s*. a week for a gentleman cadet who is an under officer, 3*s*. 6*d*. a week for a gentleman cadet who is a corporal, and 2*s*. 6*d*. a week for all other gentlemen cadets. The expense of this allowance will be de-

frayed out of the amount deposited for the purpose of meeting contingent expenses, and in the case of Queen's or Indian cadets it will be borne by the public.

Discipline.

33. All gentlemen cadets are subject to such rules and regulations as are, or may be from time to time, established for the maintenance of good order and discipline.

34. Every gentleman cadet will be liable to be removed from the college at any time should his conduct be such as to render it obvious that his remaining would be either hurtful to the institution or unprofitable to himself.

35. To every cadet will be assigned, at the commencement of each term, 100 marks for conduct.

From this number deductions will be made in certain authorized proportions for every offence which shall have been met by a punishment of more than two days' drill.

Should the cadet forfeit more than three-fourths, or 75 of the above 100 marks, he will not be gazetted to his commission until all other gentlemen cadets of the same batch shall have been provided for; and should he lose all his marks for conduct he will be rusticated for one term.

36. Gentlemen cadets are strictly prohibited from contracting debts with any publican or tradesman in the vicinity of the college.

37. No perquisites or presents of any kind are to be received by any person belonging to the college from either the gentlemen cadets or their friends.

38. Gentlemen cadets will not be allowed to remain at the college during the vacations without the special sanction of the Secretary of State for War, on satisfactory proof being shown that they have no friends in the United Kingdom to whom they could go. Payment of 1*l.* 1*s.* a week will be required in such cases from those who are not Queen's cadets.

Termination of the Course, and removal from the College.

39. The course of study is calculated for a residence of three terms, or 18 months, reckoned from the commencement of the term in which a gentleman cadet may join. It is open, however, for any cadet, who at the end of his first term shall have proved himself qualified for promotion at once to the third term classes, to compete for a commission without purchase, or to be examined for a commission by purchase, at the end of his second term; but no fourth term will be allowed on any plea but that of long continued sickness, in which case special application must be made to the Commander-in-Chief, accompanied by an opinion from the surgeon of the college.

Gentlemen cadets allowed a fourth term will not be permitted to compete for commissions without purchase.

40. Examinations for commissions will be held periodically. The number of commissions to be given without purchase will be announced previously to the examination. These will be competed for and awarded to the candidates who are first in order of merit.

41. Candidates who have not succeeded in obtaining a place amongst those to whom commissions without purchase can be awarded, but who have obtained the minimum number of marks required for qualification, will be considered to have prior claims to all other candidates for commissions by purchase.

42. Queen's and Indian cadets will receive commissions without purchase on passing the qualifying examination. The names of those who distinguish themselves equally with competitors for commissions without purchase will be published in the same lists with the latter.

43. In every case a certificate of conduct and proficiency in military and athletic exercises will be required from the governor of the college before a cadet can be examined for his commission.

44. Any gentleman cadet desirous of entering the Royal Artillery or Royal Engineers will be permitted, if otherwise eligible, to offer himself as a candidate at any of the competitive examinations for admission into the Royal Military Academy at Woolwich; and his position at the Royal Military College will not be affected by his failure at such examination.

45. No gentleman cadet will be allowed to present himself at a direct commission examination during his residence at the Royal Military College.

46. No gentleman cadet is to be removed from the college without the permission of the Commander-in-Chief, obtained through the governor of the

college. And when a parent or guardian intends to withdraw a cadet, or, if of age, the gentleman cadet intends to leave the college at the end of a term, at least six weeks' notice of his intention is to be given to the governor. In default of such notice a quarter's subscription must be paid.

Miscellaneous.

47. The establishment for Queen's cadets having been sanctioned by Parliament when the age of admission to the Royal Military College was from 13 to 15 years, it has been decided that in any case when the services of the father and the circumstances of his family are such as to constitute a claim, an addition of not more than 40*l.* a year to the "compassionate allowance" may, at the discretion of the Secretary of State for War, be allowed to a candidate who is over 13, to enable him to complete his preparatory education, as he is ineligible for immediate admission into the college in consequence of the minimum age of admission having been raised to 16.

48. It is desirable that every candidate who is under 21 years of age should, at his admission, be accompanied by his parent, guardian, or some other responsible person, to satisfy the requirements of the college on his behalf.

49. The responsible parent or guardian of every successful candidate, and the candidate himself, before he can be admitted as a cadet, will be required to sign respectively the following declarations:

Declaration by Cadet.

"I ————————————, do hereby declare that I have attentively considered the regulations for admission to the Royal Military College, and I consent to abide by the same in every particular, as well as to observe and follow all such orders and directions as I shall from time to time receive from the governor, the commandant, or other officers or authorities of the Royal Military College. And I further hold myself bound to conform, in every respect, to Her Majesty's regulations, and to the rules and discipline of the service."

(Signature)————————————

Declaration by the Parent or Guardian.

"I hereby declare that I consent to the admission of my (son or ward) to the Royal Military College, on the foregoing conditions."

(Signature)————————————

Subjects of the Final Examination.

	Max. allowed to count.	Min. allowed to count.	Min. required for Qualification.
50. Field fortification and elements of permanent fortification, including preparatory course of practical geometry,	1,800	450	1,200
Military drawing and surveying,	1,800	450	
Military history and geography,	1,800	450	

	Max. allowed to count.	Min. allowed to count.
Mathematics:		
First Section.—Arithmetic: algebra, up to simple equations; Euclid, four books, use of logarithmic tables, elementary problems in heights and distances, and mensuration,	1,200	300
Second Section.—Euclid, Books V., VI., and XI. (propositions 1-20), higher algebra, plane trigonometry, and mensuration,	1,200	—
Third Section.—Practical mechanics and hydrostatics,	1,200	—
Higher fortification,	600	300
French,	1,200	300
German,	1,200	300
Chemistry,	1,200	300
Geology,	1,200	300
Free-hand drawing,	600	150

In order to qualify for a commission, every gentleman cadet will be required to obtain 1,950 marks in th obligatory section of fortification, military drawing and surveying, military history, the first section of mathematics, and one foreign language; of which number of marks 1,200 must be gained in the three *military* subjects before specified.

SUBJECTS AND COURSE OF INSTRUCTION.

The studies of the college are mathematics, fortification, military drawing and surveying, military history and geography, and one modern language (either French or German), which are obligatory on all cadets, and, in the final examination 1,950 marks (out of 5,400 required), with a certificate of proficiency in military and athletic exercises, are required to qualify for a commission. To these studies are added chemistry or physics, geology, and a second modern language.

For educational purposes, the cadet corps is divided into three companies, designated A, B, C, each company pursuing the same subjects at the same time, with a classification of members into sections, according to the results of the minor and term examinations. The minor examinations take place every six weeks, and the term examinations every six months, and the final examination at the close of the course, which occupies three terms of six months each. The final examination is conducted by examiners attached to the Council of Military Education. The final result, as bearing on a commission, is reached by adding the marks as determined by the average of the minor and term examinations, and the answers of the final examination.

The instruction is given in halls of study, of which there are 18, large enough to accommodate, each, 18 cadets, but generally occupied by 15. The lecture hall will accommodate 100 without crowding.

1. *Mathematics*, elementary for all sections, including arithmetic, algebra up to simple equations, euclid, the use of logarithmic tables, elementary problems in heights and distances, and mensuration; and higher in the third section, including trigonometry and practical mechanics and hydrostatics, occupies 21 hours a week during the entire residence. To this branch is assigned a professor, one senior master, and three other masters. To the highest proficiency in mathematics is assigned a maximum of 1,200 marks, and a minimum of 300 is allowed to count.

2. *Fortification* includes field and the elements of permanent fortification, with a preparatory course of practical geometry. To this study, which occupies three hours every day, or 18 hours per week, are assigned six professors, and to the highest

proficiency is awarded a maximum of 1,800 marks, with a minimum of 450. Field fortification is taught in the first two terms, plan drawing and practical work going on together. The cadets trace and execute portions of fieldworks, making and planting revetement, gabions, and fascines, and doing all but the heavy work, which is left to the sappers. They are also instructed in bridge making and in pontooning, and witness every species of work done in the hall, on the fortification ground.

3. *Military Surveying and Drawing* occupy together 17 hours, under 12 professors. The cadets commence by drawing from copies, then from models, being in the meantime also taught the use of instruments; then in six weeks after joining the corps, they are taken out to triangulate with the prismatic compass and pacing, and traverse roads. The former practice with the theodilite and sextant has been abandoned, and the whole instruction has been concentrated on the art of field sketching as of more importance to an infantry officer. To the highest proficiency in this subject is given 1,800 marks, and a minimum of 450 is allowed to count in the final result. In the final examination the candidate for a commission must obtain at least 1,200 marks in the above subjects.

4. *Military History and Geography* is under the charge of one professor and two instructors. The present course is to give instruction by lecture, in the organization and mode of action of the three arms, and explanation of the operation of the commissariat and transport department of an army, followed by a short and simple campaign. In the second half-year, two campaigns are selected, with a view to illustrate the generally received principles of tactics and strategy, and in the third half-year one campaign is thoroughly worked out in detail. The cadets take notes of the lecture, on which they are examined orally, and after the main propositions and facts are printed by the professor, a subsequent study and examination on the printed scheme is had. In this study the cadets draw plans of the theatre of war and of battles, showing the position of the opposing forces.

5. *Languages*, French and German,—the former with one professor and three masters, and the latter with one master. The usual course in either language is grammar, exercises, dictation, translation, and composition. To the highest pro-

ficiency in either, 1,200 marks are assigned, and a minimum of 300 is allowed. One of these languages is obligatory in the final examination, but the candidate can be examined in both. The cadets can change from one language to the other at the beginning of the term.

6. *Chemistry* (including sound, heat, electricity, and magnetism) and *Geology* (including mineralogy and physical geography) occupy each a half hour four days in the week, and employ part of the time of two professors.

7. *Freehand or Landscape Drawing* receives two lessons per week, first from copies and models, and in the third term one lesson per week from nature. To the highest proficiency is assigned 600 marks, and a minimum of 150 is allowed.

8. *Military exercises* enter into the programme for the day, and consist of gymnastics for the first term, gun-drill and riding (one lesson per week) in the second term, and two lessons in the last exercises for the third term. Parade and infantry drill occupy, in addition, half an hour before breakfast, and 50 minutes between the first and second period of study in the morning (9.30 and 10.50).

For qualification a cadet must obtain an aggregate of 1,200 marks out of 5,400 on the three military subjects, and a total aggregate of 1,950 of these. Similar proportions of marks must be obtained each term that the cadet may return in the following term.

RESULTS OF EXAMINATIONS.

Out of 2,399 admission examinations in eleven years, from 1858 to 1868, 444 were unsuccessful; and in the final examinations, in the same period, out of 1,726, 25 failed. The results of the examinations show better preparation from year to year.

EXPENDITURES.

The expenditures of the government, on account of the Military College, were as follows: for 1858–9, £27,969; for 1863–4, £39,690; for 1866–7, £36,416, exclusive of payments made by the cadets or by the Indian government, which, in 1866–67, was £4,237.

ROYAL MILITARY ACADEMY AT WOOLWICH.

HISTORICAL NOTICE.

The Military Academy at Woolwich was instituted by George II. in 1741, to give instruction to officers who served in the Artillery and Engineers. It began in a small room in a building at Woolwich, where the Board of Ordnance used occasionally to assemble, under the instruction of two masters, who lectured by rotation during four consecutive hours in three days of every week. At first only the officers of the single battalion composing the Artillery, and of the corps of Engineers, were required to attend. In the second year non-commissioned officers, and privates too, were at liberty to attend, and upon its close cadets, to the number of five to each company of artillery, resorted to the hall. Being sons of officers of the corps, and not in uniform or under military control, the cadets became an element of disorder, which led to a more systematic organization. In 1744, the cadets were clothed in uniform, and collected into a distinct company, under two officers, with a drum-major. By 1782, the number of cadets had increased from twenty to sixty, and in 1798, to one hundred,—boarding with their families. In the last year arrangements were made to lodge and board the cadets by allowing 2*s.* a day per head, until by degrees, in 1857, an imposing pile of buildings had been erected, and the establishment for government and instruction consisted of 18 officers on the military staff, and some fifty professors and masters in the civil and educational corps.

REGULATIONS FOR ADMISSION.

Previously to the year 1855 admission to the Royal Military Academy could only be obtained by a nomination from the Master-General of the Ordnance. The limits of age for admission were at that time from 14 to 16, and the candidates

nominated were required to pass an entrance examination before the professors of the Academy, which varied somewhat according to the age of the individual. A certain number of the candidates previously passed though the preparatory school at Carshalton, admission to which was equally obtained by nomination from the Master-General of the Ordnance, and were transferred to the Academy on passing an examination similar to that required from those who entered the latter establishment direct. The term of residence at the Academy varied, according to the progress of a cadet, from two to four years.

The inability of the Academy to meet the demand for officers for the Artillery and Engineers created by the Crimean war, led to the introduction of a new system of obtaining commissions in the scientific corps. At first a limited number of nominations were placed in the hands of the head masters of the great public schools of the country, and the candidates nominated by them were appointed to provisional commissions on passing an examination at Woolwich; but after a short time the principle of open competition for admission to the Artillery and Engineers was adopted, in 1855, by Lord Panmure, when Secretary of State for War. Simultaneously with this change—the first recognition of the competitive principle in regard to military education in this country—a great alteration was made in the limits of age for admission to the scientific corps. Both direct appointments to commissions in the Artillery and Engineers, without any previous special instruction, and admissions to the senior or practical class at the Academy, without passing through the lower or theoretical classes at that institution, were thrown open to public competition among all natural-born subjects of Her Majesty. The limits of age for candidates for the direct appointments were from 19 to 21. Those who were successful were in the first instance to receive provisional commissions, and to be placed for instruction under the Director of Artillery Studies, at Woolwich, for a period of about six months, at the end of which they were to be permanently commissioned. Candidates for admission to the practical class at the Academy were required to be between the ages of 17 and 19; those admitted were to remain in the practical class for six or eight months, after which, on passing an examination, they were to receive com-

missions in the Artillery or Engineers. The first competitive examination under this system (the regulations for which will be found below) was held in August, 1855, and was conducted by a body of examiners specially appointed for the purpose, under the direction of Canon Moseley. The examination for both classes of appointments thrown open to competition was the same, and was based on the general education of the country, the object being merely to compare the abilities and attainments of the candidates without reference to special professional knowledge. Two other similar examinations, both for provisional commissions and for admission to the practical class, were held in January and June, 1856, the only difference being that the limits of age of the candidates were somewhat extended, and that in these later examinations no commissions in the *Engineers* were offered to competition.

On the conclusion of the Crimean war, however, the system of appointing officers directly from civil life to commissions in the scientific corps, as well as that of admitting candidates to the practical class at the Academy, which had been adopted to meet the pressure of the war, came to an end. No other examination after that in June, 1856, was held for a year; but in June, 1857, the first competitive examination for admission to the ordinary course of instruction at the Academy took place. The limits of age for admission were fixed at 17 to 20, and it was announced that the successful candidates would remain under instruction at the Academy "until sufficiently advanced in scientific knowledge to pass a satisfactory examination."

Since this period open competitive examinations have been held regularly every six months for admission to the Academy; and though various modifications in their details have been made, their general character remains little altered. The limits of age for candidates, originally placed at 17 to 20, were, however, in 1862, reduced to 16 to 19, at which they are at present fixed.

The examinations for admission to the Academy, like those which had previously been held for provisional commissions and for appointments to the practical class, were at first conducted by Canon Moseley and a special Board of Examiners appointed by the Secretary of State for War, with whom the general management of the Academy, after the abolition of

the office of Master-General of the Ordnance, remained. In 1858, however, the superintendence of the system of instruction at Woolwich was transferred to the Council of Military Education, who, since July, 1859, have conducted the examinations.

Although the principle of open competition for appointments in the scientific corps was first recognized in 1855, and in 1857 was extended generally to admission to the ordinary course of instruction at the Academy, yet the system of competitive examination did not become the sole and universal means of admission to Woolwich until the year 1861. Time was required to clear off the vested interests of candidates who had been placed on the old nomination list of the Master-General of the Ordnance; of youths who had been admitted to the preparatory school at Carshalton; of cadets who, at the time of the proposed amalgamation of Sandhurst and Woolwich, had obtained admission to the former institution on the understanding that they would have the opportunity of obtaining commissions in the Artillery and Engineers; and, lastly, of cadets at the Indian Military College at Addiscombe, who, on the abolition of the local Indian army, were transferred to Woolwich before receiving commissions in the Royal Artillery and Royal Engineers.

Out of 3,085 admission examinations in eleven years, from 1858 to 1868, more than one-half (2,136) failed. Of those who entered after this trial, in the same length of time, only three failed to pass the final examination.

STAFF OF GOVERNMENT AND INSTRUCTION.

President.—Duke of Cambridge, K.G.
Governor.—Major General J. L. A. Simmons. K.C.B.
Secretary and Treasurer.—Bt. Major E. J. Bruce, R.Art.
Professor of Mathematics.—M. W. Crofton, B.A., and five masters.
Professor of Fortification.—Lt. Col. J. J. Wilson.
Instructors.—Major W. J. Stuart, and three others.
Professor of Military History.—Capt. H. Brackenburg, R.Art.
Professor of Military Drawing.—Lt. Col. A. W. Drayson.
Landscape Drawing.—William Clifton.
Professor of Artillery.—Lt. Col. C. H. Owen, and five masters.
Professor of Practical Geometry.—T. Bradley, and two masters.
Professor of German.—C. H. Schalble, and two masters.
Professor of French.—Theodore Karcher, and two masters.
Professor of Chemistry.—C. L. Bloxham.
Chaplain and Classical Instructor.—Rev. W. F. Short.

EXPENDITURE FOR MILITARY ACADEMY AT WOOLWICH:

In 1858, £27,969; in 1861-62, £25,188; in 1866-67, £36,416,—exclusive of payments made by the cadets.

REGULATIONS FOR ADMISSION.

N.B.—All candidates for commissions in the Royal Artillery and Royal Engineers are required to go through a course of instruction at the Royal Military Academy.

I. Competitive examinations for admission are held in London twice a year, in January and July. They are conducted by examiners appointed for the purpose, in the presence and under the superintendence of the Council of Military Education.

The candidates must be between 16 and 19 years of age.

II. The admissions will be determined by the result of the examination, the subjects of which will be as follows, viz. :

		Marks.
1. Mathematics	Pure { Section I. Arithmetic, algebra, Euclid, plane trigonometry, 2,000	3,500
	Pure { Section II. Spherical trigonometry, elements of co-ordinate geometry, and of the differential and integral calculus, 500	
	Mixed :—Statics, dynamics, and hydrostatics, 1,000	
2. English language and composition,		1,000
3. History of England, its dependencies and colonies,		1,000
4. Geography (modern),		1,000
5. Classics	Latin language,	1,500
	Greek do.,	1,500
6. French language,		1,000
7. German do.,		1,000
8. Hindustani do.,		1,000

The examination in French, German, and Hindustani, will include writing from dictation.

9. Experimental sciences, *i.e.*, chemistry, heat, electricity, magnetism,		1,000
10. Natural sciences, *i. e.*, mineralogy and geology,		1,000
11. Drawing	Free-hand drawing of machinery, architectural, topographical, landscape, or figure subjects,	1,000

Every candidate must qualify in geometrical drawing; *i. e.*, drawing in ink, with accuracy, neatness, and to scale, the several problems of Euclid. The standard of qualification in this subject is 100 marks, which must be gained out of a maximum of 300 nominally assigned to it. But the marks so gained will not count toward the general aggregate.

III. No candidate will be allowed to be examined in more than five subjects, of which one must be mathematics, and no one who does not obtain at least 700 marks in section I. of pure mathematics, will be eligible for an appointment.

From the other subjects of examination, to which marks are assigned as above, each candidate may select any, not exceeding four in number, in which he desires to be examined. The rules for counting marks in such subjects are as follows:

In all subjects carrying marks, except the 1st section of mathematics, in which 700 marks are required, one-sixth of the number allotted to each must be gained before they can be allowed to count.

In classics, the subject is divided into two sections as above, either or both of which the candidate may take up as one subject; but he will not be allowed to count the marks gained in either section unless they amount to one-sixth of the number allotted to it.

In either *French*, *German*, or *Hindustani*, every candidate will be required to obtain for qualification one-sixth of the maximum of marks, whether he takes it up as a subject in which he desires to compete or not.

It should be understood that, although only a small qualifying test has been imposed in respect to modern languages, a knowledge of them on admission will contribute greatly to a candidate's future success at the Royal Military Academy.

IV. The candidates are allowed to answer as many questions as the time allotted to the subject will permit.

V. No candidate will be admitted unless he obtain an aggregate of at least 2,500 marks.

VI. The successful candidates will remain under instruction for about two years and a half, or until they are sufficiently advanced in scientific knowledge to pass a satisfactory examination, and they will then be qualified to receive commissions in the Royal Artillery or Royal Engineers. If, however, they should be found unable to qualify themselves within three years in their professional studies, or to acquire a sufficient proficiency in military exercises, or if at any time, by failure at the half-yearly examinations, it should appear

improbable that they will ultimately succeed in qualifying for a commission, they will be removed. Further, every cadet will be liable to be removed temporarily or permanently on the commission of any of those offences to which such penalty is awarded by the regulations of the Royal Military Academy.

VII. Each cadet on joining will be required to pay a sum of 25*l.* to cover the expense of uniform, books, etc., and to bring with him the articles of clothing of which he will receive notice, and which must afterward be kept up at his own expense. He will also be required to pay a contribution of 62*l.* 10*s.*, payable in advance, for each half year of the time during which he remains under instruction; and a deposit of 5*l.* into the hands of the paymaster on account, for contingent expenses, which latter sum he will be required to make up on returning to the Royal Military Academy after each vacation, to cover any unavoidable expense that may be incurred on his account during the ensuing half year.

The annual contributions, however, for sons and orphans of naval and military officers will be regulated at the followig rates, as heretofore:

For sons of admirals and of generals having regiments,	£80
For sons of generals without regiments, - - -	70
For sons of captains and commanders of the navy, and of colonels and regimental field officers of the army, -	60
For sons of all officers of the army and navy under the above ranks, - - - - - -	40
For sons of all officers of the army and navy who have died in the service, and whose families are proved to be left in pecuniary distress, - - - -	20

The sons of general officers who are paid only on their commissions as field officers will pay the same contributions as the sons of field officers.

Officers who have sold their commissions are in this classification reckoned as private gentlemen.

The cases of officers who have retired voluntarily upon half pay previous to having served 25 years on full pay will be specially considered.

Officers who retire on half pay after 25 years' service on full pay will be entitled to be classified for payment with the rank they last served in.

The sons of officers of the civil departments of the army and navy, of officers of the permanent Militia Staff, and of adjutants of the Volunteer Force, are admissible to the Academy upon the same terms as those prescribed for naval and military officers.

The sons of Indian naval and military officers will be admitted on the same terms as the sons of officers of the Queen's service.

The sons of professors at the Staff and Royal Military Colleges, at the Royal Military Academy, and at the Royal Military College, Addiscombe, - - -	£60
The sons of masters at the above institutions, - -	40

If a cadet be absent a whole term in consequence of sickness or rustication, a payment of 10*l.* will be required for the privilege of his name being kept on the rolls of the establishment, and for a vacancy being guaranteed at the commencement of the next term.

If a cadet be absent from sickness during a portion of the term, his pay will continue to be issued and credited to his account; but no refund of the contribution will be permitted.

If rusticated during a term, the daily pay will cease from the date on which the cadet is sent away, and the contribution made for the half year will be forfeited.

In the case of a cadet of the orphan class, whose annual contribution is only 20*l.*, the amount to be paid when absence extends over a whole term is to be determined by the Secretary of State.

VIII. Any gentleman who wishes to present himself at one of the half-yearly examinations must send in his name to the military secretary at the Horse Guards one month before the time of examination, forwarding with his application to be noted the following papers:

1st. An extract from the register of his baptism, or, in default of that, a declaration before a magistrate, made by one of his parents, giving his exact age.

2d. A certificate of good moral character, signed by a clergyman of the parish to which he belongs, and by the tutor or head of the school or college at which he has received his education for at least the two preceding years, or such other proof of good moral character as will be satisfactory to the Commander-in-Chief.

3d. A statement of the subjects of examination in which (in addition to mathematics) he may desire to be examined.

A candidate who has been examined before, when he applies for leave to present himself again, will only be required to forward the list of subjects he selects, and a certificate from his tutor or the head of his school, etc., for the interval between the two examinations.

IX. The candidates will be inspected by military surgeons on the first day of the examination, in order that it may be ascertained that they are free from any bodily defects or ailments calculated to interfere with the performance of military duties.

Extreme short-sight, or any serious defect of vision, is regarded as a disqualification.

The responsible parent or guardian of every successful candidate, and the candidate himself, before he can be admitted as a cadet, are required to sign, respectively, obligations to conform to the regulations.

SUBJECTS AND STAFF OF INSTRUCTION.

For instruction the Cadets are divided into five classes of equal strength, according to length of residence; forty-four in the first four classes, and forty-six in the junior. The subjects are:

1. Mathematics, under a professor and four instructors, is studied in three classes, and the final examination is held after a residence of a year and a half, with a maximum of 6,800 marks in all.

2. Fortification, under a professor and four instructors, is studied in four classes. The final examination is in the last class, and the maximum of marks attainable in all is 6,300.

3. Artillery, under a professor and three instructors, is studied in two classes; the second and first, and the final examination, is in the first, with a maximum of 6,200 marks.

4. Surveying and topographical drawing, under a professor and four instructors, is studied in all the classes, and the final examination is at the completion of the course, with a total of 4,200 marks.

5. Practical Geometry, under a professor and two instructors, is studied in two classes, and the final examination is at the close of the first year, with an aggregate of 2,100 marks.

6. Mechanics and Natural Philosophy, under one professor, are studied in the last two terms, and the final examination is in the last, with a maximum of 1,600 marks in the former, and 900 in the latter.

7. French and German are studied, each under a professor and two instructors, for four terms, and after the final examination in the second class. The total marks in each is 1,500. Hindustani can be substituted for German.

8. Landscape Drawing, under two instructors, is studied in three classes, and the final examination is in the third class, with a maximum of 1,500 marks.

9. Military History is taught by one professor in the last two terms, and has a maximum of 2,000 marks.

10. Chemistry, under one lecturer, is taught in the last term, and receives a total of 1,200 marks.

11. Gymnastics, drill, and riding are taught as follows: Regular gymnastic instruction is conducted by a superintendent and three sergeants, for at least six months, and practised through all the terms. Artillery drill, with gun, sword, and other military drill and tactics, are conducted partly by military officers and partly by the professors and instructors of artillery. Riding drill is conducted under the officers of the Royal Artillery, in the last two terms, and is practised four or five hours a week. Swimming is taught optionally.

12. Recreations and amusements are optional and at the expense of the Cadets. Workshops are maintained by the government, but tools and materials are furnished at the expense of the Cadets. There are two reading rooms.

SCHOOL PREPARATION FOR WOOLWICH.

From the returns and evidence furnished, it is an extremely rare occurrence for a candidate to go up direct from a public school which does not possess a Modern Department to the examination for admission to Woolwich. Out of 855 candidates admitted to Woolwich in 10 years—from 1858 to 1867—the six public schools of Eton, Harrow, Rugby, Winchester, Westminster, and Shrewsbury, only sent up five direct. Colonel Addison states that at Sandhurst, out of 320 admissions during the last two years, there have been only 16 from the nine schools mentioned in the Report of the Royal Commission on Public Schools; but from Cheltenham and Wellington College the admissions have been more numerous. Even for the direct commission examination, those who present themselves from public schools (including Cheltenham and Marlborough, where Modern Departments exist), without seeking the assistance of a private tutor, scarcely amount to five per cent. of the whole number of candidates. At the same time, it may be observed that the proportion of failures among such candidates in the latter examination is comparatively slight, not amounting to more than 8 per cent., while the average number of failures among the candidates generally during the last four years has been very nearly 25 per cent. In fact, the general tenor of the evidence goes to show that, in the case of the examinations both for direct commissions and for admission to Sandhurst, there is, or at least should be, no necessity for candidates who have had the ordinary education of a classical public school to have recourse to private tuition. The Woolwich examination appears generally to be regarded in a different light. Its higher and more special character, and the great importance attached to mathematics, coupled with the competition which exists for it, render it apparently doubtful whether success would generally be obtained by candidates from public schools—other than those where, like Cheltenham, instruction is given with a particular view to this examination—without a special preparatory tuition.

The general character of the "Modern Side" at Harrow, which was established in September of 1869, "for the benefit of boys for whom, from various causes, an advanced classical training seems undesirable," is explained as follows in a circular issued by the Head-Master when announcing the intention of adopting the institution:

The principal subjects of instruction on the "Modern Side" will be mathematics, French, German, Latin, history, English literature, and physical science.

The requirements of boys not intended for the Universities will be specially kept in view, including the case of those who are candidates for Woolwich or the Indian Civil Service. It is hoped that this provision may obviate the supposed necessity for removing boys to a private tutor's precisely at an age when the influences of public school life are most powerful and most salutary.

Except for purposes of instruction there will be no distinction whatever between boys on the Modern Side and boys on the Classical Side.

No boy will, for the present, be admitted to the Modern Side unless he has been in the school for at least a year, and has hitherto shown diligence and made fair progress.

The nature of the instruction in the "Army Class" at Eton is described by the Head-Master (Rev. Dr. Hornly) as follows:

The Army Class was established by Dr. Goodrich in the year 1858. It was established in order to give Eton boys greater facilities for preparing certain subjects which were required in the army examinations, and to obviate the supposed necessity of giving Eton boys a special preparation, elsewhere than at Eaton, in order to fit them for the army examinations.

At first fortification and military drawing were included in the course, and a considerable proportion of the ordinary school work (*e. g.*, Latin verse writing) was remitted.

This was not found to answer. The course included more than was necessary for the ordinary army examination, and not enough for the higher examinations at Woolwich. There seemed to be a danger of the class becoming a sort of refuge for the idlest boys in the school.

Dr. Goodford subsequently altered all this, and placed the class upon its present footing, which is as follows:

Two lessons a week (repetition lessons) are remitted to make time for lessons in modern history. English essays, or abstracts of what has been taught in school, are written by the boys out of school (one exercise a week), and carefully looked over. No other part of the ordinary school work (except the two repetition lessons) is given up. Boys cannot join the class till they are 16 years of age. They are expected to stay at Eton till the time comes for their examination. The class consists at present of 28 boys, with an average of 25.

The class has certainly been successful. No boy going up from Eton has failed yet in the army examination since the reconstitution of the class of which I have spoken. I think the class has done good in the school.

It will be seen that nothing more has been seriously attempted as yet than to secure boys from failure in the ordinary examinations. If boys are to be prepared at Eton for any higher competition, such as that at Woolwich, a very different course will obviously be necessary, and probably a system of "bifurcation" will be found indispensable.

I am not prepared to say that this may not be introduced with advantage at Eton; but the impending changes in the governing body at Eton, and the anticipated changes with regard to army examinations, make it difficult to commence any work of reconstruction at the present moment.

The most successful institutions in preparing candidates either for Sandhurst or Woolwich are the Cheltenham and Wellington Colleges — each having a Modern Department, in which Latin and Greek yield their supremacy to modern science and living languages.

The Modern Department in Cheltenham College was established in 1843 as a Military School, and is claimed to be such at this time. The studies of subjects consist of mathematics, drawing of all kinds, physical science, two modern languages (French and German), English, surveying, and fortification, both field and permanent. The principal (Rev. T. A. Southend), in his evidence before the Military Education Commission in 1869, states that his pupils, at

the age of eighteen, went through the whole Addiscombe course, and all that was done at Woolwich, and a good deal of what was done at Chatham. The whole of his class, in 1868, went up for the entrance examination at Sandhurst, and passed. From twelve to fifteen go to Woolwich every year, and in 1869, forty out of one hundred and twenty in the Academy were prepared at Cheltenham. The special military instruction is based on a course of Latin and Greek.

Out of three hundred and twelve students in Wellington College, ninety-six boys are in the Modern Side, entering at the age of twelve and thirteen, and remaining till seventeen or eighteen. But of the ninety-six, forty are preparing for the Engineers or Artillery, and twenty for the Line. The subjects taught in the military division are the same as at Cheltenham, except fortification; and the head-master (Rev. Dr. Benson) claims, in his evidence before the Commission, that his graduates are as well trained in the same subject as the pupils of Sandhurst or Woolwich. He advises the establishment of exhibitions in the Military School, open to competition to the pupils of all the public schools, and regards the modern side as an essential feature in all public schools.

Rugby School was the earliest of the great Public Schools of England to make Physical Science a regular part of its curriculum, and to give any considerable prominence to modern languages and history; but its governing authorities have resisted all efforts to establish a distinct Modern Side.

The Rev. Dr. Temple, head-master of Rugby School (now Bishop of Exeter), in his evidence before the Commission, remarked that the general education of boys entering Sandhurst should be the same as that given to other boys of the same age, destined for any other profession than that of arms. His opinion was adverse to having a modern department, in which the ancient classics held a subordinate place, in a school in which the classics held the first, and over which the head-master presided. The modern studies should have an independent scope, and their own master, who will by his character and personal attention fix the standard of attainment. The great public schools should hold on to their present aim and methods, introducing other studies to perfect their mental discipline and results. No side sections or departments in any existing school can do the work of scientific school culture so thoroughly as an independent school, in which the natural sciences and modern languages are taught by the main staff of professors. All teachers, in any school, civil or military, should be specially appointed for their educational qualities.

In Marlborough College, a modern department exists, which was established to prepare boys for definite examinations in which they would not succeed if they competed direct from the classical side of the College, and at the same time to solve the problem of giving a good school education on a basis of instruction in which the dead languages hold a subordinate place. Boys enter the Modern School after they have reached the fourth form in the classical department, so that Latin and Greek constitute a substantial part of their attainments and discipline. The success of the graduates of this institution in competing for admission into the military or civil service of the government, or in any of the walks of active or professional life, shows conclusively that the modern curriculum with its studies properly adjusted, and a well trained staff, under an able head-master, is quite equal to the classical, not only in practical utility, but in comprehensive and liberal discipline.

ROYAL SCHOOL OF MILITARY ENGINEERING AT CHATHAM.

ORGANIZATION, ETC.

THE Royal Engineering Establishment at Chatham was instituted in 1854, to furnish a sound course of practical instruction in Military and Civil Engineering to the officers, non-commissioned officers, and sappers of the corps of Royal Engineers, in addition and prior to which both officers and men pass through the ordinary drill and military duties common to the army generally.

The present organization and staff are composed of a director; an instructor and assistant in construction and estimating; an instructor and assistant in field works; an instructor and assistant in surveying; an instructor and assistant in telegraphy, photography, and an assistant in signalling; a brigade major; quartermaster in charge of stores, and field officer for military discipline.

The number of officers under instruction, recently commissioned, captains and subalterns, - - -	81
Non-commissioned officers and sappers, average, -	1,200

NATURE AND LENGTH OF COURSE.

There are six distinct courses:

1. Drill and military duties, which occupy 107 days. This includes, besides the interior economy of a company, proceedings of courts-martial, boards of survey, courts of inquiry.

2. Telegraphy, signalling, submarine mines, etc., which occupy thirty-five days. This includes the construction and maintenance of lines, a knowledge of instruments and batteries, application of electricity to explosions, management of torpedoes, etc.

3. Chemistry, which occupies fifteen days. This course comprises the analysis of limes, cements, and other building materials.

4. Field works, military bridging, etc., which occupies 122 days. This comprises instruction in earthworks, pontooning, rafts, spar, and other temporary bridges, reports on existing fortresses, construction of railways, escalading, diving, etc.

5. Architectural course, which occupies 183 days. This course includes building material, design, estimate, and specification for a building, instruction and report, with hand sketches of various works in execution, lime and cement works, quarrying, brickmaking, etc.

6. Surveying and Astronomy, which occupy 183 days. This course includes trigonometrical survey, military reconnoissance, special survey, road reconnoissance, astronomical memoranda and calculations, adaptation of works of defence to a contoured site, inspection tours of works of defence in England, and report on same, isolated lectures on geology, electricity, machinery, etc., by selected professors.

The first allowance toward expenses of junior officers of the Royal Engineers, in visiting engineering works, at home and abroad, was made in 1854, and is now 500*l.* per annum.

INSTRUCTION FOR NON-COMMISSIONED OFFICERS AND SAPPERS.

All recruits for this corps join at Chatham, and for about sixteen months are subject to daily drill and military duties in field work and all branches of the engineer service, and are drafted off, from time to time, into the special classes in construction, photography, telegraphy, lithography, printing.

Synopsis of the Course.

The following synopsis of the instruction given at the Royal School of Military Engineering at Chatham, was drawn up by Major General J. L. Simmons, the Director of the establishment.

I.—THE SURVEY COURSE.

The course of surveying for the officers of the Royal Engineers is intended to qualify them for carrying on survey operations of every description, and for designing and laying out engineering works, so far as these are influenced by the features of the ground on which they are placed, or over which they are carried.

The course consists of two parts,—the one relating to surveying processes exclusively, the other to the uses made of the plans and maps prepared by such processes, for engineering purposes.

Under the first of these divisions the officers are practically instructed in astronomical, general, special, and reconnoitring surveying, including the accurate delineation of the inequalities of ground by levelling and by contours traced instrumentally, and also the giving reliefs to hill forms by sketching with the pen and drawing with the brush.

Under the second division they are exercised in the adaptation of works of fortification to contoured sites, and in the selection and survey of lines of communication by roads, railways, and canals, and in drawing up projects for their execution.

Astronomical Surveying.

The officers are taught the construction and use of astronomical instruments, and are practised in making observations with them. They study from published works and memoranda printed at the establishment, the most useful problems for finding the time, the latitude and longitude, the direction of the meridian, and the variation of the compass.

Examples of each problem are worked out by them from their own observations or from observations made in their presence.

The use of meteorological intruments and the reductions of the observations made with them are also practised.

General Survey.

As a preliminary exercise in drawing each officer constructs a plate of scales from data supplied to him. For particular information on the delicate and powerful instruments and apparatus which have been used in great national surveys, and which cannot be studied in the establishment observatory, the officers are referred to published works; and they are instructed in the adjustments, the unavoidable errors of construction, and the powers of the instruments put into their hands for the execution of their survey course.

The general survey comprises:

1st. *The selection and measurement of a base.*—The base is measured with an ordinary chain and a five-inch theodolite, and this measurement having been reduced to its horizontal value at the level of the sea, the section of the base is laid down on paper.

2d. *Triangulation.*—The measured base is extended by a triangulation over 10 or 16 square miles of country, and the relative altitudes of, and the distances between, the stations selected are determined from observations. The computed horizontal distances are laid down, and the azimuth of one of them is determined.

3d. *Traversing.*—The positions of the roads, streams, boundaries of woods, and other marked features, surrounding and intersecting an area of six or eight square miles of the country triangulated, are then determined by running traverses with a theodolite from one station to another, so as to cut up this area into spaces which will admit of being filled in by a less accurate method, without introducing an error in the plan.

4th. *Plotting of detail and completion of the work.*—The protracted lines are now transferred to another sheet of paper, and the detail, obtained as the traverses proceed, is plotted from the field-book. From this plot sketch sheets are prepared, and the remainder of the work is sketched in with the aid of a prismatic compass, the form of the ground being represented by pencil strokes, assisted by contours put in with the aid of a portable level.

The sketch sheets are etched in with a pen, and a finished brush-work plan of the complete survey, embracing all the information collected, is prepared from them, with the original plotted detail as a basis.

Special Survey.

A piece of ground, about half a mile in area, is surveyed with minute accuracy as for some special purpose, and is laid down on a scale sufficiently large to admit of the calculation of the areas of the enclosures from the paper. The method followed is the same as that pursued on the Ordnance Survey, and with the Tithe Commutation Surveys, etc.

Contouring.—On the ground thus specially surveyed contours are traced instrumentally at given vertical distances apart and are plotted on the plan.

Military Reconnaissance.

This is conducted on principles similar to those which govern the operations of the general survey; the instruments employed, however, are all portable. The measurement of a base is made by such means as readily offer themselves (generally by pacing), and the trigonometrical points are fixed simply by protracting angles observed with a box sextant or compass. The whole of the remaining features and details considered necessary in a military point of view are sketched in with the aid of bearings and pacing. The reconnaissance embraces about six square miles.

In addition to the topographical sketch of the ground, each officer sends in a detailed report of its general character, its resources, and military capabilities. Each officer also makes a hasty reconnaissance of a road with a view to

its employment as a military communication. All the information which can be obtained as to the character of the country through which it passes, and towns and villages near it, together with the construction, gradients, etc., of the road, are noted on the face of the sketch.

Fortification Branch.

Every officer is required, in this branch of the survey course, to design one or more works of defence for the occupation of a site of which a contoured plan is furnished to him.

In performing this exercise the officer becomes expert in reading the various forms and slopes of ground, as expressed by contours; he meets with and learns to provide for some of the many modifications of the conditions of defence which the occupation of irregular sites necessitates, and he acquires facility in the application of descriptive geometry to the determination of the planes of defilade and the several planes of a work.

The data upon which the design is framed consist of a plan of ground shown by contours, and of some of the conditions to be filled by the proposed fortification, such as the objects for which the site is occupied, the strength of the garrison, the extent of the works, the nature of the defence of the ditches, the trace, or the profile to be adopted, etc.

On the completion of his design the officer writes a report explanatory of the character of the works he has adopted, and describing his arrangements both for the distant and near defence, with any improvements which have suggested themselves in working it out; and since the scale of the design admits of considerable accuracy in its preparation, he is required to enter very fully into the detail of the arrangement he proposes.

The report is accompanied by tables showing how the remblai and deblai are equalized, and that the distribution of the latter is economical.

Civil Applications.

Projects for a line of communication, general plan, and trial sections.—The officers are instructed in the general principles which should guide them in laying out lines of communication, whether by road, railway, or canal, and are then sent out to examine the country between two points five or six miles apart, and are required to decide on two or more routes which apparently offer the greatest facilities in point of gradients, soil, and the materials of construction. Availing themselves of the best map or plan they can obtain, they draw a plan showing approximately the divisions of the properties through which the trial lines are run; they then make trial sections; and from these sections and their previous examination of the ground, they determine on the line to be adopted, embodying in a report a general description of the country, the obstacles encountered on each route, the gradients, curves, etc., and also the calculations which led to their decision. In their calculations they estimate the cost of the necessary constructions on each of the trial lines, the cost of conveyance for heavy goods on an assumed basis of daily traffic, and the time occupied in each case for quick transit.

Working plan and section.—A length of one mile of the route determined on as the best is selected, and for this a special survey is made, which is laid down as a working plan, the line being picketed out when no objection is made by the owners of the property through which it passes. A working section of the line is also prepared from accurate levels.

Plan of details, etc.—For the works proposed on that portion of the line which is included within the limits of the working section, a plan of details is prepared, as well as a specification for the works and an estimate of their probable cost.

II. THE COURSE OF CONSTRUCTION AND ESTIMATING.

For this course 142 days, including Sundays, are allowed. The course is divided into four parts.

Part I.—Theory of Construction.

This part consists of a series of examples in construction, about 50 in number, which will be varied from time to time.

They are drawn up with a special view to the application of the mathematical knowledge already possessed by the officers to some of the cases which they are likely to have to deal with in practice.

References are given in the margin of the printed paper of examples to

some of the many books in which the information necessary for their solution can be found.

The instructing officer will explain every morning, except Saturday, as many of the examples as he considers the officers can work during the remainder of the day, and the officers are expected to study these subjects from some one of the books referred to.

The object of these short explanations is twofold: 1st, to explain the principles on which the particular cases or similar cases are to be dealt with; 2d, to impart in a condensed form some of the varied information which is familiar to all engineers of experience, but which an engineer at the commencement of his career often has a difficulty in finding.

The officers will take notes of these explanations, and write each morning notes at the head of the fair copy of the examples to which they refer. The examples explained on each day are to be worked out on that day in the fullest manner; the reasoning of each step is to be stated, and all rough calculations are to be left on the paper, so as to lessen as much as possible the labor of examination. They are to be brought to the instructing officer the following morning, and after examination are to be written out fair on ruled foolscap, quarter-margin, on the right-hand sheet, with explanatory diagrams to a large scale, where necessary, on the left-hand sheet.

The fair notes of each week's work must be sent in before the end of the following week.

The weights, strength of materials, and other information, will be found in the printed tables.

This part of the course occupies about 40 days, and while it continues leave will be granted on Saturdays and Sundays only.

Part II.—Materials.

The object of this part of the course is to give the officers some sort of guide in judging of the quality of the principal materials which they will have to use, as well as to afford them information as to the particular material most suitable for a building or engineering work.

It may be subdivided into three parts, viz., lectures given by professors in the lecture theatre; lectures given by the instructing officer; and visits made by the officers to lime works, cement works, brickfields, etc.

The lectures in the lecture theatre are delivered at the periods most convenient to the lecturer, but the notes taken by the officers form part of this course, and will be bound up with the rest of the papers.

The notes of the lectures delivered by the instructing officer are to be written out fair immediately after the lecture, in accordance with the instructions given, and brought to the instructing officer on the following morning.

A printed paper detailing the particular points to which officers visiting manufacturing works are to direct their attention will be given to each officer, and a report is to be sent in as soon as possible after each visit to the instructing officer.

Sketches to illustrate the lectures and visits are to be as numerous and complete as possible.

The value of these sketches for future reference, and as aids to officers in their professional constructions hereafter, will be very much enhanced by having the dimensions clearly written on them, which should include at least those of all principal parts of machines and structures.

This part of the course occupies about three weeks, inclusive of the time required to visit the works referred to.

The officers will also be instructed, after they leave the course of construction, in the method of testing the quality of some of the materials by chemical analysis, for which a fortnight is allowed.

Part III.—Valuation and Measurement of Work.

This part of the course will occupy in all about 37 days, and will commence with a series of lectures, the subject matter of which will be found chiefly in the printed "Notes on the Practice of Building" and "Notes on the Building Trades." They will comprise, in separate lectures for each trade,—

1. The materials, tools, etc., and apparatus employed, together with their application to the different kinds of work produced.
2. The technical terms in vogue.
3. The general practice of measuring and valuing.

Hints and memoranda useful in designing, estimating, and carrying out works will be given, and explanations afforded by reference to models and

drawings, from some of which colored sketches, with the names and dimensions of the different parts given on them in full, will be made by each officer and attached to his printed notes. These sketches will be done in the Hall of Study from the originals deposited there.

A lecture will be given explaining the different steps taken in preparing the annual estimates of a district, to be laid before Parliament, and the various methods of carrying out the services which may be authorized.

The cost of a building will be approximately estimated by cubing it out from the general plans and elevations.

The quantities of the same building will then be taken out from the specifications, working drawings, and a model, by filling in a measurement form having the details of work done printed on it.

Details and estimates of the same building will be made out on W. O. Form 1554, the items and prices being taken from the W. D. Schedules of the district, and the descriptive part printed on.

Lastly, the quantities will be abstracted and brought into bill, as though the work were to be put up to tender, or as would be done in drawing out contractors' bills for work to be paid for on a schedule of prices.

The portions of the copper plates to be colored will be partly done in the course of lectures, but about a week at the close of this part of the course will be allowed to complete the whole. They are to be colored in the Hall of Study from pattern drawings deposited there. No drawing whatever to be removed from the Hall of Study.

Part IV.—Design.

At the commencemet of this part of the course each officer will read through the "Notes on Military Buildings," by Colonel Collinson, Royal Engineers, studying more particularly the parts which have special reference to his own design. The lithographed drawings which accompany them are not intended to be models to be copied from, but are given as examples of works executed, many of which with the advance of sanitary science have become obsolete as a whole. They contain many useful details still applicable.

The design is intended to afford to each officer an opportunity of applying the knowledge he may have acquired in the course to some case which he may actually hereafter have to deal with.

About six weeks are available for this part of the course, and the conditions under which the design is to be made will be furnished to each officer.

As a rule the design will consist of a general plan and report, with some part worked out in detail, this part being specified for and estimated.

The drawings are to be prepared in accordance with the instructions deposited in the Hall of Study.

Tour Reports and Lectures.

All tour reports and lectures pertaining to the course of construction will be written in accordance with the general regulations for reports, that is to say, on foolscap paper, quarter margin, on both sides of the paper, divided into paragraphs, with headings in the margin, and signed and dated by the officer. They will form part of Part II. of the course, and will be bound in the proper places.

In writing tour reports and lectures the object should be to condense as much practical information and fact into as small a space as possible without abbreviating the language or omitting any of the facts. Sketches should be made by hand, approximately to scale, but should be clear, and contain full dimensions. Statistical and tabular information should be given in full.

For the tour report each officer will receive a statement of the particulars of each work he has to report on.

Binding.

The whole of the notes, etc., of each officer will be bound in one or more volumes. Therefore, before leaving the establishment, each officer should arrange his notes in the order in which he wishes them bound.

III.—FIELD WORK COURSE.

The time allowed for this course is 122 days, including Sundays. While on it officers may be required to attend drill one day in each week, and also brigade field days.

The course comprises instruction in all those duties (with the exceptions mentioned below) which devolve upon the Royal Engineers when employed with an army engaged offensively or defensively, either at a siege or in the field.

The exceptions are surveying, reconnaissance, telegraphy, firing mines by electricity, etc., torpedoes, and demolition of permanent works; on all which subjects instruction is given to the officers while on other courses.

The officers are required to read carefully the notes on field work instruction, to make models in sand, etc., of such works as admit of this practice, to take part in the construction of the several works in the field, etc., and to draw up projects on the subject.

Before leaving the course an officer must be competent to impart instruction to sappers in all their field duties.

The practical instruction is divided into seven parts.

Part I.—Modelling in Sand, etc.

This part consists of making models of gabions, fascines, hurdles, and sap-rollers; of throwing up models in sand of portions of a first parallel and its approaches, of a second parallel, of single and double saps, both kneeling and standing, of a trench cavalier, of a lodgment by half double sap, of rifle-pits, and of trons-de-loup.

Also of making models in sand of field powder magazines, and of elevated, sunken, half sunken, and screen, gun and mortar batteries (ordinary and indented), revetted with gabions, fascines, and sand bags.

It includes the laying of model gun and mortar platforms, the making of a saliout of a field redoubt, with gun en barbette, of a field kitchen, and of the passage of a wet ditch by means of gabions and fascines.

Also the erection of spar bridges of different forms with model spars, and the laying in of a cross-over road to connect two lines of railway.

Part II.—Siege Works.

This part consists of making gabions, fascines, hurdles, and sap-rollers; of tracing (part by night) parallels, approaches, batteries, etc.

Also of seeing parallels, approaches, batteries, saps, trench cavaliers, etc., constructed by the sappers; and the mode of extending men and setting them to work.

The officers are also required to take up for enfilade the prolongation of faces, etc.

Part III.—Works of Defence.

This part consists of instruction in forming abattis, entanglements, rifle pits, trons-de-loup, etc., and in putting up stockades, palisades, fraises, etc.

Part IV.—Mining.

This part includes boring and blasting rock, sinking shafts, driving galleries, making chambers and powder hose, loading, tamping, and firing mines, also the preparation and firing of fougasses.

Part V.—Bridging.

This part includes knotting, splicing, and lashing spars, diving, rowing in boats, packing pontoons, and forming temporary military bridges over streams with large and small pontoons, casks, etc.

Also the construction of spar, timber, and suspension bridges to reëstablish a communication by turnpike road or railroad.

Part VI.—Railways.

This part consists in seeing the mode of laying down and repairing lines of railway, and of putting in a cross-over road to connect two lines of railway, and also the mode of destroying railways.

Part VII.—Sundry Practices.

Under this head are included boring for water (with the American tube wells as well as with the ordinary apparatus), erecting field kitchens, filling and throwing hand grenades, and escalading, also the erection of field observatories.

The officers are, in addition, required to draw up the following projects:

1. Project of attack of a fortress actually in existence.
2. Project for the restoration of a bridge.
3. Project for a floating bridge.
4. Project for a field work as a bridge-head.
5. Hasty project for a temporary bridge, or, hasty project for the demolition of a portion of a line of railway.

IV.—MISCELLANEOUS SUBJECTS.

(*a.*) *Course of Telegraphy.—Fifteen days are allowed for this course.*

All officers under instruction learn the theory and practice of telegraphy and visual signalling, bearing in mind that a thorough knowledge of the theory will enable them to overcome difficulties which would be perplexing to the men, who can only be expected to learn the practical working of the telegraph.

The various instruments in use for signalling and testing are explained to them, and they are taught the ordinary methods of measuring electrical forces and resistances, and of testing conducting wires for insulation and conductivity, and for determining the nature and positions of faults. The degree of accuracy which may be attained in these measurements is pointed out to them.

They learn the European Morse alphabet, and the method of sending and receiving messages, but they are not expected to devote so much time to the subject as would enable them to become expert telegraphists.

Each officer is required to give in a project for the construction of a line of electric telegraph, including at least three stations. In the report are described the instruments to be used and the modes of connecting them in circuit; the batteries, the conductors, the supports, the insulators, and the mode of putting up the line; and the number of cells required to work the line is calculated.

An estimate of the stores and materials required accompanies the report, with a general plan showing the route proposed.

The various methods of exploding gunpowder by electricity are taught while the course of telegraphy is going on; the application of this branch of electrical science is made when the officers are employed on projects for demolitions by mining.

In the School of Telegraphy a certain number of the men of the corps are trained every year as telegraphists.

The instruments of which the use is taught are,—

The single needle instrument worked by voltaic electricity.

The Morse recording and sounding instrument.

The double needle instrument.

Wheatstone's magneto dial instrument.

Also day and night signalling with the approved visual apparatus.

Each man is required to read a specified number of words per minute, and to send correctly by each instrument, before he passes on to the next.

The European Morse alphabet is used with all the instruments, except with the double needle instrument, which has a special alphabet.

The men are taught how to make up and repair the voltaic batteries and instruments, and to put up conducting wires over ground, and to lay them underground, and also to test roughly for the position of faults. Their previous education does not generally admit of their acquiring a knowledge of the theory of electricity, or of performing the more delicate tests required in telegraphy.

The men who enter the Telegraph School are also instructed in the practical manipulation of Grove's voltaic batteries, Wheatstone's magnetic exploder, and the dynamo-electric machine, in the use of frictional electricity, in making the electrical fuzes, and in connecting and arranging the wires necessary for firing mines by electricity.

(*b.*) *Chemical Laboratory Course.—Fifteen days are allowed for this course.*

The object of this course is to enable officers and men at the establishment, who may show an inclination for chemical studies, to pursue them practically.

The course is confined to the chemical relations and behavior of the substances which affect the qualities of building materials, or which may influence the questions which are most likely to require the professional investigation of a military engineer. It is arranged with the idea of supplying the

want of practical experience in dealing with substances used in construction, by giving an insight into their nature and composition; and also with that of imparting such information as may lead in a new colony, should an officer be called upon to act as its explorer and pioneer, to a more rapid development of its resources.

The course for the officers consists,—

1st. In making themselves acquainted with the action of reagents, both by wet methods and by the blow-pipe, on different simple substances, in experiments to which they are directed by a text-book.

2d. In applying the information so gained to the qualitative examination of substances, simple and compound, specially prepared as exercises for analysis.

3d. In the quantitative as well as qualitative examination of building stones, lime and cement stones, gypsum, brick earths, paints, solders, and other building materials. A sample of water is also examined, and a qualitative examination is made of one or more ores.

4th. In preparing, on an experimental scale, bricks, limes, cements, and plasters, directly from natural stones or earths by simple calcination, and also by the more complex method which it is often necessary to adopt.

5th. The chemistry of the voltaic battery.

The course for the men only differs from that for the officers in respect of the order in which the several divisions of the subject are taken up. The men, instead of commencing with a thorough examination of numerous simple substances, begin with a few easy experiments on recognizing lime and cement stones, and on the mode of ascertaining their comparative values, so that, in case it is judged inexpedient, in any instance, that the whole course shall be completed, the knowledge which has been gained may be of a character requiring comparatively little skill and intelligence to apply to practical uses.

A certain number of men only are taught.

(*c.*) *Course of Photography.*

This study is not compulsory; but any officer and a limited number of men who have completed the prescribed course satisfactorily, and who wish to study photography, are allowed to do so.

The officers devote their attention more particularly to the chemical theory of the subject, in order that they may be able to overcome the practical difficulties which constantly occur when this art is pursued in foreign countries under circumstances of climate and situation different from those in England, and when chemicals get out of order and produce anomalous results. In such cases men who have acquired considerable skill in manipulation, but who have no knowledge of chemistry, are unable to devise remedies or to overcome difficultics, and it is the place of their officers to assist them by their superior knowledge and intelligence.

The men are taught the negative wet collodion process in all its branches (except the manufacture of pyroxyline), also the dry process, and photozincography.

They are also practised in the use of the dark tent, and in taking negatives in the field, and of photographic reductions of plans.

It is seldom that their previous education admits of their becoming well versed in the chemical theory of the art, but the means of overcoming the usual practical difficulties are pointed out to them. Each man is required to enter in a note-book the various solutions, and to make memoranda of the processes.

(*d.*) *Lectures.*

Lectures are delivered between the months of September and April on civil and mechanical engineering, metallurgy, architecture, electricity and its applications, and on other subjects of a professional character. The lectures are attended by all the officers and men under instruction, and the former are required to take rough notes, and afterward to write them out fairly, for binding with their other work.

(*e.*) *Visits to Professional Works.*

With the object of giving an idea of the best methods of carrying on extensive works, and of imparting practical information on professional subjects, a certain number of the junior officers are selected every year to visit

engineering, architectural, and other works of professional character, accompanied by one of the instructing officers of the establishment.

Of the various constructions and processes seen during these tours they make notes and drawings, which are embodied in the form of reports to the director, and are subsequently bound up with the other parts of the course.

General Note.—Further explanations of the mode of filling up the details of the course, and of the forms for the notes and drawings, are given in the special instructions.

(*f.*) *Demolitions.*

The ignition of gunpowder or other explosives by powder hose and Bickford's fuze as well as by electricity, both on land and submerged under water, is taught to all officers.

In order that the best methods of using gunpowder or other explosives for the demolition of works and buildings by mining may be thoroughly understood, each officer is required to make projects for the following demolitions, viz.:

1. A front of fortification, or some similar work, exhibiting various sorts of revetments, and requiring the simultaneous explosion of a large number of mines.

2. A casemate, powder magazine, or other substantial military building under two suppositions: 1st, that there is plenty of time, that sufficient men and tools are available, and that it is required to effect complete demolition without wasting gunpowder unnecessarily; 2d, that time presses, and that the demolition must be effected in the most expeditious manner possible.

3. A bridge or viaduct under two different suppositions, as in No. 2.

The mines in some cases are directed to be fired by powder hose, and in others by electricity.

Each of these projects consists of a memoir and explanatory drawings. The memoir comprises,—

1st. A description of the building, or work to be destroyed, in all points which may influence the mode of demolition.

2d. A general description of the proposed mode of demolition.

3d. The calculations for the charges of the mines.

4th. The mode of preparing and firing the mines.

5th. An estimate of the men, tools, and materials required and of the time necessary for the operation.

6th. An estimate of the gunpowder.

7th. When electricity is to be employed for firing the mines, a full description of the batteries, etc., is given, with calculations of the number of cells, etc.

The drawings include a plan and such sections as may be required to explain clearly the situations of the various charges of gunpowder, and of the shafts and galleries.

(*g.*) *Submarine Mines.*

All officers and a certain number of men are practised in the use of submarine mines.

The course consists of,—

1. The nature and construction of case.
2. Mode of mooring.
3. Mode of arranging and laying insulated cables.
4. Mode of testing fuzes, also testing cables for conductivity and insulation and for the detection of faults.
5. Modes of firing at will and by self-acting arrangements.

PROFESSIONAL INSTRUCTION FOR COMMISSIONED OFFICERS.

HISTORICAL NOTICE.

Although examinations preparatory to promotion had been instituted by the Duke of Wellington in 1850, no attempt was made to provide any general machinery for affording to officers of the army means of instruction, even in those subjects a knowledge of which was by the regulations of the service required of them. The Department of Artillery studies at Woolwich, originally instituted on a small scale in 1850, and the Royal Engineer Establishment at Chatham, supplied to the officers of the scientific corps, though to a much more limited extent than at the present day, opportunities of carrying on their professional studies after entering the army. But to officers of other branches of the service no means of instruction were afforded in any subjects beyond the mere routine of drill and regimental duties, except by the Senior Department at Sandhurst and the School of Musketry at Hythe. The state of the former institution, the advantages of which extended only to a very small proportion of the officers of the army, is described in the accounts of the Royal Military College and of the Staff College. The school at Hythe was first established in the year 1853, for the purpose of training a certain number of officers and soldiers in the new system of musketry, which was adopted on the introduction of rifled arms into the service.

The first official suggestion, with the object of remedying the deficiency of professional knowledge among the officers of the army, was made by Mr. Sidney Herbert, when Secretary at War, in 1854. The outline of the plan proposed by him at this time was sketched out in a letter addressed to Lord Hardinge, then Commander-in-Chief, and its details were subsequently more fully explained in speeches in the House of Commons. The scheme contemplated a general reorganization of the system of military education,—the improvement

of the examinations instituted by the Duke of Wellington for admission to the army and for promotion,—the conversion of the Senior Department at Sandhurst into a special school for the staff,—and the introduction of a system of professional instruction for officers after entering the service. With the view of carrying out the latter part of the scheme, it was proposed, in 1854, to appoint garrison instructors at certain large stations both at home and in the colonies. It was not intended to make attendance at the instruction thus given compulsory, but a stringent examination in the subjects which entered into the course was to be a necessary condition of promotion to the ranks of lieutenant and captain respectively.

The scheme of garrison instruction proposed by Mr. Sidney Herbert met with the approval of Lord Hardinge, and obtained the sanction of the Treasury. A sum of 2,000*l.*, for the purpose of making a commencement in carrying it out, was inserted in the estimates for 1854–5, and the plan, as explained by Mr. Herbert in moving the army estimates, met with the entire approval of the House of Commons.

The outbreak of the Crimean war, however, in the first instance, interfered with the practical realization of the scheme, although it appears that some of the instructors had been actually selected for their posts, and that it was intended to send them out to the Crimea to acquire a practical acquaintance with such of the minor operations of war as would fall within the intended course of instruction. This latter intention was not carried out, and after the resignation of Mr. Sidney Herbert, which took place in the beginning of 1855, no further steps appear to have been taken in the matter. At the same time money continued to be voted for the purpose of carrying out the scheme (although no application of the funds was made), until the general reduction in the estimates which took place on the conclusion of peace in 1856; it appears also, from statements made by the Under Secretary at War, in the House of Commons, that the Government had never abandoned the idea of adopting some measure for the professional instruction of officers.

In the debates in both Houses of Parliament, during the Crimean war, numerous discussions took place on the subject of military education; the failure of the existing examinations for promotion, the lax mode in which they were carried out,

the want of acquaintance with many of the mere rudiments of military science displayed by the majority of officers, and the necessity of supplying them with some means of instruction in the practical duties devolving upon them on active service, formed frequent subjects of remark. On the 5th of June, 1856, after the termination of the war, Mr. Sidney Herbert, then a private member, again brought his proposal for the appointment of garrison instructors before the notice of the House of Commons, in connection with his more general scheme for the improvement of the education of officers; but, although the proposal again met with the approval of nearly every speaker who took part in the discussion, the Government declined to pledge themselves to the adoption of the scheme in its details, as the question of the reorganization of the whole system of military education was then under consideration.

During the latter part of the year 1856, as has been elsewhere stated, the attention of the military authorities was seriously directed to the question of improving the education of the army. Nearly all the plans submitted to Lord Panmure with this object included, as an essential feature, the adoption of some means of professional instruction for officers after entering the service; and the machinery suggested was, in almost every case, based in its general principles on Mr. Sidney Herbert's original proposal for the establishment of garrison instructors. The Commissioners appointed in the same year to visit the military schools of the continent, while their inquiries were chiefly confined to the improvement of the education of the scientific corps, recommended in their report that young officers of all branches of the service should, after entering the army, go through some course of professional study; at the same time they suggested no machinery for carrying their recommendation into effect. The military witnesses examined, during the years 1856 and 1857, before the Royal Commission on the Purchase System, very generally concurred in the opinion that higher professional acquirements should be demanded from officers, and that means of instruction should be afforded to them; and the Commissioners, in their Report, endorsed this view in the following terms: "Nor can it be fairly said that the purchase system is the obstacle to introducing a better system of military edu-

cation. A stricter examination before granting the first commission, an improved training afterward, and a further examination on promotion from ensign to lieutenant, are measures perfectly compatible with the system of purchase."

The system of garrison instruction suggested by Mr. Sidney Herbert appears to have found general favor at this period. The instructions issued to the Council of Military Education, on their appointment in 1857, directed them, in connection with the subject of the professional examination of officers up to the rank of captain, to consider the question "of the establishment of instructors at the large stations." The plan proposed by the Council, in 1857, did not contemplate the general appointment of either garrison or regimental instructors; its main feature was the establishment of officers' schools at depot battalion stations, through which all young officers, who were in the first instance to receive provisional commissions, should pass before joining their regiments and being permanently commissioned. This recommendation was supplemented by one for the partial establishment of district instructors at stations where classes of ten officers could be formed, for the more advanced instruction of those who had been some years in the service.

The great demand for officers occasioned by the Indian mutiny, combined with practical objections which were made to the Council's scheme, prevented their proposals from being carried into effect. The only immediate result of their recommendations was the establishment, in 1857, of a class at Aldershot for the instruction of officers quartered at the camp in military sketching. A full account of this institution, which has since been considerably developed, and is now called the Survey Class, will be found further on.

At a subsequent period the attention of the Council appears to have been directed more to the question of securing the professional competence of officers by a special military education before entering the service, than by compulsory instruction at a later period. The proposal, originally made in 1858, for requiring all candidates for commissions in the line to pass through Sandhurst, has been already described in connection with the Royal Military College. The Council have, however, never ceased to urge the expediency of providing officers, after they have entered the service, with facilities for

instruction in the higher branches of military science; and in their last General Report they recommended the establishment of institutions similar to the Aldershot Survey Class at other large stations.

Although no general machinery has been introduced for affording instruction to officers of the cavalry and infantry after entering the service, various steps have, from time to time, been taken with the object of extending their professional knowledge to subjects beyond the mere routine duties of their own arms. In January, 1859, commanding officers were directed to require from the officers of their regiments reports and, if possible, sketches of the roads traversed when route marching in winter; and later in the same year an order was issued that officers of infantry should, whenever practicable, be instructed in great gun drill. In the present year a system of instruction in military signalling has been introduced at the School of Engineering at Chatham, to which detachments of officers are periodically sent. In addition to the recommendations of the present Royal Commission for the introduction of a system of garrison and regimental instruction, the Royal Commission on Courts-martial, in their recent Report, recommended that more attention should be paid to the education of officers in military law, and that stricter examinations in the subject should be enforced.

The necessity of an improvement in the professional acquirements of officers appears to have been almost universally recognized from the time when Mr. Sidney Herbert brought the subject to public notice in 1854. Various opinions, however, have been entertained as to the means by which the desired object could best be effected.

The different plans which have from time to time been suggested may be classified under two main divisions:

(1.) Those which propose a special military education for all candidates for commissions before entering the service.

(2.) Those which advocate, in preference, the postponement of professional instruction, at least for the majority of the officers of the army, until a later period, after the service has been entered, and the rank of officer been attained.

Under the former head comes the scheme suggested by the Council of Military Education in 1858, the adoption of which was at one time determined upon by the military authorities,

for requiring all candidates for commissions in the cavalry and infantry to pass through Sandhurst. A similar proposal was suggested by witnesses to the Royal Commission on the Purchase System in 1856; it was supported by the authority of the Duke of Cambridge and Mr. Sidney Herbert (who had originally been opposed to it) before the Select Committee of the House of Commons on Military Organization, in 1860; and the Committee, in their Report, though declining to pronounce any decided opinion on the subject, stated that they considered the measure "well worthy of the most careful consideration." Of late years the same principle has been publicly advocated by Sir C. Trevelyan, who considers that there should be but two modes of admission to the rank of officer,—one through a military college, and the other by serving in the ranks; and the advantages which would result from passing all candidates for commissions through a military college have been urged by several witnesses, including His Royal Highness the Duke of Cambridge, before the present Royal Commission. On the other hand, opponents of this view have pointed out the objections entertained by them to any such measure.

Allied to the plan for making a military college the sole channel of admission to the commissioned ranks of the army is one for requiring all candidates for commissions to serve as cadets, in order to acquire a practical acquaintance with their duties, before obtaining the rank of officer. This proposal, originally suggested by Lord Clyde, before the Royal Commission on the Purchase System, has more recently been supported by the authority of Sir W. Mansfield and Lord De la Warr; the latter officer, however, appears of late to have somewhat modified his views, and to advocate at present, for all young men who obtain direct commissions by purchase, a probationary course of six or twelve months' instruction in military subjects and drill, at their parents' expense, prior to joining their regiments, in accordance with a plan submitted to the Commission. The cadet system has also been advocated by Lord Walden before the Commission.

To the class of plans which advocate the postponement of professional instruction for the majority of the officers of the army until after the service has been entered, belong Mr. Sidney Herbert's original proposal, in 1854, for the introduction of a system of garrison instruction—the recommendation

of the Commissioners of 1856 "that young officers after entering the army should go through some course of professional study,"—the suggestion made by the Royal Commission on the Purchase System for "an improved system of training after the first commission is granted,"—and the proposal of the Council of Military Education, in 1857, for the establishment of depot battalion schools for young officers. Opinions founded on the same principle have been expressed by several witnesses before the present Commission. The system of garrison instructors at large stations, that of regimental instructors in each corps, and, lastly, a combination of both systems, have been respectively advocated by various authorities as the machinery by which the later instruction of officers should be carried out. Even those who advocate a special education at a military college as the universal condition of obtaining a commission do not, in the majority of cases, contemplate the cessation of all instruction on the commission being obtained; at the same time in many instances they do not consider that this later instruction should be made compulsory on officers, and, while recommending that facilities should be afforded for it, they maintain the superior efficacy of a system of preliminary military education at an earlier age.

I. SURVEY CLASS AT ALDERSHOT.

The survey class at Aldershot originated in an order of the Quartermaster-General in 1857, appointing two extra deputy-assistants to afford professional instruction to officers of the division stationed there in military sketching and surveying, field and permanent fortification, and photography.

These courses and conditions of attendance are as follows:

1. An elementary course comprises practical geometry, so far as is necessary for the understanding of the principles of surveying and fortification, plan-drawing, the construction and use of scales, and military sketching.

The other course embraces surveying in its more advanced branches, military reconnaissances and road reports, field fortification, including the attack and defence of small posts, the construction of simple intrenchments, redoubts, and field works, profiling and tracing on the ground, gabion and fascine making, camping, and the construction of field ovens and cook-houses.

2. Officers will not be allowed to go through the course of instruction unless their commanding officer will certify that they are intelligent, zealous, and well conducted; but considering that the stay of regiments at this camp is frequently limited, the Lieutenant-General Commanding would wish that every facility should be given to officers to avail themselves of the instruction, even though they may not be thoroughly acquainted with all their duties.

3. Every officer wishing to attend the course of instruction will submit his application to his commanding officer, who will forward it with his recommendation and the certificate mentioned in the last paragraph, or with such remarks as he may have to offer, should he consider it his duty not to recommend the application.

4. Officers going through the elementary course will be struck off all duty for two months (Sundays excepted). They will go on flying columns.

5. Officers anxious to attend the second course will be allowed to do so for four months, during which time they will take all regimental duties which would entail extra work on the other officers, but will be excused all brigade and divisional duties, except those mentioned in paragraph 7.

6. Officers permitted to attend are not to absent themselves without leave from the Lieutenant-General commanding.

7. Officers are to be present at divisional field days, and when the division marches into the country during the winter months, either with the deputy assistants quartermaster-general sketching the ground, noting the movements, preparing reports, etc. (in undress, without swords), or if not so employed they are to fall in with their respective corps.

8. The number of officers attending is restricted to two per regiment.

9. The instruction will extend from 10 A.M till 1 P.M., excepting on Saturdays, when all the officers will attend till 12 only.

10. Staff officers who may wish to avail themselves of the instruction given at the Survey Office, or in the field, may attend at such hours as the nature of the duties they have to perform will admit.

11. Officers of the division generally will be assisted by the D.A.Q.M.G.s as far as practicable, in pursuing their studies in other branches.

12. A diary will be kept showing the names of all officers attending, the hours of attendance, the work done, etc.; this diary is to be submitted for the inspection of the Lieutenant-General commanding, and from it a monthly report will be prepared for the information of the Field Marshal.

13. Officers will be allowed the use of surveying instruments, but will have to provide their own drawing and other materials. They will, however, be permitted to retain all sketches, plans, and reports thus made on their own materials, after they have been returned from the Council.

The course actually carried out in 1868–69 was as follows:

Explanation, use, and construction of scales—several examples worked and a plate of scales drawn—mode of using the usual drawing instruments, protractors, and Marquois' scales.

Use of the prismatic compass—a road is traversed with the compass—bearings and measurements entered in a field-book, and the result plotted indoors on a large scale.

A plate of the conventional signs used by the topographical department, and a set of the seven examples of shading ground (by the late Major Petley), according to the latest scale of shade, are given to each officer to copy.

The general principles of plan drawing, and the mode of conducting a survey by means of measuring a base, and by a triangulation, are explained, and a flat piece of ground is sketched with the compass, and plotted in the field.

The method of representing ground by contours only is now explained and illustrated by models, drawings, etc., and it is shown how from a contoured plan sections and elevations of ground are made, also how by adding shade to the contoured plan, a certain pictorial effect is produced, etc.

Abney's pocket level and clinometer is explained, and various modes of rough levelling illustrated.

The method of using the pocket sextant is next shown, and the officers are taken to a plateau with strongly marked slopes, a base is measured, triangulation made by means of the sextant; and the artificial features filled in.

Contours at 25 feet vertically apart are now sketched in chain dotted lines, and several sectional lines taken by means of the level, clinometer, compass, and a scale of hypothenuses, and the various angles of inclination written on the sketch. The scale of shade is explained, and the officers taught how to apply it to the sketch of ground so contoured, and the sketch finished up as directed in the memorandum by the Council of Military Education.

Major-General Napier's pamphlet on reconnaissance is given to each officer, and four or five miles of road reconnoitred, sketched, and reported on.

A sketch on a small scale of as large a tract of country as time and weather will permit of is next made, triangulation done with the sextant or theodolite, and lastly, a rapid eye-sketch, without instruments, of some hilly ground.

Some work on field fortification, chiefly the chapters describing the defence of buildings, villages, and positions, also some work on surveying, is read.

At the conclusion of each course all sketches and reports, with a return showing the number of hours' attendance of each officer, his attention and progress, are forwarded to the Council of Military Education.

ADVANCED CLASS FOR ARTILLERY OFFICERS AT WOOLWICH.

THE necessity of more advanced attainments both in the science and practice of gunnery was pointed out by the Commissioners in 1856, but nothing was done till Colonel Lefroy urged the matter on the Council of Military Education in 1862, and in November, 1863, regulations were issued for the establishment of Advanced Classes of Artillery Officers at Woolwich.

A Director of Artillery Studies was first appointed in 1850, upon the recommendation of Field-Marshal Sir Hew Ross, G.C.B., R.A. (then Adjutant-General of Artillery). His duties were to take charge of and direct the studies of the young officers of artillery on first joining at Woolwich, to assist them in their professional pursuits, and read with them military law, military history, treatises on artillery, fortification, etc.

The appointment was made provisionally in the first instance, but confirmed before the close of a year. In April, 1853, the department was increased by the addition of French and German masters, who, besides assisting the young officers, were called upon to afford instruction in their respective languages to officers of artillery of all ranks who might be desirous of profiting by it.

An allowance of 300*l.* per annum was also made to enable a proportion of the more intelligent of the young officers to accompany the Director in visits to arsenals and fortresses abroad and manufacturing districts at home.

In July, 1855, the Director of Artillery Studies was allowed the following assistants: 2 Captains of Artillery, 1 Instructor in Surveying, 1 Instructor in Military Drawing, etc., 1 Lecturer on Natural Philosophy and Mechanics, 3 Non-commissioned officers, for the purpose of giving instruction to certain gentlemen provisionally commissioned from public colleges or schools after a competitive examination, but without passing through the Academy.

The Director was expected to advise and assist the efforts of officers of the Royal Artillery in improving their professional qualifications, and to arrange classes of officers for instruction in chemistry, photography, drawing, French, and German, at the Royal Artillery Institution. He was to inform himself of all the more interesting experiments under the Ordnance Select Committee, as well as the operations and processes carried on in the Government manufacturing departments. He was to arrange and conduct the annual military tour on the continent; and direct the studies of young officers.

Upon the formation of the Advanced Class in 1864, the staff was greatly increased, and an Assistant Director appointed, to take charge in the absence of the Director; to give instruction to classes of officers of the regiment sent to Woolwich from time to time, to officers from the Staff College, and to Militia and Volunteer artillery officers; to prepare questions for the examination of subaltern officers Royal Artillery for promotion, and report on the results of such examinations; to attend on foreigners of distinction, and other duties performed by the Director prior to the formation of the Advanced Class.

The following shows the attendance for the year ending 31st March, 1869:

Advanced class of artillery officers,	6	2 years' course.	
Firemasters' class, R.A.,	7	9 months' course.	
3 short course classes, { Royal Artillery, / Military Store Staff,	29 / 8	2	" "
Shoeburyness gunnery class, R.A.,	20	3	" "
Officers of the late Indian brigades,	3	{ 1 for 3 months' course; 2 for 2 months' course.	
Officers from the Staff College,	13	1½	" "
Militia artillery officers,	6	2	" "
Volunteer artillery officers,	2		
	— Total, 94		

Non-commissioned Officers and Men, Royal Artillery.

2 long course classes, non-commissioned officers,	19	6 months' course.	
10 short course classes, non-commissioned officers and men,	200	2	" "
Shoeburyness gunnery class, non-commissioned officers,	36	3	" "
	— Total, 255		

The young officers lately joined attend here twice a week to receive instruction, by lectures, from the Assistant Director of Artillery Studies on military law, courts-martial, and interior economy.

REGULATIONS FOR ADMISSION IN 1869.

The examination will be early in February of each year, at Woolwich, under the Council of Military Education.

Candidates for this examination must have undergone a course of instruction at Shoeburyness; or they must pass satisfactorily a preliminary examination in practical artillery.

No officer will be admitted who will not have completed six years' service on 31st March, 1870.

The subjects in which the candidates will be examined, and the relative importance attached to the subjects, are as follows:

Mathematics, - - - - -	700
Chemistry and physics, - - - -	300

Mathematics includes—

Plane trigonometry (so much of it as is included in the first 16 chapters of Todhunter's treatise).

Coördinate geometry of two dimensions (Hymer or Todhunter), viz.:

Straight line referred to rectangular, oblique, and polar coördinates. The circle, parabola, ellipse, and hyperbola, referred to rectangular and polar coördinates. The equation to the tangent, and the normal to the circle, parabola, ellipse, and hyperbola referred to rectangular axes, the sections of a right cone made by a plane.

Applications of the above to solutions of simple problems.

Differential Calculus.—Differential coefficient of simple, inverse, trigonometrical, and complex functions; proof of Taylor's and Maclaurin's theorems and examples of expansions of functions; differentiation of functions of two variables; limiting values of functions which assume an indeterminate form; change of independent variable; maxima and minima of functions of one variable; tangents, normals, and asymptotes to plane curves; differential coefficients of arcs, areas, etc.; radius of curvature (Hall or Todhunter).

Integral Calculus.—Meaning of integration; examples of simple integration; integration by parts; lengths of curves; areas of plane curves (Hymer, Hall, or Todhunter).

Elementary Mechanics.—(Whewell or Parkinson.)

Chemistry.—The general laws of chemical combinations,—the chemistry of oxygen, hydrogen, carbon, and nitrogen, and of their chief inorganic compounds. The metallurgic chemistry of iron. The chemical principles of the manufacture and explosion of gunpowder.

Physics.—In heat,—the subject of "thermometric heat" as treated in the first seven chapters of "Tyndall on Heat."

In electricity,—the subject of frictional electricity.

Officers competing are expected to be able to read French scientific works, such as Helie's "Traité de Balistique," Piobert's "Cours d'Artillerie," etc., etc., reference being constantly made to such works during the course of instruction.

At the conclusion of each year's course there will be a final examination in the subjects read during the year; the marks gained at the first examination being carried forward to the second, when certificates will be given to those students who are found qualified.

The course of instruction extends over two years.

The subjects of study the first year are: Pure mathematics; metallurgy; chemistry; mechanism and the steam engine; royal gun factories; royal laboratory, Part I.

The subjects for the second year are: Mixed mathematics and applied to gunnery; metallurgy; chemistry; heat and electricity; royal laboratory, Parts II., III., IV.; royal gunpowder factory, including manufacture of gun cotton; royal small arms factories, Enfield and Birmingham; royal carriage department.

In connection with the instruction on metallurgy, the class visit each year some of the principal private establishments in England and Wales, accompanied by Dr. Percy, F.R.S., the lecturer on this subject. They also visit locomotive and marine engine works in connection with the lectures on the steam engine.

The following processes of manufacture are noted:

In the Royal Gun Factories: Metallurgy of copper, tin, zinc, and their compounds; mechanical and chemical properties of gun metal.
Metallurgy of iron, including cast iron and wrought iron, steel and alloys; mechanical and chemical properties.
Principles of construction of cast guns.
Principles of construction of built-up guns, welding, etc.
The steam hammer.
Turning, boring, rifling, and sighting guns. All the machines, lathes, special tools, and processes.
Comparison of systems of rifling and breech-loading for cannon.
Gauges and micrometrical measurements.
Organization of labor in the Royal Gun Factories.
System of account keeping, pricing, and payment in the Royal Gun Factories.
Relations to the Director of Stores, Director of Contracts, Principal Superintendent of Stores, and Director of Ordnance.
Patterns, system respecting them.
Examination of Stores.
Duties of the Inspector of Artillery: proof of guns; examination of guns and stores.

The Small Arms Departments, Enfield and Pimlico, will follow the Royal Gun Factories, and be treated in the same comprehensive manner, including the system of supply of small arms to the army, their repair, and comparison of systems of rifling and breech-loading for small arms.

From the Royal Gun Factories the class will proceed to the Royal Carriage Department, where the subjects will be:

Selection and purchase of timber.
Seasoning of timber.
Sawmills.
Planing and other machinery applied to working of timber.
Construction.
Mechanical principles as applied in military machines.
Friction, draught, traction, locomotive power.
Harness.
Organization of labor in the Royal Carriage Department.
System of accountability and payment.
Prices.
Relations to Director of Stores, Director of Contracts, Principal Superintendent of Stores, and Director of Ordnance.
Patterns, systems respecting them.
Examination of stores.

Here will evidently conveniently come in the organization and duties of the department of the Principal Superintendent of Stores, including the detail of equipments for all services, and proportions of stores, packing ammunition, arrangement of magazines.

The last term will be devoted to the manufacture of gunpowder, ammunition, and generally the duties of the Royal Laboratory, including the chemistry of the subjects.

Selection and purchase of pyrotechnic material.
Examination and refining of saltpetre, etc.
Gunpowder and powder-mills.
Theory of gunpowder, qualities, effect of different sized grains.
Electro-ballistic apparatus, and other modes of proof.
Gun cotton.
Detonating compounds.
Other laboratory preparations.
Small arm ammunition, cannon ammunition, fuzes, rockets, etc.
Manufacture of bullets.
Casting of every description of projectile for smooth-bored and rifled ordnance.
Organization of the Royal Laboratory Department.
Supply of raw material.
System of account keeping and payment.
Prices.
Relations to the Director of Stores, Director of Contracts, Principal Superintendent of Stores, and Director of Ordnance.
Patterns, inspection. Examination of stores.

III. SCHOOL OF GUNNERY AT SHOEBURYNESS.

Shoeburyness first became a station for artillery practice in the year 1849. The practice was, however, at that time confined to experiments, which were conducted on a very limited scale, under the department of the Director-General of Artillery. A battery was constructed and some wooden huts erected at the station in that year; but for several years nothing but experimental practice was carried on by batteries of artillery who were sent to Shoeburyness merely for the summer months, and were quartered, at least partially, under canvas. No permanent staff were employed, the senior officer present with the troops being in command of the station. In 1854 the establishment assumed a more permanent character, and was placed under a lieutenant-colonel of artillery as commandant, who was also at the same time superintendent of experiments. It still, however, continued to be merely a station for artillery practice and experiments, until 1859.

The objects for which the School of Gunnery was established are to ensure a completeness and uniformity in the instruction of the officers and men of the Royal Artillery in the use of the weapons and military machines they are called upon to use; impart to them a knowledge of the ammunition, stores, and appliances made use of in the artillery service; of the effect of shot and shell under various circumstances; and, by constant practice from guns of every description, to train and educate from year to year a number of officers and men who would carry with them to their respective brigades an amount of valuable knowledge and experience which would become in that way, and in due time, diffused throughout the Royal Artillery, in the same manner as the gunnery instruction for the Royal Navy on board the "Excellent," and the musketry instruction for the infantry at Hythe have percolated with such advantage through those services.

On the first of April in each year a class of from 20 to 25 officers is formed for what is termed a "long course," embracing a period of 12 months; and a class of about 40 non-commissioned officers, for a similar course.

These classes are formed into two separate squads, and entirely occupy the time of the chief instructor, one gunnery instructor, and four assistant instructors. They are instructed

in the drills and exercises of every species of ordnance, and the mode of mounting and dismounting them under various circumstances and with different means; in transporting the heaviest guns from place to place and mounting them under difficulties; in making rafts; embarking and disembarking guns; making up ammunition; preparing demands for stores; carrying on gun practice with shot, shell, etc.; making signals; throwing up batteries as at a siege, and afterward testing their efficiency by firing at them; attending lectures on artillery subjects by the officers instructing the classes, and on subjects of a scientific nature, and bearing upon the science of artillery, by professional gentlemen engaged from time to time for the purpose.

The non-commissioned officers attend these latter lectures, and also receive from the schoolmaster, under the direction of the officer in charge of the class (and with great advantage), instruction in mathematics, and in mechanical drawing applicable to the course they are being carried through.

In addition to these "long courses," as they are termed, another class of 33 non-commissioned officers is sent every three months to go through what is termed a "short course," for the purpose of being instructed in the various duties connected with the service, transport, etc., of heavy guns.

The result of this system is that an officer and two non-commissioned officers highly qualified to instruct in all artillery duties and exercises are sent annually to each brigade; also eight non-commissioned officers well qualified to assist in the instruction of the non-commissioned officers and men of their brigades in most duties connected with heavy ordnance, and with enlarged views of artillery subjects generally.

Further instruction is imparted to the regiment by sending batteries from Woolwich, Aldershot, and other contiguous stations, to carry on their practice, and regimental duty. They take guards and fatigues, move guns, and otherwise prepare for experiments, and each in its turn goes through a short course of instruction. The officers and a proportion of non-commissioned officers of these batteries are formed into a class under one of the gunnery instructors and his two assistants, and when they have gone through a preliminary course, one of the batteries, or more if practicable, are taken off duty for a month, in order to go through a systematic course, which, though short, is nevertheless highly valuable.

The staff for government and instruction consists of:

Commandant and Superintendent of Experiments, Brigade major, Surgeon, Adjutant, Quartermaster, Master gunner, Sergeant-major, Quartermaster-sergeant.

School of Gunnery.

1 chief instructor, a field officer.
4 gunnery instructors (including 1 at Woolwich), captains.
1 first-class clerk.
1 third-class clerk.
6 first-class assistant instructors.
1 army schoolmaster.
22 store, magazine, and lobbymen.

Experimental Establishment.

1 Assistant superintendent.
1 second-class assistant superintendent.
1 first-class clerk.
3 laboratory sergeants.
3 range sergeants.
15 storemen, etc.

1 staff wheeler, 1 hospital sergeant, 1 photographer, 1 armorer, 2 wheelers, 2 smiths.

Elementary exercises for the purpose of instructing the squad in dealing with heavy weights without machines, showing the best mode of applying power in moving guns, commencing with light and progressing to guns of 23 tons; instruction concerning ropes, tackles, knots, etc.

Field, garrison, and siege gun drill with smooth bore and rifled guns mounted on various carriages and platforms; drills with howitzers and mortars; throwing up works of offence and defence, arming them and laying platforms, making up ammunition, and arrangements for night firing.

Exercises with military machines; construction of sheers, derricks, etc., and placing them in awkward places; construction of trestle and other bridges for the purpose of passing heavy artillery across ditches, etc., and of rafts for similar purposes.

Embarkation of artillery and horses.

Mounting, dismounting, and moving heavy guns without the aid of machines.

Practice from heavy and field guns, smooth bore and rifled, at known and unknown distances, with full and reduced charges.

Battalion drill and telegraphy.

In the lecture room, instruction in the mechanical powers, in gunnery, systems of rifling, action and penetration of the service projectiles; construction, examination, and record of guns.

Army administration as affecting artillery.

Lectures on gunpowder, gun cotton, and fulminates; on metallurgy; on the various modes of computing velocities and the instruments employed; on electricity and steam; on strategy and tactics.

Cordage, knotting, tackles, parbuckling, pinching, slewing, etc.

Mounting and dismounting with and without gins.

Drill and practice with 32-pr. and 8 seconds guns.

Drill and practice with mortars on standing and travelling beds, also mounting and dismounting.

Drill practice with 40-pr. and 64-pr. guns, firing at moving target; drill with 7 seconds B. L. guns; drill with 7 seconds, 9 seconds, and 12 seconds M. L. R. guns and practice; dismounting and mounting the above.

Laying platforms, etc.

Use of platform wagon.

Light sheers.

Rocket drill and practice.

Facing B. L guns.

Practical examination, etc,

Cordage, knotting, elementary exercises.

Ordinary shifts and machine drill.

Mortar drill and practice.

12-pr. B. L. gun drill and practice.

40-pr., 64-pr. and 7 seconds B. L. gun drill and practice.

7 seconds and 9 seconds M. L. gun drill and practice.

Dismounting 7 seconds and 9 seconds guns by gins and jacks.

Parbuckling 7 seconds and 9 seconds guns and moving on sledges.

Laying platforms.

Rocket drill and practice.

Sheers (heavy and light), derricks, etc.

Facing vent pieces.

Redrilling and examination of the non-commissioned officers.

STAFF COLLEGE AND STAFF APPOINTMENTS.

HISTORICAL NOTICE.

THE Senior Department of the Military College at Sandhurst was constituted in 1808, to enable officers "to qualify themselves for the Quartermaster-General's and Adjutant-General's departments;" and during the Peninsular war, most of the officers in these branches of the service were educated there. So high was its reputation, that the French Staff School was suggested and modeled after it. From motives of economy, its independent government and instruction was gradually reduced, and its graduates, no matter how well qualified, were no longer sure of appointment and promotion, as against purchase, until, in 1855, it became virtually extinct, —the teaching force being reduced to two professors in mathematical studies, and the number of students to six. In the same year, the French Staff School, with its thirteen military and five civil professors, and its range of instruction covering the entire field of practical duties which belong to an efficient staff officer, was held up as a model. In the plans and discussions respecting the reorganization and extension of the educational system of the army, which followed the Crimean war—in the Report (1855) of the Select Committee of the House of Commons on Sandhurst; on the suggestions (1856) of the Commissioners on the Training of officers for the Scientific Corps; the plan of Mr. Sidney Herbert, as Secretary of War, in 1854 and 1856; in the instructions of Lord Panmure, in 1856; in the resolution of the House of Commons, July 28, 1857; in the recommendation of the Royal Commission on the purchase system, in their Report of 1857; in the plans of the Council of Military Education, in the same year—the supreme necessity of a staff college, with admission by competitive examination, and the assured encouragement of appointment and

promotion on ascertained proficiency and general fitness, was so clearly demonstrated, that at the close (December 17) of 1857, the Senior Department of Sandhurst was changed to that of a staff college, with a corps of professors of its own. A separate building was completed for its accommodation, in 1862; admission was open to officers of all branches of the service by competitive examination. All appointments to the Staff were limited to graduates of the College, who had been attached, for specified periods, to each branch of the service, and to officers of approved ability in the field.

The present establishment consists of

1 Commandant; 1 Adjutant; 2 Professors of Mathematics; 7 Professors (1 in each) of Military history, Fortification and Artillery, Military Topography, Military Administration, French, German, and Hindustani; besides the services of the Riding-master, and the Professors of Chemistry and Geology attached to the Cadet College of Sandhurst.

CONDITIONS OF ADMISSION IN 1868.

The college consists of thirty students. Fifteen vacancies will be offered for competition annually. Only one officer at a time can belong to the college from a battalion of infantry or a regiment of cavalry, and only four officers from the Corps of Royal Artillery; but any number can compete. The officer desiring to compete must be serving with his regiment.

The qualifications requisite for admission are:

1. A service of not less than five years previous to examination, exclusive of leave of absence.

2. A certificate from his commanding officer, as to his standing as a regimental officer, and his general knowledge of the service, character, habits, and disposition in respect to employment on the staff.

3. Certificate of having passed the examination for a troop or company.

4. Medical certificate of good health and fitness for the active duties of the staff.

The subjects of the admission examination, and the relative value of each, in the final result, are

Mathematics,		1,200 Marks.
Military History,	600	900 "
Military Geography,	300	
French,		300 "
German,		300 "
Hindustani,		300 "
Fortification,		600 "
Military Drawing,		300 "
Mineralogy and Geology,		300 "
Chemistry, Heat, Electricity, and Magnetism,		300 "

In mathematics 400 marks are allotted to arithmetic, the first four books of Euclid, and Algebra, including questions producing simple equations; and of this number, at least 250 must be obtained for qualification.

Every candidate must take up either the French, German, or Hindustani language for qualification; the qualifying minimum is, in French, 150 marks; in German or Hindustani, 100 marks.

The remaining subjects, as well as the higher portions of mathematics, may be taken up or not at the option of the candidate, the marks gained therein being reckoned in determining his position in the list of competitors. No candidate, however, will be allowed to count marks in any subject left optional unless he obtains at least one-sixth of the number allotted to it.

COURSE OF STUDY.

The course of study occupies two years, and the yearly course is divided into two terms, viz., from February 1 to June 15, and July 15 to December 15. The subjects are

Mathematics.
French, German, and Hindustani.
Fortification and artillery.
Topographical drawing, military surveying and sketching.
Reconnaissance.
Military art, military history and geography.
Military administration, including the organization and equipment of armies in the field.
Military legislation.
Elements of natural philosophy, chemistry, and geology, as applied to the military sciences.
Exercises in composition will be afforded to the students during the whole course of instruction, in writing memoirs or essays on the subjects of the course.
Riding.

During the whole course, monthly reports of the application and progress of each student are forwarded for the information of the Council of Military Education. Examinations are held at the end of every half year; the summer examination being conducted by the professors of the college, and the winter examination by examiners independent of the establishment, under the superintendence of the Council.

EXAMINATIONS.

The examination at the termination of the first year is probationary, and any student who fails to obtain the minimum aggregate of marks specified below, is required to withdraw.

The following five subjects will be taken up by every student at the probationary examination, viz.:

	Maximum.	Minimum.
I. Fortification,	280 Marks	90 Marks.
II. Military drawing and surveying,	270 "	90 "
III. Military history,	300 "	100 "
IV. Military administration and legislation,	300 "	100 "
V. French, German, or Hindustani,	400 "	133 "

Every candidate is expected to obtain 800 marks on the above subjects.

All credits gained on the four military subjects are carried forward to the final examination.

Of the following subjects the student may select any two, and in those numbered from one to six, as well as in the language already selected as "obligatory," the student may, at his option, carry forward to the final examination the marks he gains, provided they amount in each case to three-fourths the allotted maximum, when he will be considered as finally examined in that subject:

1.	Mathematics, lower course,	400 Marks.
2.	Mathematics, higher course,	500 "
3.	French,	400 "
4.	German,	400 "
5.	Hindustani,	400 "
6.	Any other modern language,	400 "
7.	Natural sciences, lower course,	150 "
8.	Experimental sciences, lower course,	150 "

In those numbered seven and eight, the marks gained are carried forward to the final examination.

In addition to any two of the above subjects, the following may be taken up at the probationary examination; and if 150 marks be gained in it, they may, at the option of the student, be carried forward to the final examination:

Spherical trigonometry and practical astronomy, 200 Marks.

The following are the marks attached to each subject at the final examination, including, in the maximum, the marks appropriated to the probationary examinations:

Subjects to be taken up by every student:

	Maximum.	Minimum.
Fortification and artillery,	600 Marks	300 Marks.
Military drawing and surveying,	350 "	350 "
Reconnoissance,	350 "	
Military art, history, and geography,	600 "	300 "
Military administration and legislation,	600 "	300 "
French, German, or Hindustani,	400 "	200 "

Every candidate will be required to obtain for qualification an aggregate of 1,800 marks on the above five subjects.

Of the following subjects, the student may select any two, and the credits gained will count for position in the order of merit:

	Maximum.	Minimum.
Mathematics, lower course,	400 Marks	240 Marks.
Mathematics, higher course,	500 "	300 "
French,	400 "	240 "
German,	400 "	240 "
Hindustani,	400 "	240 "
Any other modern language,	400 "	240 "
Natural sciences,	400 "	240 "
Experimental sciences,	400 "	240 "

In addition to any two of the above-mentioned subjects, the following may be taken up by any student who did not take it up at the first year's examination, or did not then obtain three-fourth marks in it:

	Maximum.	Minimum.
Spherical trigonometry and practical astronomy,	200 Marks	120 Marks.

In the examination in modern languages, great stress will be laid on original composition.

All officers recommended for staff appointments, who have not proved their fitness in the field, must pass examinations before a board of officers and by the Council.

a.—Aide-de-Camp.

Regimental Duty.—The candidate must be prepared in all the subjects required in the examination for promotion to a troop or company.

Tactics and Field Movements.—He will be expected to show a competent knowledge of the tactics and field movements of that branch of the Service to which he is destined to be attached as a staff officer, and a general knowledge of those of the other two arms; the examination will include the movements of a brigade, and will be based on the regulation books.

On being reported by the Adjutant-General to possess the necessary professional qualifications, the candidate will be examined by the Council in

English Composition.—The candidate's proficiency in this respect will be tested by his answers to the examination papers.

Foreign Languages.—He will be examined *viva voce* by the examiner appointed under the Council of Military Education in whatever language he may select and he will also write a short letter on a given subject in that language.

Military Sketching.—He will be required to sketch at least two square miles of ground selected by the Council. The sketch need not be elaborately finished, but it must clearly and intelligibly represent the features of ground, which must be determined by means of the pocket sextant or prismatic compass.

Field Fortification.—He must show a knowledge of the principles and construction of field works, and must explain the objects to which they are respectively applicable, as well as the modes of attacking and defending them.

b.—Brigade Major.

A certificate will be required from the commanding officer of the regiment to which the candidate belongs, or has belonged, that he possesses all the qualifications of a good adjutant. The examination for brigade major will be especially directed to the points more immediately connected with the duties attached to the appointment, as Military Law, the "Queen's Regulations and Orders of the Army," the Royal Warrant for Pay, Promotion, etc., and, in tactics, all that relates to alignments, points of formation, distances, etc. The subjects of examination are the same as in that for the appointment of aide-de-camp, but the examination will be, throughout, of a higher order.

c.—Deputy Assistant Adjutant-General, Deputy Assistant Quartermaster-General.

Military Drawing and Sketching, Judgment of Ground, and its Occupation by all Arms.—The candidate will be required to make a rapid sketch on horseback, with report, of about six square miles of country; and to select a position which might be occupied by a given force of the three arms, for some stated object, and to show how he would dispose the troops for that purpose. He will afterward be required to make a correct and more finished plan of the position selected, with the disposition of the troops shown upon it.

Practical Geometry and Trigonometry.—The examination in these subjects will be limited to determining heights and distances by ground problems, and the ordinary trigonometrical calculations with the aid of logarithms.

Castramctation.—The candidate will be expected to know the mode of encampment for each arm of the Service.

Permanent Fortification.—The theory and construction of permanent works, as exemplified in Vauban's or any other system the candidate may select, as well as the modes of attack and defence applicable to them.

Military History and Geography.—The candidate will be expected to give proof that he has carefully studied at least four of the most memorable modern campaigns, of which the details are best known, such as those of Marlborough, Frederick the Great, Napoleon, and Wellington, and in these he must be able to explain the apparent objects of the various movements and the reasons which he supposes led to their adoption, and, further, to describe the military geography of the seat of war.

Foreign Languages and Professional Subjects.—In languages before the Council of Military Education, as well as in professional subjects before the Board of Officers, the examination will be of a higher order than those in (*a*) and (*b*).

The examination for Assistant Adjutant-General and Assistant Quartermaster-General will, throughout, be of a higher order.

MUSKETRY, AND OTHER ARMY SCHOOLS.

SCHOOL OF MUSKETRY AT HYTHE.

The first School of Musketry was established in June, 1853, and was composed of detachments from regiments in the neighborhood, viz.: a sergeant, a corporal, and eight rank and file, from the first, second, and third battalion of the Grenadier Guards, Coldstream Guards, Scots Fusileer Guards, Rifle Brigade, etc., to the number of eleven sergeants, eleven corporals, and eighty-eight rank and file. In 1855, a permanent corps of instructors of musketry was organized, and in 1861 a second school was instituted at Fleetwood, which was discontinued in 1867, as one establishment was found sufficient for training an adequate number of officers of the regular army, and a due proportion of officers and sergeants of militia and the Rifle Volunteer Corps.

In connection with the establishment at Hythe, district inspectors are appointed to superintend the general system of musketry instruction throughout the army, viz., three in Great Britain, two in Ireland, five in the colonies, and ten in India.

The instruction embraces not only the practical use of fire-arms, but the details of construction, both of the weapon and ammunition, the theory of projectiles, and the comparative value of different arms for different services.

The staff of the School of Musketry at Hythe consists of 1 Commandant and Inspector-General of Musketry Instruction; 1 Deputy Assistant Adjutant-General; 1 Chief Instructor; 2 Captain Instructors; 1 Paymaster; 1 Quartermaster and Acting Adjutant; 1 Surgeon.

In addition to the preparatory and professional schools for officers of the British Army, already described, there are other public institutions of a military character and for the military service, which will be briefly noticed.

ARMY SURGEONS.

In addition to the competitive examination of candidates for the post of Assistant Surgeon, for which a medical degree is preliminary, the successful candidates must spend four months at Netley, where the Army Medical School is now located (since 1863), in connection with the Royal Victoria Hospital (capable of receiving one thousand patients), where large numbers of invalid patients of the army are treated. Here, with every facility of study, observation, and practice, instruction is given by four professors, each with an experienced assistant, in military surgery, medicine, pathology, and hygiene, and all the specialities of the military hospital and field practice, peculiarities of climate, etc. After spending at least four months in the hospital, laboratory, museum, and lecture-rooms, the candidate is then examined for his commission as Assistant Surgeon.

VETERINARY SURGEON.

Although not exclusively for military service, all veterinary surgeons in the army must hold the diploma of the Royal Veterinary College in St. Pancras, London, or of the Veterinary School in Edinburgh.

ARMY SCHOOLS FOR SOLDIERS AND SOLDIERS' CHILDREN.

In 1811, on the recommendation of the Duke of York, then Commander-in-Chief, a royal warrant was issued, authorizing the appointment of a sergeant-schoolmaster to each batallion for young recruits and the children of soldiers, with provision for room, fuel, and light in each regimental barrack, and allowance for necessary books and stationery. In 1846, to give greater efficiency and uniformity to the schools established under the warrant of 1811, a new warrant was issued, requiring that the sergeant-schoolmaster should obtain a certificate of fitness from the military training college at Chelsea, and ordering the appointment of an inspector of army schools. In 1854, the following classification of masters was introduced: *First Class*, at 7*s.* a day and certain allowances; *Second Class*, at 5*s.* 6*d.* per day; *Third Class*, at 4*s.* per day; and *Assistants* at 2*s.* The first-class schoolmaster was a warrant officer, and ranked next to those holding a commission; the second and third class ranked next to sergeant-major, and the assistants ranked as sergeants. At this time the privileges of the regimental schools were extended to the children of discharged soldiers, pensioners, and various persons employed about the barracks. A schoolmistress was also employed for the infant division of pupils, and for teaching needle-work to the girls. In 1863, the office of superintending schoolmaster, with a relative rank of ensign, was created, and four (since increased to twelve) from among the most experienced first-class masters, were appointed to inspect and examine all army schools in their several military districts, and candidates for pupil-teachers and schoolmistresses.

According to the report of the Council of Military Education, for March, 1870, there were two hundred and fifty-nine masters employed by the army schools, and four hundred and eighty-five mistresses and assistants in the children's schools. In Great Britain there were three hundred and eighteen schools, and thirty-five thousand three hundred and seven non-commissioned officers and men on the books, nine thousand three hundred and fifty-nine boys and girls, besides 11,414 children in the infant schools.

ASYLUM FOR SOLDIERS' ORPHANS.

Prior to the establishment of the Army Schools in 1811, two large institutions for orphan children of soldiers who had fallen in battle or serving at foreign stations, had been founded and maintained at the public expense.

The Royal Hibernian Institution at Dublin, Ireland, was commenced on a sum appropriated by the Irish Parliament in 1765, and chartered in 1769. It has large buildings, with thirty-four acres of land, and provides for four hundred and ten children on an annual parliamentary grant of twelve thousand pounds for its maintenance, besides the income from a small endowment.

The Royal MilitaryAsylum in Chelsea was begun by the Duke of York in 1801, and can now accommodate five hundred children on a public grant of twelve thousand pounds, besides a further grant of three thousand pounds for furniture and clothing from the Board of Works and the general vote of the army.

NORMAL SCHOOL FOR TEACHERS IN ARMY SCHOOLS.

In the Military Asylum at Chelsea, since 1846, there has existed a Normal School, where teachers of army schools may review their studies, or candidates for vacancies, or pupil teachers, may qualify themselves by study, observation, and practice, for appointment as schoolmasters, and when found qualified they receive certificates of the first, second, and third class, and are paid accordingly.

MILITARY SCHOOL OF MUSIC AT KNELLER HALL.

In the British Army the cost of maintaining the regimental bands falls upon the officers. In the infantry a sergeant, a corporal and nineteen privates are taken from the effective strength of each regiment to form a band. These receive their ordinary regimental pay,—the rest of the pay, and the entire salary of the band-master, if a civilian, together with the cost of the music and musical instruments, are provided out of the Band Fund, which is raised by "stoppages" from the officers on first appointment, and promotion, and by subscription. This fund is managed by a committee of officers. Owing to difficulties in retaining the men, and of finding band-masters with all the requisite qualifications, the Commander-in-Chief (Duke of Cambridge) established a Military School of Music in 1856, in concert with the Secretary of War, which was opened in Kneller Hall for the reception of pupils in March, 1857. The institution must be viewed (1) as a barrack, and (2) as a school of music. (1). As a barrack it is under the direction of the Secretary of War, and is managed as any other barrack. (2). As a school it is under the immediate direction of a military officer (who is appointed by the Commander-in-Chief), and a musical staff composed of nine permanent professors, four occasional professors, and a varying number of special assistants who are selected from the first-class students. There is also a schoolmaster who gives instruction one hour a day in general knowledge to each class, and a military chaplain. The instruments taught in Soprano (8); Alto (3); Tenor (3); Bass (6). The students are divided into four classes, each of which is divided into sections according to the instruments to be learned. Seven hours a day are devoted to obligatory study—but more are given, and a restriction prohibits all practice after 6.45 in the evening.

This course of study occupies two years, and there is a higher which comprises, beside practical instruction in playing and teaching the instruments composing the band, some general acquirements under the theory of harmony. There is also practical training in the duties of a conductor. In addition to ordinary military music, classical concert pieces, or chamber music, specially arranged for wind instruments, are performed. Cheap admissions to the operas and principal concerts of the metropolis are obtained (900 in one year), to such of the advanced students as are recommended for diligence by the professors.

Pupils are selected from the various regiments, and often selected for this special purpose. Boys specially trained for the bands are obtained from the Royal Military Asylum, Chelsea, the Hibernian Military School, Dublin, and the Metropolitan Poor-law School. Each candidate must be examined by the surgeon of the regiment, and certified to as in good health and with no tendencies to disease liable to be aggravated by playing on a band instrument.

A military band-master is now sanctioned by the Government for any regiment and battalion throughout the service, who receive regimental pay of first-class staff sergeant, and 100*l.* from the Regimental Band Fund.

The expenses of Kneller Hall as a barrack are borne by the government; as a school of music, by the regimental officers—including an original assessment of 5*l.* for supply of instruments, and the salaries to about 1,100*l.* annually.

The average number of students annually admitted is 74; the average number in attendance, 148. The total number admitted since 1857 is 592, of whom 163 were practiced musicians, 63 band-masters, 271 band-men.

III. NAVAL AND NAVIGATION SCHOOLS IN ENGLAND.

Preliminary Remarks.

Before describing a class of schools in England, which is now receiving special attention and aid from the Science and Art Department of the Committee of Council on Education, viz. Navigation Schools, we will glance at the condition of Nautical Education generally in this great maritime and commercial country.

The old system of training officers for the Royal Navy, under which mere children with the smallest possible amount of elementary knowledge, made the ship their school, even after a Naval Academy was established, had its peculiar advantages as well as its drawbacks. The captain, having the nomination of an almost indefinite number of "youngsters," stood towards them in *loco parentis*. He was their governor, guardian, and instructor, and did not "spare the rod" when he thought its application necessary. The captain was then looked up to with a feeling bordering on awe. Without assigning a reason he could disrate or discharge a midshipman; and he could also do much towards pushing him on in the service. The youngster felt that he was entirely in the power of his captain, and, unless of a reckless cast, used his best endeavors to gain his favor. The captain, on the other hand, talked of *his* youngsters with pride. He, (if he belonged to the better class of naval captains,) took care that every facility should be afforded them for learning their duty, often made them his companions on shore, and superintended their education afloat, sometimes taking a leading part in their teaching. He felt responsible for their bringing up, for some were sons of personal friends or relatives whom he had promised to watch over the youthful aspirants, and all were more or less objects of interest to him. But all this was swept away in 1844, and the captain's patronage limited to one nomination on commissioning a ship, the Admiralty taking the rest of the patronage into their own keeping. And what was the result? No sooner had the Admiralty absorbed the naval patronage—for the captain was frequently shorn of his one nomination before leaving Whitehall with his commission—than old officers and private gentlemen in middling circumstances found themselves unsuccessful applicants, while the influential country gentleman totally unconnected with the service, but able perhaps to turn the scale of an election, was not under the painful necessity of asking twice for a naval cadetship for his son, or the son of his friend. But what cared the captain for these Admiralty nominees? Too many of them were incapable of profiting by

their opportunities, and others neglected to avail themselves of the instructions of the professors of mathematics, and became the victims of dissipation.

I. Naval Officers.

Royal Naval Academy.

The first attempt to educate lads for the naval service of England was in 1729, when the Royal Naval Academy was instituted in Portsmouth Dockyard. The course of instruction included the elements of a general education, as well as mathematics, navigation, drawing, fortification, gunnery, and small arm exercises, together with the French language, the principles of ship-building and practical seamanship in all its branches, for which latter a small vessel was set apart. The number was limited to forty cadets, the sons of the nobility and gentry, and attendance was voluntary. Small as the corps was, it was never full, probably because there was an easier way of gaining admission to the service through official favoritism, by appointment direct to some ship, on board of which during a six years' midshipman's berth, he acquired a small stock of navigation and a larger knowledge of seamanship and gunnery practice. In these ships where the captains were educated men, and took a special interest in the midshipmen, and competent instructors were provided and sustained in their authority and rank, this system of ship instruction and training worked well, as under the same conditions it did with us. In 1773 a new stimulus was given to the Academy by extending a gratuitous education to fifteen boys out of the forty, who were sons of commissioned officers. In 1806, under the increased demand for well educated officers, the whole number of cadets was increased to seventy, of whom forty were the sons of officers and were educated at the expense of the government. From this date to 1837 the institution was designated the Royal Naval College, but without any essential extension of its studies. In 1816 a Central School of Mathematics and Naval Architecture was added to the establishment, and in 1828 the free list was discontinued, and the sons of military officers were allowed to share the privileges of the school with the sons of naval officers, at a reduced rate in proportion to their rank. To keep up the number of students who would go through the four years course, it became necessary to extend special privileges, such as made promotion certain and rapid over those who entered the navy direct. This produced inconveniences and jealousies, and in 1837 the Naval College was discontinued.

Training Ship and Naval College.

In 1857 the Admiralty adopted the plan of a Training Ship for naval cadets. The candidate was to be from thirteen to fifteen years of age, and to pass an examination in Latin or French, Geography, Arithmetic, including Proportion and Fractions, Algebra, to Simple Equations, the First Book of Euclid, and the Elements of Plane Trigonometry. At the end of twelve or six months, according to age, spent in study and practice on the Training Ship, the cadet was examined in the studies before enumerated

with the addition of Involution and Evolution, Simple Equations, the Elements of Geometry, and of Plane and Spherical Trigonometry, the simple rules of Navigation, the use of Nautical Instruments, Surveying, Constructing Charts, and the French language, besides an elaborate course of Seamanship, and attendance on lectures on Chemistry, Physics, Hydrostatics, &c. If this examination was satisfactory, the cadet was appointed to a sea-going ship, and at the expiration of fifteen months' service he was eligible for the rating of midshipman upon passing a further examination. The course in the Training Ship (first the "Illustrious," and subsequently changed to the "Britannia," first in Portsmouth harbor and more recently at Dartmouth,) proved too extensive for mastery in one year; and in 1861 the conditions for admission were lowered, the examinations in the school were made quarterly, and competitive, and if passed creditably at the end of a year, according to a fixed standard, (3,000 being the number of marks attainable, and 2,100 giving a first class certificate,) the cadet is rated at once as midshipman, and credited a year's sea-time. If he receives a second class certificate (1,500 marks,) he must serve six months at sea, and pass another examination before he can be rated midshipman. The cadet with a third-rate certificate (1,200 marks,) must serve twelve months at sea, and pass another examination for his midshipman's rating. Prizes and badges are also given, and the stimulus of competitive examination is applied as shown in the grading of certificates.

Gunnery Instruction.

In 1832 a uniform and comprehensive system of gunnery instruction was provided on the "Excellent," under command of Captain (now Sir Thomas) Hastings. To give such officers who were found deficient in the scientific knowledge requisite for a full understanding of the theory of gunnery, the Naval College was re-opened in 1839, under the general superintendence of the Captain of the Excellent, with Professors of Mathematics, Navigation and Nautical Astronomy, Steam Machinery, Chemistry and Marine Artillery. Accommodations were provided for twenty-five half-pay officers, (captains, commanders, and lieutenants,) and a certain number of mates on full pay, for whom a special course of study was instituted. The time allowed at the College was a clear year's study, exclusive of vacations, and those who have completed the course rank among the most distinguished officers of the profession.

Instruction in Steam and the Steam-Engine.

When steam vessels came into use in the Navy, to qualify officers for special service in them they were encouraged to resort to Woolwich Dockyard, and afterward to the Portsmouth yard, where an instructor was appointed and facilities for observation, study, and experiments were provided. Many officers repaired to private factories, and worked at the lathe, in stoke-hole and the engine-room, and thus acquired a practical knowledge of this department of their profession. When the Naval College was estab-

lished on its present footing, a small steamer, the "Bee," was built and attached under the charge of the instructor in steam-machinery. And now the greater part of the captains and commanders on the active list have obtained certificates of having passed the course in Steam and the Steam-engine.

Admiralty Order respecting Naval Cadets and Midshipmen, dated April 1, 1860.

CADETS.

"I. No person will be nominated to a Cadetship in the Royal Navy who shall be under 12, or above 14 years of age, at the time of his first examination.

"II. Every candidate, on obtaining a nomination, will be required to pass an examination at the Royal Naval College at Portsmouth, within three months of nomination.* In the special cases of nomination granted to the sons of natives of the colonies a candidate will be allowed to pass a preliminary examination on board the flag or senior Officer's ship on the Station. But such an examination must be passed in strict accordance with these regulations, and should the candidate be found qualified, it will still be necessary that he should be sent to England, to be entered on board a training ship, where he will be subject to the same regulations as other Cadets.

"III. The candidate must produce a certificate of birth, or a declaration thereof made before a magistrate.

"IV. Must be in good health and fit for the Service—that is free from impediment of speech, defect of speech, rupture, or other physical inefficiency.

"Candidates will be required—1. To write English correctly from dictation, and in a legible hand. 2. To read, translate, and parse an easy passage from Latin, or from some foreign living language—the aid of a dictionary will be allowed for these translations.

"And to have a satisfactory knowledge of—3. The leading facts of Scripture and English history. 4. Modern geography, in so far as relates to a knowledge of the principal countries, capitals, mountains and rivers. To be able to point out the position of a place on a map, when its latitude and longitude are given. 5. Arithmetic, including proportion, and a fair knowledge of vulgar and decimal fractions. 6. A knowledge of the definitions and axioms of the First Book of Euclid.

"As drawing will prove a most useful qualification for Naval Officers, it is recommended that candidates for the Service should be instructed therein.

"V. Candidates will be allowed a second trial at the next quarterly examination Should he not pass this second examination he will be finally rejected.

"VI. If the candidate succeeds in passing the required examination he will be at once appointed to a training ship, for the purpose of instruction in the subjects contained in Sheet No. 1,† as well as in the rigging of ships, seamanship, the use of nautical instruments, &c.

"VII. Quarterly examinations will be held on board the training ship, when any candidate may be examined in the subjects contained in Sheet No. 1, and also, in the course of instruction, in the rigging of ships, seamanship, &c.

"VIII. If a candidate be found at the quarterly examinations, not to have made sufficient progress, or if, by indifferent conduct or idle habits on board the training ship, he shall show his unfitness for the Service; it will be the duty of the Captain to make a special report thereof to the Admiralty, in order that the Cadet may be at once removed from the Navy.

"IX. When the candidate shall have completed twelve months' instruction, exclusive of vacations, in the harbor training ship, he will be examined, and

* These examinations will take place on the first Wednesdays in the months of March, June, September, and December.

† The examination on leaving the training ship will embrace all the subjects of the former examination, except Latin, and in addition to them it will include, in algebra, simple equations; the elements of geometry, plane trigonometry, and the solution, &c., as in the Circular No 288, dated Feb. 23rd, 1857; and in addition the use of the globes with correct definitions of latitude, longitude, azimuth, amplitude, and other circles of the sphere, and drawing.

should he obtain a certificate of proficiency, he will be discharged into the sea-going training ship. A first-class certificate will entitle him to count twelve months' sea time; a second-class, will entitle him to count six months' sea time; a third-class, will entitle him to count six months' sea time. But should he not obtain a certificate, he will be discharged as unfit for the Service.

"X. On leaving the harbor training ship, it is intended that the Cadet shall pass three months in a sea-going training ship, for practical instruction in seamanship and navigation, which period will count for sea time, and at the end of this period, if his conduct has been satisfactory, he will be appointed to a ship with the rating of a Midshipman.

MIDSHIPMEN.

"To qualify a Midshipman for a Lieutenant's Commission he must have attained the full age of 19 years, and have completed 5½ years' actual service in Her Majesty's Navy, including the time awarded to him on leaving the training ship.

"XI. All Midshipmen, until they have passed their examinations for Lieutenants, are to keep a book in which the ship's reckoning is to be worked out and noted; at sea, this book is to be sent in every day to the Captain, instead of the slip of paper containing a day's work. It is also to be produced at their examinations; and during the last six months of their service as Midshipmen, it must contain the working of the observations.

"XII. A Midshipman when he shall have served two years and a half in that rank will be required to pass the following examination:—1. In practical navigation, showing that he understands the principle of navigating a ship from one distant port to another, by dead reckoning and by his own observations; and that he can explain the principles of the same; and that he can also take and work a double altitude and azimuth. 2. A sufficient knowledge of a chart to enable him to place thereon the position of the ship by observation as well as by cross bearings; and to lay off the true and compass courses. 3. Such knowledge of nautical surveying as may enable him to measure a base line and determine positions by angles, and the manner of ascertaining heights and distances. 4. If he has served in a steam vessel, an acquaintance with the different parts and working of the steam engine. 5. A proficiency in French to be attained if he has had an opportunity. 6. He must be a good practical observer, and his sextant must be produced in good order. 7. He must produce log-books kept by himself from the time of his entering into a sea-going ship, and certificates of good conduct.

"8. He will likewise be examined as to his progress in the knowledge of rigging masts, bowsprits, &c. He must also know the great gun and small arm exercise, the use of tangent sights, the charges for the guns of the ship, and be able to exercise the men at his quarters. A report of the progress he has made in each of the above subjects is to be made to the Secretary of the Admiralty in the half-yearly return.

"This examination is to be conducted by the Officer in command, not below the rank of Commander, and the next senior Officer in the ship, and the examinations in navigation in the presence of a Captain or Commander, by two Naval Instructors, when it may be practicable, or by a Naval Instructor and a Master, or, where there is no Naval Instructor, by two Masters; that in gunnery, by a gunner, or other competent Officer; and the candidate is to be made to take and work out his own observations for latitude, longitude, variation, &c., as the case may be. First or second class certificates are to be given according to the merit of the candidate, in the form A, page 8, or he is to be rejected if found incompetent.

"XIII. A Midshipman, having completed his term of service, and being 19 years of age, may be provisionally examined by the Captain or Commander of such ship or vessel with the aid of other competent Officers, Lieutenant, Master, or second Master, when no other ships are present; and if they find him to be duly qualified they are to give him a certificate to that effect, dated on the day of such examination, and the Captain may forthwith give him an acting order as Mate; but he must be re-examined, on the first opportunity that shall afterwards offer, by three Captains or Commanders, and if he passes successfully he

will receive from the Commander-in-Chief, or senior Officer, an acting order as Mate, to take rank according to the first certificate.

"The examining Officers are to be most strict in their investigation of the qualifications of Officers, and they are to see that everything required by these Regulations has been complied with by the candidates, and that he produces certificates of good conduct from Captains he has served under from the time of his discharge from the training ship.

"XIV. All Acting Mates and Midshipmen will be required to undergo the following final examinations,—1. In Seamanship—On board the training ship at Portsmouth. 2. In Gunnery—On board the *Excellent*. 3. In Navigation and the Steam Engine—At the Royal Naval College.

"Acting Mates, who have already passed abroad, are to present themselves for examination, on board the training ship at Portsmouth, at the first examination day after their arrival in England, or after being paid off, and having passed in gunnery they are then at liberty to select either the first, second, or third examination day at the Royal Naval College.

"XV. Any Officer rejected on his first examination at the College will incur the forfeiture of three months' seniority in his rank as Mate. He may present himself on the next examination day, but a second rejection will incur the forfeiture of three months' more seniority; he may again present himself on the next examination day, but a third rejection will cause his name to be removed from the list of the Navy.

"XVI. Officers, when they have passed their final examination at the Royal Naval College, as provided for in these Regulations, will be confirmed from the date of their first certificate. The non-appearance of an Officer for examination at the Royal Naval College at the times required by these Regulations will be considered as an acknowledgment of his not being qualified, and he will be dealt with in the same manner as if he had been actually rejected, on each day on which he may have omitted to appear, unless under certified ill-health, to be duly reported at the time.

"XVII. Naval Instructors are to keep a school journal, or register, which is to be produced when required by the Captain of the ship or the examining Officers, and the Captain is to allow them reasonable access to the charts and chronometers, for the purpose of instructing the Officers in their use.

"XVIII. The Captains of Her Majesty's ships are to take care that a convenient place is set apart and proper hours are fixed for instruction by the Naval Instructor; and all Acting Mates and Acting Second Masters, as well as all executive Officers under that rank, are to attend; and care is also to be taken that they are regularly instructed in practical seamanship, rigging, and the steam-engine, and a monthly examination day is to be established.

The subject of Education for Officers has been recently under discussion in Parliament, and some modifications of the existing system is now under the consideration of the Admiralty, looking to greater maturity of age and preparation for admission, a more extended and thorough course of scientific training in cadets, and continued opportunities of study with accompanying examinations for officers up to the grade of commanders.

II. The Royal Marine Artillery.

In 1804 an artillery company was attached to each of the three divisions of the Royal Marine Corps, to supply the service of the bomb-vessels, and in time of peace, to drill the whole of the marines in gunnery. But they were soon made available for other purposes, and on the outbreak of the American war in 1812, a large body of the Marine Artillery, with a field battery and rocket equipment, accompanied the battalions of marines then formed for service in America. In 1817 this force was augmented to eight companies, and Sir Howard Douglass, while advocating the establishment

of "Naval Depots of Instruction," for the purpose of converting officers and men of the Royal Navy into efficient gunners, complimented the Marine Artillery as being "either a corps of good infantry, of scientific bombardiers, or expert field artillery men, well constituted, thoroughly instructed, and ably commanded." It was not until June, 1830, that an Admiralty order directed that a school of gunnery should be established at Portsmouth, on board the "Excellent," and with the intention of making this school the one means of instruction in this department, it was farther ordered, in December, 1831, that the Marine Artillery, as a distinct and separate corps, should be broken up, retaining two companies as a nucleus of a larger force, should such become necessary. And the necessity appeared; for the experience of a few years proved that it would be impossible for the school to effect, to any important extent, the results which were desired. In 1841, therefore, a third company of the artillery was ordered; in 1845, two more; and by subsequent additions, its strength was raised in 1859, to sixteen companies, with a total of 3,000 officers and men, who were formed into a separate division with its head quarters at Fort Cumberland.

The officers of the Marine Artillery were at first appointed from the marine corps, without any particular qualifications being required, but afterwards their appointments were made probationary and conditional upon the satisfactory completion of a prescribed mathematical course. In 1839 it was decided that a certain number of second lieutenants should be allowed to prepare themselves for examination on board the Excellent, and upon the re-opening of the Royal Naval College as an educational establishment for mates, it was arranged that the students for the artillery should be transferred to it, and that their success or failure, after a years' further study, should decide upon their appointment to the artillery. Another and final modification took place upon the introduction of preliminary examinations for the marines, and the subsequent formation of a cadet establishment on board the Excellent. In case of vacancies in the artillery, those who had passed the best examinations upon first entering the corps, were selected for the College, and no officers were allowed to become candidates on any other terms, their final success depending as before, upon the progress they might make as students at the College.

The cadets have their periods of study limited to two years; it may be less, but can not be more. They have to acquire a competent knowledge in Arithmetic, Algebra, Euclid, including the first four books and part of the sixth, Plane Trigonometry, the use of the Sextant, Fortification, English History, and French. To this may be added a practical course of Naval Gunnery. Their studies are carried on under the direction of a mathematical instructor, and an instructor of fortification. A French master attends twice a week. If on obtaining his commission, the young marine officer is selected to qualify for the artillery at College, he must be prepared at the end of a year to pass an examination in Analytical Trigonometry, Differential and Integral Calculus, Conic Sections, Statics and Dynamics,

Hydrostatics, and "Steam," besides being required to have an increased knowledge of Arithmetic, Algebra, and Fortification. In a year little more than a superficial knowledge of these studies can possibly be attained, yet insufficient as this period clearly is, it has sometimes been the case that, when a large number of subalterns were required for the artillery, young officers have been appointed who have completed only half their term at College. Having thus gained his appointment to the artillery, his remaining in it depends upon there being a vacancy or not at the time when his seniority on the general list of the corps advances him to each successive grade of rank.

The men are volunteers from the light infantry divisions, possessing certain specified qualifications as to age, height, intelligence and character.

The course of training, which is with a few exceptions, common to both officers and men, is very comprehensive; it includes—

1. The usual infantry drills and musketry instruction.
2. The exercise of field guns and rockets, with such field battery movements as are of real practical importance.
3. The service of heavy ordnance, including guns, howitzers, and sea and land service mortars.
4. The naval great gun exercise.
5. Mounting and dismounting ordnance, with or without machines.
6. The various methods of slinging and transporting ordnance.
7. Knotting, splicing, and fitting gun gear, use of pulleys, &c.
8. A laboratory course, including:—use and preparation of tubes, rockets, and fuzes; making up cartridges; manufacture of port fires, Valenciennes stars, signal rockets, blue lights, &c., with instruction in the manufacture and effects of gunpowder and other explosive compounds.
9. A course of practical gunnery, comprising—instruction in the nature and uses of the various kinds of guns, howitzers, and mortars; in the natures, employment, and effects of the various projectiles; disparting and sighting ordnance; heating and firing red-hot shot; and such matters connected with the theory of projectiles as may have a practical application.
10. Practice from different natures of ordnance, with every description of projectile.

The system of instruction is so arranged that every officer and non-commissioned officer is qualified, as far as practicable, as an instructor, a registry being kept of each man's progress and capabilities. A spirit of emulation has been created, attended with the happiest results, and the whole course is now gone through in less than twelve months, without the men being wearied or overworked.

III. Schools for Warrant Officers, Seamen, and Boys.

1. *Seamen's Schoolmasters.*

Schoolmasters for seamen are allowed on all ships having a complement of not less than three hundred men, and an allowance of £5 per annum is

granted, in addition to the pay of any rating he may hold, to a qualified person doing this duty of the captain's orders, in ships not having a seamen's schoolmaster. An allowance is made for books, slates, &c. to all ships having schools. The success of the school to the boys and the men depends mainly on the interest shown in it by the captain and second officer in command, and especially on the character of the schoolmaster employed. The situation is too often filled by an old quartermaster, or sergeant of marines, who obtains the berth as a kind of retirement, or by some person who has a fancy for sea life, but who is fit for nothing on shore, much less for teaching under the difficulties of a ship at sea. It is found that when the schoolmaster is qualified for this special service, and is entered for continuous service, and being placed in regard to pay, pension, and good conduct badges on an equality with other chief petty officers, and when a log or register of attendance is kept, and frequent reports are made to superior authority, the result is highly conducive to discipline, and to the elevation of the seamen's habits and character. One of the Commissioners recently appointed to examine into the state of popular education among every class of British subjects, speaking of the effect of this class of schools upon the men on board the ships, says: "After visiting the "Cambridge," at Plymouth, as I walked with the captain through the lower deck, I found many, both boys and men, reading books with the greatest attention. In the evening of the same day, on the lower deck of the "Agincourt," I found the same scene, while others were engaged in draughts, chess, or writing letters to their friends." With the present scale of punishment on board of men of war, the school is an indispensable element of discipline. The Commissioners referred to, in their report to the Queen, recommend that schoolmasters of higher qualification be appointed, with an increase of pay, and promotion by merit, when their schools are reported favorably upon by any authorized inspectors, and with the same retiring pension as master-at-arms, and that in addition to an elementary general education, a knowledge of navigation, physical geography, and natural history be required of candidates.

2. *Schools on board of Ships in Harbor.*

A second class of naval schools consists of Harbor Ships, into which boys entered for admission to the Navy, are received until they are drafted into the various sea-going ships. Four of these ships, the "Victory" and "Excellent," at Portsmouth, the "Impregnable" and "Cambridge," at Plymouth, are specially devoted to instruction. Boys remain in these ships for one year. The first part of this period is generally spent on board the ship, the latter part in the practising brig, in which during the summer months they are out at sea for five days during the week. There is a school under a seamen's schoolmaster on board of each of these ships. The Commissioners report that the school time is necessarily subject to great interruptions, but that much valuable instruction might be given with better organization and methods. They recommend that an educa-

tional test for admission to these training ships be introduced, which would at once have a good effect upon the general education of the people resident in the seaport towns, and elevate the intelligence, morality and manners of the seamen.

3. *Royal Marine Schools.*

There are four schools attached to the divisions of marines quartered in barracks respectively at Woolwich, Chatham, Portsmouth and Plymouth, and another to the division of marine artillery quartered at Portsmouth. These five schools are attended by the marines and their children. The attendance of the men is for the most part voluntary, with the exception of the non-commissioned officers, who are obliged to attend the school until they have passed a prescribed examination. In the marine artillery every man is required to read and write, and if deficient in these respects, he is obliged to attend the school until his requirements are reported to be satisfactory. The Commissioners recommend that a better class of schoolmasters be specially trained and employed, and that they receive better rank and pay, and more efficient assistance in the discharge of their duties, and that trained mistresses be employed as assistants in the boys' schools, and have the exclusive charge of the girls' schools, in all of which sewing should be taught and practised daily.

4. *Dock-yard Schools.*

There are seven dock-yard schools, held in the respective dock-yards of Deptford, Woolwich, Chatham, Sheerness, Portsmouth, Devenport, and Pembroke. They were founded in 1840, and are designed for the instruction of the apprentices employed in these establishments. The masters of them were originally foremen of the yard, men of good attainments, who had for the most part received their education in the School of Naval Architecture; but in 1847 a special class of schoolmasters was established, ranking as foremen of the yard. The object of these schools is to advance the education of the young men, since none are admitted as apprentices to become shipwrights until they have passed an examination.

Examinations for admission as apprentices to the dock-yards are held half-yearly, and about one-half are given to the lads who pass the best examinations, and the other half to nominees of the superintendent. These latter, however, are required to come up to a prescribed intellectual standard. The examinations are held under the Civil Service Commissioners, in the following subjects:—1. Dictation exercises to test Hand-writing and Orthography. 2. Reading. 3. Arithmetic. 4. Grammar. 5. English Composition. 6. Geography. 7. Mathematics, (Euclid, first three books, Algebra including Quadratic Equations, Arithmetical and Geometrical Progression.) The master shipwright and the schoolmaster are of opinion that the boys entered by competition are the best, and among the working shipwrights themselves the opinion is unanimous that the system of entering at least one-half by competition ought not to be done away.

The effect in inducing parents to keep their children at school in order to fit their sons for examination is very manifest, and the justice of promotion by personal merit is felt and acknowledged by all.

For the first three years all the apprentices are compelled to attend, while those in the fourth year may volunteer to attend with others if they show an aptitude for study, and a disposition to profit by the opportunities afforded them. The fifth-year apprentices may attend after the hours of labor. So long as admission to the Central School of Mathematics and Naval Construction at Portsmouth, and an immediate appointment and regular advancement to the higher offices in the yard, after leaving the latter establishment, stimulated young men to the acquisition of knowledge, the attendance for the fourth year was numerous and regular. But the abolition of the School of Mathematics, and with it the consequent promotion of its graduates, operated very unfavorably both on attendance and habits of private study.

In 1859 the Admiralty adopted a supplementary course of study for such apprentices as have been diligent in their work, exemplary in conduct, and made satisfactory progress in acquiring a knowledge of their trade. This course, extending over two years for three hours a day, embraces Descriptive Geometry, Elementary Mechanics, and Hydrostatics, Logarithms, Calculations of displacement, Stability of ships, &c., Plane Trigonometry, Differential Calculus, with Analytical Geometry, Advanced Mechanics, Hydrostatics, and Dynamics. This class of apprentices perform the duty ordinarily devolved on mould loft apprentices, under the superintendence of the draughtsmen in the mould loft. Scholarships of twenty pounds per annum are granted to such members of the class as show superior ability, attainments, and good conduct.

In the year 1859 there were 1,060 pupils in the five Dock-yard Schools, viz.: 461 apprentices, and 599 factory boys, the latter attending mainly in the evening.

The Commissioners pronounce these schools valuable institutions, both to the state and to the individuals, and they have demonstrated, according to the testimony of one of the master shipwrights, that the educated boy makes the superior workman, and the most moral and temperate man. They recommend that a better class of teachers be employed, and that their pay should be increased by half the amount of the scholarship accorded to the most proficient pupils of the advanced class, and that the intellectual part of the examinations for promotion should be conducted by the Civil Service Commissioners. To make this class of schools what they should be, much must be done to improve the education of the laboring classes, outside of the dock-yards.

5. *Greenwich Hospital Schools.*

The Greenwich Hospital School for 200 pupils, the orphans and sons of disabled seamen, and known as the Upper School, was founded in 1715. In 1805 the Royal Naval Asylum (founded in 1798,) consisting of 600 boys

and 200 girls, was removed to Greenwich, and in 1821, was united to the former, and was designated the Lower School, making in that year (1821) a total of 1,000 children. In 1828, the number of boys in the Lower School was reduced to 400, and the Upper to 600, one-third of the latter being the sons of commissioned and ward-room officers. In 1841, the girls' school was abolished, leaving 400 in the Upper, and 400 in the Lower School.

The schools are supported partly by the income of a special endowment (£136,000,) and partly by the general funds of the Hospital. The total expenditure for the two schools in 1859 was £20,234, for an average attendance of 774 boys.

Boys are admitted to the Lower School solely upon the claims of their fathers' services. Until quite recently admissions to the Upper School were by patronage, but by recent regulations all exclusive privileges of nomination have been discontinued, and all claims for admission into the school (the distinction of Upper and Lower School having been done away,) are decided by a Committee of Selection, according to a scale laid down. The 110 boys found to be best in the last examination of 1860, were constituted the Nautical School, admission to which is now gained by competitive examination among the other boys of the school. The instruction of this school (for a Nautical School had always existed, composed of the two first classes of the Upper School,) is confined to Mathematics and Navigation, and qualifies its recipients to rise in their profession as masters' assistants in the Royal Navy, and as midshipmen and apprentices in the merchant service. A system of pupil teachers, selected on account of aptitude for teaching, and a willingness to adopt the profession of schoolmaster as their career in life, has been recently introduced.

The Commissioners referred to, recommend that a Normal School for the Navy be established at Greenwich, similar to that for the Army at Chelsea, that the present pupil-teachers who are above the age of eighteen form the nucleus of this school, and that others to the number of ten at first, be admitted after examination; that the course of their education be adapted to their future calling, and that at the close of their career they be examined, and receive a certificate of qualification. These teachers thus educated and trained, would be fitted to take charge of the Navigation Schools, under the Board of Trade; would enter the Dock-yard Schools, as assistants at first, and they would be appointed to masterships on board the Training Ships, both in the royal and commercial ports.

They also recommend that boys from the second class in the Ship Schools be selected to serve as pupil-teachers under the schoolmasters, and that a small allowance be made them, in addition to their pay, if they pass a satisfactory examination at the end of the year, and their conduct is reported to be satisfactory, and at the end of three years they be admitted, if found competent, to the Normal School at Greenwich, or that they be entered for continuous service as assistant schoolmasters, with rank and pay and pension of first class petty officers. At the end of two years

this last class of assistants, if found competent, will be admitted to the practising school at Greenwich, for six months at the least, during which residence they will devote their time to the art of teaching, and to the study of Navigation, Physical Geography, and Natural History. On the completion of their training they will go out as Royal Navy Schoolmasters, and will be divided into three classes, viz.: 3d class, who shall have the rank and pay of chief petty officers, (continuous service,) and shall be entitled to the same pension. 2d class, who shall rank above master-at-arms, and shall receive the same pay and pension. 1st class, shall rank with third class warrant officers, with same pay and pension, and after long and approved service, masters of this class shall be eligible for further promotion to rank and pay of second and first class warrant officers. Schoolmasters in each of these classes shall be entitled to £10 per annum in addition to their pay, if they are recommended by the captain and chaplain, and their schools are certified to be in an efficient state when examined.

NAVIGATION SCHOOLS.

In 1853 the English Government constituted the Department of Science and Art, to extend a system of encouragement to local institutions of Practical Science, similar to that commenced a few years before in the Department of Practical Art, the two Departments being united in the course of the same year, and the united Department being administered at first by the Board of Trade, and in 1856, by the Education Department. To this Department of Science and Art, was assigned in 1853 the general management of a class of schools which had been instituted or aided by the Mercantile Marine Department of the Board of Trade, for the benefit of the navigation interests of the country. Instruction in navigation was given in the seaports by private teachers, without system, and to a very small number of those who should be well grounded in the principles of the art before being entrusted with the responsibilities of command, involving the lives and property of others. To introduce system, to give permanent employment to a larger number of well-qualified teachers of navigation, to elevate and improve the attainments and character of British masters, mates and seamen, and indirectly but largely increase the supply for the Royal Navy in time of war, the Government had determined to encourage local effort in establishing Nautical Schools. With this view the Marine Department of the Board of Trade had established two schools prior to 1853, one in London, and the other in Liverpool; and an arrangement had been made with the Admiralty, by which it was believed five or six pupil-teachers, who had completed their term of instruction at the Royal Naval School at Greenwich, would be able to attend the scientific courses in the Metropolitan Schools of Science and Art, and be instructed in those sciences which would better fit them to become masters of schools of navigation in the

seaport towns. In 1854, the Trinity House* of Hull reorganized its old school of navigation, after the plan of the Royal Naval School at Greenwich, with two divisions, the lower for a class of boys who need elementary instruction, and the upper, for boys in the technical studies of a seafaring life. With the latter was opened an evening school for adult seamen. Similar schools, with a junior or lower division to revise and complete the general and preparatory studies, and a senior or upper school for special scientific and practical instruction in navigation and seamanship, were established at Yarmouth, Leith, Glasgow, Aberdeen, Belfast, Dublin, Waterford, and other ports, fifteen in all up to 1862, giving instruction to over 3,000 persons, and all of them enlisting local co-operation and individual payment with governmental aid. As an example of this class of schools we cite a brief description of one of the earliest established, from a Report of the Inspector, Edward Hughes, one of the masters of the Greenwich Hospital Schools.

London Navigation School.

The London Navigation School is held on the upper floor of the Sailors' Home Institution, situated in Well Street, London Dock, and consists of two separate apartments, occupied by the Upper and Lower sections.

The upper section is for the instruction of masters and mates of the merchant service in the following subjects, viz.:

Sextant Observing. Chart Drawing. Geometry. Algebra. Trigonometry. The Sailings. Use of the Nautical Almanac and Mathematical Tables. Principle and Construction of Chronometers. Methods of determining the Latitude and Longitude. Nautical Surveying. Compasses and Magnetism of Ships. Theory of Winds, Tides, and Currents. Methods of taking and recording Meteorological Observations. Principle and Construction of the Steam Engine as applied to the Paddle Wheel and Screw Propeller.

The Lower section is for the education of seamen and apprentices. The course embraces the following subjects:—

Reading. Writing. Dictation and Letter Writing. Arithmetic. Geography. The Sailings. Sextant Observing. Method of Keeping Ships' Books.

The hours of attendance are from 9 to 12 a. m., 2 to 4 p. m., and 6 to 9 p. m. on the first five days of the working week, and from 9 to 12 a. m. on Saturdays.

The fees are six shillings per week for masters and mates, sixpence for seamen, and apprentices are admitted free.

The instruction of both sections is conducted by teachers who have been educated and trained in the Greenwich Hospital Schools, and who hold certificates of competency for teaching Navigation and Nautical Astronomy, from Mr. Riddle, the Head Master of the Nautical School.

As regards the students who at present attend the school, it is manifest that the masters and mates taught in the senior section come for the express purpose of learning to solve certain problems in Navigation and Nautical Astronomy, required for passing the examination of the Local Marine Board, and they are unwilling to devote any portion of their time to the other subjects that enter into the course of instruction. These, though essential to the education of every master mariner, are unfortunately not at present required of a candidate to pass an examination which proclaims him competent to take command of a vessel.

The lower section is composed of seamen and apprentices, who are for the most part employed during the day at their ships in the docks, and have acquired

* The Trinity Board of Hull was established in 1537, in imitation of Trinity House, London, incorporated by Henry VIII in 1515, (but existing long before,) for the promotion of commerce and navigation, licensing pilots, erecting beacons and lighthouses, &c. Both were probably in imitation of Charles V who established at Seville, in Spain, at the *Casa de Contratacion*, lectures on navigation, and an examination of persons to act as pilots and mariners

the rudiments of an English education before entering the school. They attend during their short stay in port from 6 to 9 in the evenings, and their chief object seems to be to acquire a knowledge of the sailings and the methods of keeping the books of a ship.

Both sections are taught the use of nautical instruments, and for this important purpose the Board of Trade has granted a liberal supply of requisites to carry out an efficient system of instruction, as will be seen by the list appended to this Report.

Those students who are sufficiently educated are accustomed to work out their own observations. None of them have been allowed to leave the school without receiving as great an amount as was possible of general information, in addition to the special instruction in the subjects for which they attended. Lectures have been delivered in the evenings upon the Steam Engine, Electricity, and Magnetism, with other branches of Natural Philosophy; and the Physical Geography of the Ocean has received particular attention.

The following statistics are given in the Report of Capt. Ryder, of the Royal Navy, in 1858.

The officers of the committee of management are:—

Chairman, Admiral Sir H. Hope.
Secretary, Captain George Pierce, R. N.
Head-Master, John Bowing, 1 certificate.

The total number receiving instruction in navigation in or through the agency of the school during 1858 has been 149, showing a total increase of 25 since last year. The total fees have been 46*l.* 15*s.* 6*d.*

The entire number of adults and boys who have at any time paid fees during the year are, masters, 3; chief mates, 17; only mates, 2; second mates, 37; seamen, 62; apprentices, 28; total number of students, 149.

The following is the rate of fees paid by adults and boys per week:—In the day classes—Masters studying for extra certificates, 6*s.*; chief mates studying for master, 6*s.*; only mates studying for chief mates, 6*s.*; second mates studying for chief mates, 6*s.*; seamen studying for only mates, 6*s.*; for second mates, 6*s.*; apprentices studying navigation, 6*s.*; those not studying navigation, 1*s.*; seamen not studying navigation, 1*s.*; boys learning navigation, 6*d.*; boys not learning navigation, 6*d.* In the evening classes—Adults learning navigation, 3*s.*; not learning navigation, 1*s.*; boys learning navigation, 3*s.*; not learning navigation, 6*d.*

The average attendance at the classes has been:—

Day classes, . . . morning, 7; afternoon, 6.
Evening classes, ... 6.

Grand total of fees, 46*l.* 15*s.* 6*d.*

The amount of aid afforded to the school by the Department has been 43*l.* 16*s.* 4*d.*, which sum includes the payments for the master's certificate and other allowances, the payments to pupil-teacher, the cost of medals, &c.

School Ships.

There is another class of nautical schools for destitute and endangered boys, which are aided by the government through the Ragged School Society, and are kept on board of ships, the practical seamanship of which might advantageously be incorporated into the navigation schools. The expense of these ships per day is thus given by Capt. Ryder, in his Report on Navigation Schools in 1858.

I have collected some statistics showing the expense of school ships. The Akbar, a frigate at Liverpool, is a reformatory, and has about a 100 boys. The Venus, also a frigate, is in charge of the Marine Society, and anchored near Woolwich; she is a school ship for destitute lads, and has about 140 boys. In the Akbar, supported partly by local contributions and partly by the Government grant of one shilling a day for each boy, the expense of the establishment is probably reduced to as low a scale as possible. The Marine Society is a

corporation which can afford to be more liberal in its arrangements. The Akbar was fitted out at an expense of 1,800*l.* but about 1,000*l.* is considered to be sufficient for a fit out, if the hull is in good repair. The Marine Society's ships are always fitted out by the Admiralty without charge. The Akbar costs about 250*l.* a year for repairs, &c.

Estimate of Annual Expense per Boy, deduced from Report.

	Akbar.	Venus.
	£ *s.*	£ *s.*
Food, ...	£10 0	£13 10
Clothes, ...	4 0	6 0
Management, &c.	10 0	10 10
	24 0	30 0

Outline of Aims and Management of Navigation Schools.

In 1858, Captain Alfred P. Ryder, of the Royal Navy, was appointed to inspect the Navigation Schools connected with the Department of Science and Art, and report on their condition and future management. The statements and suggestions of this report harmonize so fully with the conclusions which we have reached respecting the need and mode of establishing and managing this class of schools in our own country, that we can not better express our own views than by making liberal extracts.

The Government is very anxious to raise the tone of the Commercial Marine for the following reasons:—

(*a.*) Because the Commercial Marine supplies even in time of peace a considerable number of men to the Royal Navy, and because in time of war we should have to rely upon it almost entirely to enable us to man our ships when our reserves were exhausted, which would soon be the case in a naval war.

(*b.*) Because on the efficiency of our commercial marine depends to a great extent our position as a commercial country, and on our position as the greatest commercial country rests our supremacy among European nations.

(*c.*) Because to the commercial marine is entrusted every year an immense amount of valuable property. Want of skill, intelligence, and readiness of resource largely increases the yearly loss of this property.

(*d.*) Because to the commercial marine every year are entrusted the lives of a large and increasing number of Her Majesty's subjects. Want of skill, intelligence, and readiness of resource largely increase the yearly loss of life at sea.

(*e.*) Because the commercial marine consists of more than 200,000 persons, and is, therefore, an important portion of the nation, considering it numerically.

(*f.*) Because the commercial marine represents England, its religion, laws, customs, and habits, in every foreign country, and it is desirable that our representatives should cease to exhibit (as is now frequently the case,) the worst side of the national character. Large numbers of the sailors in our commercial marine are at present neither good men nor good sailors, but are disorderly, addicted to drink, inefficient at sea and all but useless in harbor. Many of them who reach the rank of mate and master compare disadvantageously in general knowledge with the mates and masters of foreign vessels. There are of course numerous brilliant exceptions. They are to be found chiefly in the service of the large ship-owners. In knowledge of seamanship English masters and mates need not fear a comparison with those of any other nation.

The Government, anxious to raise the tone of the Commercial Marine, has endeavored to purify the stream at its source, by the creation or support of Navigation Schools, in order that as soon as possible, by the introduction of well educated lads, its character may be elevated and improved. The Navigation Schools referred to are supported by fees, by local subscriptions, and by aid from the Department of Science and Art. Their object is to offer instruction in

the scientific branches of an Education specially adapted to the Nautical Profession.

In commencing an investigation into the present position and prospects of the Navigation schools, it is evidently advisable to ascertain the number of vacancies that occur annually in the commercial marine; these vacancies are occasioned by death, desertion, and change of profession. It is much to be desired that these vacancies should all be filled by well educated English, Scotch, and Irish lads, for in time of war we could only recruit from the Commercial Marine those sailors who are British subjects.*

Capt. Ryder estimates the number of lads required to supply the annual vacancies by death in the British Commercial Marine at over 5,000, and by desertion and change of profession, by at least 1,000 more, or a total of over 6,000; and that schools for seamen and officers should be sufficient to give an annual supply of at least that number, and so accommodate 18,000 students. According to the Report of the Registrar General of Seamen, there were bound and registered at the several ports of the United Kingdom, in the year 1856, 7,410 apprentices. The 176,387 men (not including masters,) employed in the Home and Foreign Trade, were classified as follows: 21,204 mates, 13,232 petty officers, 83,682 seamen, 23,974 apprentices and boys, 12,640 other persons, 1,612 engineers, 4,896 firemen. Of this number 14,375 were foreigners, and 7,712 lascars. During the year 1856, examinations were passed for extra masters, 22; for ordinary masters, 1,223; for first mates, 689; for only mates, 12,223; for second mates, 940—a total of 4,097. Capt. Ryder calculates that the total number required every year to fill up the vacancies and meet the demands of an expanding commerce as follows:

Of those who leave the service, ...	6,690
Of those who are drowned, ...	1,300
Of those who die of disease, ...	2,660
The average annual increase by expansion of commerce,	3,365
Total supply required, ...	14,015

Capt. Ryder remarks that the system of nautical education should be broad enough and attractive enough to bring in all the boys of all classes who wish to go to sea, or may be required to meet the demands of the national and commercial marine. The education given should make athletic, intelligent, handy seamen, and impart such an amount of scientific knowledge of navigation and seamanship as will qualify a due proportion for a lower grade of officers.

The first point to be aimed at would apparently be the establishment of an adequate number of schools, so as to offer scientific instruction on the lowest terms to a sufficient number of boys, to supply the demand for educated young men to fill the vacancies in the ranks of masters and mates. Their knowledge of seamanship must of course be gained before the mast.

A commercial navy, fed by a supply of lads that had for three years attended

* According to the Registrar General's Report for 1858, there were 13,200 Foreigners serving in the Mercantile Marine in 1854, natives of the following countries:—Americans, (U. S.,) 3,888; Austrians, 532; Belgians, 198, Danes, 423; Germans, 319; Greeks, 76; Hollanders, 1,(83); Italians, 110; Norwegians, 570; Portuguese, 564; Russians, 44; Prussians, 563; Spaniards, 338; Swedes, 1,512; French, 479; Various, viz., South Americans, Chinese, &c., &c., 2,499; total, 13,200.

the classes at a Navigation school would challenge comparison for general knowledge and information with any profession in England, and would soon cease to be the last resort of those idle, troublesome fellows, expelled from the agricultural class and the various trades, who are too old, too ignorant, or too profligate ever to make even indifferent sailors.

Having stated what appears to me to be the ground that may be beneficially covered by a network of navigation schools, I will proceed to state what, in my opinion, are the means by which a Navigation School may be rendered most attractive and efficient.

I. *A Navigation School assisted by the Government should offer sound Instruction especially adapted to the Nautical Profession.*

Although at first sight the number of subjects named hereafter may appear large, and the education of too high an order, these objections will vanish when it is remembered that lads are not acceptable on board merchant ships until they are 15–16, because they are of little use, and give trouble; and yet, as has been already stated, if not attracted to the Navigation schools at the age of 12–13, and induced to remain in attendance on the classes until they are 15–16, they will be drawn into some other profession.

The course of instruction which is adopted must necessarily therefore be sufficiently comprehensive to extend over *three* years, and at the same time continue to the last to be specially adapted to conduce towards the boy's success in his profession.

The subjects which appear to be suitable for boys destined for the nautical profession and retained under instruction from 12–13 to 15–16 are as follows:—

* (1.) Reading and writing from dictation.
* (2.) First four rules of arithmetic.
* (3.) Grammar.
(4.) A complete course of arithmetic.
(5.) Algebra to quadratics, with application.
(6.) Geometry, Books of Euclid, I. II. III., and a few propositions in Book IV.
(7.) Trigonometry, plane and spherical.
(8.) Navigation.
(9.) Nautical astronomy, including lunar double alt. and Sumner's method.
(10.) Practical use of the instruments used at sea.
(11.) Geography, descriptive, } especially as regards products, climates, &c.
(12.) Geography, physical, }
(13.) Chart drawing; surveying.
(14.) Free-hand drawing.
* (15.) History, particularly Scripture History and English History.
* (16.) Letter writing; book-keeping.
(17.) Mechanics and steam-engine.
(18.) Magnetism and electricity in relation to ships.
(19.) Laws of storms and tides.
(20.) Knowledge of the code of signals.
(21.) Mercantile laws and usages, as far as is necessary for the master of a merchant ship.
(22.) Gymnastics.

The above subjects are taught in the Navigation School at Hull.

II. *A Navigation School should provide a good supply of apparatus, viz., instruments, books, maps, slates, &c. without any charge to the pupils.*

In Ireland, where a class of Navigation Schools has been established as part of the system of National Education, a very liberal supply of sextants, books, maps, &c., is given to each school by the Board of Education.

III. *A Navigation School aided by Government should offer valuable prizes in the shape of exhibitions, instruments, books, &c.*

The great difficulty we have to contend with is the reluctance on the part of some parents, the inability on the part of others, to maintain their children during the three years' course.

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* The boys are expected to be proficient in these subjects before entry, and they need only be taken up in the way of review.

Exhibitions and prize-schemes should therefore be established on the most liberal footing.

Prizes had been awarded by the Department in only two or three instances before my tour of visits.

(*a.*) I beg to suggest that *prizes* be awarded, when deserved, at all the schools every half year.

The prizes to consist of sextants, watches, instruments, books, &c. The future prizes to be placed at the commencement of the half-year under the charge of the local committee, to be exposed in the schoolroom in a case with a glass lid or cover. (The half-yearly value of the prizes to be about 15*l.*); the prizes to be fairly and openly competed for.

A very limited number of sextants should be given away, not more than one each half-year among all the schools. The prizes not to be awarded except on the most satisfactory proof of the lad's sufficient proficiency.

(*b.*) I beg to suggest that *exhibitions* be established on the following scale, viz., at the rate of twelve for a school giving instruction to 100 boys, or one to every eight boys, and be awarded at all the schools every half-year.

The boys after the examination to be divided in the following manner:—

The First Division to consist of all the boys who had attended the Classes for a period under 6 months.

The Second Division to consist of all the boys who had attended the Classes for 6, and under 12 months.

The Third Division to consist of all the boys who had attended the Classes for 12, and under 18 months.

The Fourth Division to consist of all the boys who had attended the Classes for 18, and under 24 months.

The Fifth Division to consist of all the boys who had attended the Classes for 24, and under 30 months.

The Sixth Division to consist of all the boys who had attended the Classes for 30, and under 36 months.

Exhibitions at the rate of one in eight boys to be given to the most successful boys in each group.

The exhibitions for the 1st and 2nd Divisions to consist of remission of fee and a donation of 6*d.* a week for ensuing half-year.

The exhibitions for the 3rd and 4th Divisions to consist of remission of fee, and a donation of 1*s.* a week for ensuing half-year.

The exhibitions for the 5th and 6th Divisions to consist of remission of fee, and a donation of 2*s.* a week for ensuing half-year.

This part of my proposal is elastic, the value of the exhibitions can be increased if the principle is approved of, and the number may be extended even to offering an exhibition to every boy attaining a certain degree of proficiency in the studies of the school.

The chief merits of this plan are (1,) that as all the exhibitions are thrown open for competition every half-year, the spirit of emulation is constantly kept alive; it is notorious that the attainment of an exhibition or scholarship which will be held throughout a student's career is often the prelude to idleness. (2.) That exhibitions are placed within the reach of the youngest boys.

The examination to decide on the exhibitions and prizes should take place at the end of the half-year. The questions to be sent from the Department, and the answers to be sealed up in the presence of the boys, and sent to the Department on the evening of the examination day. The prizes and exhibitions should be awarded at the commencement of the next half-year. As the examination should not, if possible, extend over more than one day, the Department might make a selection from among the subjects taught. As the inspector can not be present, one or more of the local committee should remain in the school during each examination.

The result of each examination should be allowed to be published in the local papers; competition will then be created among the various schools at the seaport, who will view with great interest the position of their boys on the examination list.

Capt. Ryder suggests (1.) that each boy who holds an exhibition or

gains prizes, have the fact engrossed on a *vellum certificate*, and receive a *medal* or *badge*. (2.) That all graduates of the school who bring a good character from their captain or shipowner, for one year after leaving the school, receive one pound from the funds of the school. (3.) That shipowners and the Admiralty be induced to look first to the Navigation schools for their apprentices, and that they open to competition among the prize boys of the schools, any choice places in their gift. (4.) That officers and masters of ships, and public men interested in nautical matters be invited to visit the schools.

IV. *A Navigation School should provide an ample Educational Staff, whose income should be sufficient, and a certain portion of it fixed, and whose energies should be mainly directed to the Education of the Boys.*

The educational staff, as a general rule, is very insufficient, owing to a school for adults having been generally established in connexion with the school for boys.* This course was adopted chiefly for economical reasons, it being intended that the large fees from the adult class should pay the greater proportion of the expense of the school; but it has resulted in the boys' school being most seriously injured, as follows, without any compensating advantages.

The boys who pay fees, from 6*d.* to 1*s.* a week, are constantly and unavoidably neglected by the head master, whose interest it is to attend to the adults who pay from 5*s.* to 7*s.* a week; and even if superior to that motive, the head master can not leave the adults for more than a few minutes at a time, because, and not unnaturally, they insist on his remaining with them.

A peculiarity in the mode of paying masters of Navigation Schools is in increasing his compensation from all other sources by the payment by the Department of an amount represented by the certificate he may hold of his success in passing examination in certain group of subjects. The scheme is as follows:

Group I. Mathematics necessary to the study of navigation,	£5
Group II. General navigation and nautical astronomy,	15
Group III. Adjustment and skillful handling of instruments,	5
Group IV. Physical geography,	10
Group V. Physics, mechanics, marine steam engine,	10
Group VI. Chemistry,	5
Group VII. Natural history,	5
Group VIII. Chart, freehand, and mechanical drawing,	5
	£50

This group payment is a well devised scheme to induce masters to improve themselves, and is applicable to teachers of every grade, and if rightly applied, will operate as a constant stimulus to professional improvement. But in the case of this class of schools, where there are pupils on a varying scale of direct payment to the teacher, the teacher will be tempted to give his particular attention to the pupils who pay best. This can be counteracted by making the masters' payment depend on the proficiency of the scholars.

To obtain and keep the services of the zealous, intelligent, and very superior men who alone are fit to take charge of navigation schools, I believe a superannuation allowance would be at the same time the greatest and most economical inducement.

I beg to suggest that at 60 years of age a navigation master be allowed to

* The school at Hull is the only navigation school at which *no* adults are received.

retire with his group money as an allowance. This would be a great inducement to remain in connection with the Department, and to pass in as many groups as possible.

The direct inducement which I propose to give to the educational staff to bring their schools up to the highest state of efficiency is a payment in money, and I have been induced to propose this from the sense of the paramount advantage derived in any undertaking from making it the direct pecuniary interest of agents to act up to their instructions.

I propose that every head master, every assistant master and every pupil-teacher employed in teaching the boys shall receive a sum of money in addition to his fixed salary and his group money to depend on and vary with the success of the school at the half-yearly examinations. The mode by which I propose to estimate the amount of this payment will be detailed further on, when I speak of inspections.

It consists of a sliding scale of payment, so contrived that it is the direct pecuniary interest of the head master to bring all his boys up to the highest state of proficiency, and also the direct pecuniary interest of all the educational staff to refrain from forcing on the clever boys, if by so doing they neglect the duller boys, and also to refrain from drawing the boys into the upper and more showy subjects to the neglect of the lower, more elementary, but more important subjects, errors commonly and but too justly ascribed to schoolmasters in their endeavors to give to their schools the appearance of high efficiency.

I am aware that the sliding scale of payment which I propose has the demerit of novelty.

The Committee of Council, fully alive to the advantage of a sliding scale, have provided that, in the primary schools, the master's pay shall depend on and vary with the school pence and the capitation grant (a grant which is made to depend upon the attendance of the children,) in the art schools it is made to depend on and vary with the number of prizes won by the students.

The disadvantage of the former plan is that the sliding scale, being made to depend upon mere numerical attendance, both particular proficiency and general proficiency are ignored.

The disadvantage of the latter is that it is made the master's direct pecuniary interest to force on the clever boys to the neglect of the dull boys, while general proficiency and numerical attendance are ignored.

There are doubtless good reasons why these very different plans should have been adopted in primary and art schools.

In the scheme of varying payment which I propose for navigation schools, both the general proficiency of the school and the numerical attendance of the scholars are made the measures of the masters' emoluments, while the proficiency of individual boys is fostered by prizes and exhibitions.

V. *The Masters of Navigation Schools should display great intelligence and aptitude for teaching, should be intimately acquainted with the best methods of instruction, and be zealous in the performance of their duties.*

As a general rule I have found the masters intelligent and apt to teach. The majority of them have enjoyed the privilege of an education at Greenwich under Mr. Riddle.

It is important that the masters should be drawn from some normal school; Greenwich school appears admirably adapted for such purpose. To draw a large supply of masters from that school, and retain their services, the position of the masters in a pecuniary point of view must in my opinion be improved. But if this is done an engagement should be entered into to remain as a navigation schoolmaster for a certain time, and after that, not to leave without at least two months' warning.

The position of assistants should be open to all persons whose credentials previously received, as to good character, proficiency in all the subjects taught in this class of schools, and required for the place, are satisfactory. The examination should be public, and the results published. The vacancies among the head masters should be open to competition among the assistant masters.

VII. *The Navigation Schools should be judiciously situated, have large airy rooms, a good playground, gymnastic poles, and a lending library.*

Exercise at gymnastics is most beneficial to the boys' health, and confirms them in their choice of the naval profession. The lads when they go to sea are much more useful aloft if they have acquired the agility and daring which can alone be gained by gymnastic exercises.

One of the causes of the rapid deterioration in the physique of our sailors is the diminution of work aloft consequent on the introduction of steam.

VIII. *The Fees in a Navigation School should be carefully adjusted.*

A carefully adjusted scheme of fees from 1*d.* to 1*s.* per week will not exclude by their amount any poor boys whom we might wish to admit, or to repel by their insignificance those parents who would attach no value to that which cost them little.

The larger portion of the fees, after deducting a certain fixed sum, or a certain definite proportion of them for local expenses, will stand in the school accounts to the credit of the local committee, and will be expended from time to time, with the consent of the Department, in paying the masters' salaries, the boys' exhibition money, &c.

In some seaports, where there is a pertinacious disinclination on the part of the parents of the boys to their going to sea, I have suggested to the committee the undertaking to return all or a portion of the school fees of any boy who has passed above a certain mark, on proof being received that the boy has sailed. This would in many cases act both on parent and child as a great inducement to the boy to go to sea.

IX. *Navigation Schools should be periodically inspected and reported on.*

Inspection to be really valuable should be thorough. Now the subjects in which it is proposed that the boys shall be taught at the Navigation School are very numerous, and none of them should, if possible, be allowed to escape the notice of the inspector and the test of examination.

I propose that there shall be two examinations every half-year, (1) the general examination, to measure the progress and proficiency of the navigation classes, and the payment to be made to the educational staff; (2) the special competitive examination for prizes and exhibitions. The first will be held in the course of the half-year, in the presence of the inspector and master, the answers, however, to be looked over and valued in London. The second will be held at the close of the half-year, in the presence of the master and of one or more of the local committee. It will be entirely a written examination, the questions to be sent from the Department. To prevent any suspicion of unfair treatment, the examination books should, after each examination, be sealed up at the close of the day, in the presence of the boys, and sent to London. The prizes and prize studentships will be awarded when the school meets again, at the commencement of the next half-year. The answers will be valued in London, by a person appointed for that special purpose. The practice I have adopted is to give full numbers for an accurate answer, half numbers for an answer which, though inaccurate, shows intelligence.

The inspector who conducts the general examination should have with him various papers of questions of equal value on each subject, so as to diminish the possibility of information as to the questions set at the examination being communicated from one school to the other. The masters have a direct pecuniary interest in preventing any information being sent to the other schools.

I suggest that the general examination, to ascertain the amount of examination money, be conducted in the following manner:

The school to be arranged previous to the arrival of the inspector, in five classes, each class separated from the other as far as the arrangements of the school will admit, and the five classes to be so composed as to be about equal, both in average and collective intelligence. No difficulty is experienced by the masters in doing this.

The number won by the boys in a class in a particular subject will be added together and divided by the number of boys in the class; the result will be the mean number for that subject for that class, and the classes being equal, that number will be a measure of the proficiency of the school in that subject. The

number of boys in the school multiplied by the sum of the mean numbers will be the number which will determine the sum of money to be apportioned to that school, and divided among the educational staff.

I propose that a sum of money, at the discretion of the Department, be divided* once a year among the schools, in the ratio of the numbers obtained as above, and that notice be given to them to that effect at the commencement of each year, naming the total sum. I propose that the sum won by the school should be divided among the educational staff in the following proportions:—

Head Master 5 shares, but total not to exceed . . .	£30
Assistant Masters, each 2 shares, but total not to exceed . .	12
Pupil-Teachers, each 1 share, but total not to exceed . .	6

As every progressive step made by the dullest boy who attends the classes tells on the gross number, and through it on the pecuniary gain of the whole staff, the staff will have no temptation to neglect, but on the contrary, every inducement to push on the dull boys, and as proficiency in the lower subjects counts as much as proficiency in the highest the common fault of neglecting the low subjects would evidently diminish very much the profits of the staff, and will therefore be prevented.

I consider this sliding scale would be preferable to paying the master a certain sum for every prize won in the school, which is a direct temptation and inducement to him to select from time to time the most promising boys, and put them under pressure to make prize boys of them, neglecting the dull boys of the same standing who can not on that system of reward be productive of any benefit. The collateral advantages of this system.

(1.) It becomes the direct personal interest of the staff to retain the boys as long as possible, in order that at each examination, there shall be as many boys as possible well advanced in all the subjects.

(2.) That it becomes their direct personal interest, to select from among the boys presenting themselves for entry, those that are most advanced in the elementary subjects, so that their backwardness may diminish the mean numbers as little as possible

(3.) That it becomes their direct personal interest to work the school with as few masters as possible, as thereby their individual gains are larger.

(4.) Competition is created among the Navigation schools and their educational staffs. The result of each examination should be allowed to be published in the local papers, and the results of the examinations at all the Navigation schools should be made known at each school.

(5.) The inspector and the Department can see at a glance whether any Navigation school has neglected any subject. The masters could not evade the rigor of this test by any artifice.

(6.) The boys will be induced generally to enter into the spirit of the competition, which will have the best effect. A few only can win the prizes and exhibitions, but all can contribute by their exertions to the comparative success of their school.

(7.) The local committee and the neighborhood would enter into the spirit of the struggle.

X. *A distinctive Dress or Badge is calculated to have a very good effect on the Navigation Schools.*

The Trinity Board at Hull gives to 80 boys in the Navigation school a neat uniform (blue jacket, blue and white trousers, and blue cap.) This has a capital effect on the boys, gives them an esprit d'ecole, and acts as a restraint on their conduct outside the schools.

XI. *In Navigation Schools great pains should be taken to ensure punctual attendance on the part of the boys.*

I beg to suggest that the best form of registers be provided, and that it be made imperative that the register be strictly kept in all the schools, and that the following practice be universal instead of partial, viz., that any boy arriving late is expected to produce a written authority from the master of his school or his parents for his absence. Prizes for good attendance have been found very useful in primary schools. I beg to suggest one prize of 10*s.*, three of 5*s.*, and five of 1*s.* every half-year, or 3*l.* a year in a school of 100 boys.

* I prefer this to any other plan, because the stimulus to exertion will be greater.

Capt. Ryder recommends that the daily record of attendance, proficiency, and conduct, be posted up on the walls of the school every week, month, half-year, and year, as well as the names of all prize boys.

Capt. Ryder goes into detail of the estimates of receipts and payments, and makes the education of each boy cost the Department about £2 10*s.* per boy per annum. The whole expense of teaching and clothing at the Hull School averages a little more than £6 per boy per annum

Obstacles to the success of Navigation Schools.

The principal obstacles in the way of success, in addition to the inefficiency of the schools, the absence of prizes, &c., are three in number.

It is my firm belief that if the Department assist liberally the establishment of navigation schools, placing them on a proper footing, and stating that they are schools established for the sole purpose of giving special instruction in scientific subjects to boys intended for the Royal Navy and the Commercial Marine, these three obstacles will gradually vanish. They are,—

(I.) *A disinclination on the part of shipowners to enter boys.*

In reply to my inquiries the owners of steamers stated, "We don't want boys, who eat as much as men, are of very little use, and give a great deal of trouble; we want men.

Steam having superseded the use of sails to a great extent, boys, who in sailing vessels are invaluable for light work aloft, are not valued in steamers.

Many of the sailors, so-called, that we find in steamers differ very little from landsmen, except that they are not sea-sick, they can take the wheel and pull an oar. To all the valuable qualities of a true sailor, which were developed by and almost entirely due to his work aloft, viz., agility, readiness of resource, indifference to all danger that may be escaped by bodily activity, as distinct from that solid courage which all Englishmen possess, the steam sailor can lay slight claim.

In the Royal Navy we want the superior class of sailors, and if possible those alone. The partial substitution of steam for sails, while it has injured our own sailors has, in the same way and for the same reason, injured those in the commercial marine, on whose aid and support we may at any time be thrown for a supply of seamen.

It is most important, therefore, that every impulse should be given to keep up in the commercial navy both the quantity and quality of the seamen; it is much to be regretted, therefore, that the same disinclination to take boys, although fortunately in a less degree, exists among the shipowners of sailing vessels.

Lads enter on board merchant ships, some as apprentices, some as boys.

In the employment of the larger shipowners apprenticeships are highly valued.* The proportion of apprentices to tonnage at present is about 1 to 200 tons. Before the repeal of the navigation laws, it was by Act of Parliament 1 to every 100 tons.

The disinclination to enter boys will, I believe, gradually vanish when the attention of the shipowners, as a body, is attracted to the valuable class of boys who will attend the Navigation schools, for they will be induced to reflect, that although at first sight it may appear to be more economical to enter no boys or

* The value attached to an apprenticeship varies largely with the employs, the port, &c. Mr. Green charges 180*l* for a four-years' apprenticeship as a midshipman. Large shipowners at Glasgow and elsewhere pay 35*l* for a similar term to a common apprentice

apprentices, or a very few only, and those at very low wages,* yet that by so doing they are contributing indirectly, but yet surely and certainly, to the deterioration of the whole class of seamen, and to the ultimate injury of the ship-owning interest.

(II.) *A disinclination on the part of parents to send their boys to sea.*

While sailors are, what they frequently are at present, not the most moral or respectable members of society, it is probable and natural that many parents would regret their sons' choice of the sea as a profession.

But as sailors and masters improve by the aid of navigation schools, where they will be instructed in their youth, and are received in sailors' homes at every port where their vessels touch, this class of objections will gradually become obsolete; and the profession of the sailor will take its proper place by that of the high skilled mechanic as one of the noblest professions a working man's son can adopt, being also one of the highest paid; 3*l.* and 4*l.* a month besides victuals and medical attendance being the not uncommon emoluments of a merchant seaman. Moreover, the profession of a sailor, if he is a steady man, may be rendered both healthy, improving, and entertaining, and acts most beneficially on the character and temper. Steam and science are rapidly diminishing the longest voyages, and long periods of absence, one of the not unnatural objections of a parent, are becoming the exception instead of the rule.

The wish to go to sea is implanted by Providence, doubtless for the wisest purposes, in large numbers of the boys of these islands, frequently in those who have never seen the sea. Those parents, ministers, or schoolmasters who take upon themselves to thwart this natural and laudable wish, going the length, as they frequently do, of treating the boy's desire as an evidence of a vagabond and depraved taste, may be fairly charged with the responsibility of the boy's immoral and depraved life, if such unfortunately is the result of his going to sea, for his naval career is probably commenced by running away from home, and he thus severs all those domestic ties which conduce so much to the preservation of purity of life and manners.

This conduct on the part of parents should be deprecated by every one who has the best interests of his country at heart.

Every respectable and well conducted boy who desires to go to sea should be aided and assisted to do so, and this course should be systematically adopted throughout the country. The Government, by the support of navigation schools, show their opinion on this subject. It only remains for the schools to be put on a proper and liberal footing, worthy of the Government and of the object which they are intended to serve. When this is done, the profession of the sailor will be rescued in the minds of the lower classes from all the odium which at present surrounds it.

(III.) *A disinclination on the part of boys to go to sea.*

This disinclination exists in some ports and not in others; it will decrease wherever it exists when Navigation schools, established on a liberal footing, offering the inducements I have suggested, are placed near the docks in every seaport town of any size or importance. It is advisable that the schools should be so placed that the boys can when out of the school play about among the shipping, witness and long to imitate the evolutions of the sailors aloft, &c.

* Owing to the low rate of wages referred to, large numbers of apprentices run away every year, after they have served a portion of their time.

An attractive evening class will have to be established for the instruction of boys who have to work for their livelihood during the day, and for apprentices. I have proposed that half the fees be given to the educational staff, to insure their taking a direct pecuniary interest in the evening class.

In concluding this report, I wish to state, that I am fully impressed with the great benefit that the establishment of good Navigation schools would confer directly on the Royal Navy, the Commercial Marine, and the country; and that I see every reason for believing, that if the schools are placed on a proper footing, the classes will be largely attended, and the schools will answer every purpose for which they are established. The limited number of thirty Navigation schools, which I have suggested, should be forthwith established, although only professing to assist in providing a sufficient supply of educated young men to fill up the vacancies among the masters and mates, yet can not fail to tell with the best effect on the commercial marine generally. For these well-educated lads, who, after leaving the Navigation schools, have to struggle through that large body, the seamen of the commercial marine, before they can win the prizes of their profession, must raise the tone of the class through which they pass.

If the thirty schools are established, and after two or three years are evidently working well, it will be worth considering whether more schools of a simpler and less expensive character should not be established to educate a sufficient number of lads fully to supply the vacancies in the seamen class.

The alterations I have proposed in the mode of payment of the educational staff are those upon which I desire to lay the most stress; they have had but one object in view, the making it the personal pecuniary interest of each member of the staff to devote himself zealously to those duties, and to no other, which the Department wishes him to perform. In individual cases, we might appeal to higher motives than these, but in dealing with a body of men, however upright and conscientious, I am firmly convinced that there is no safer course than the appealing to the lower motive in aid of the higher.

The plan of payment of the teachers of navigation schools generally, presented by Capt. Ryder, was substantially adopted by the Department having charge of this class of schools, in 1860, but was changed to the following Minute in April, 1863, on the recommendation of Capt. Donnelly, for the purpose of restricting the efforts of the teacher, and the industry of the scholars, to the subject of Mathematics, Navigation, Nautical Astronomy, and the Use of Instruments, leaving general elementary studies to be mastered in other schools.

Aid to Navigation Schools and Classes.

I. Payments will be made by the Department only on the results of instruction in the following subjects:

1. Mathematics, including such portions of Algebra, Geometry, Mensuration, Plane and Spherical Trigonometry, Logarithms, as far as necessary for understanding Navigation and Nautical Astronomy.
2. General Navigation.
3. Nautical Astronomy.
4. Physical Geography.
5. Steam and the Steam Engine.

II. The payments will be made to those teachers only who have taken certificates as qualified to teach the above studies.

III. Examination for teachers will be held annually in November, in South

Kingston, Dublin and Edinburgh. The traveling expenses of candidates if successful will be paid.

IV. Examination for students will be held

(1.) The adults, seamen and others, at the seaport towns where local Marine Boards are formed and are prepared to undertake them from year to year.

(2.) The youths, in inland towns once a year, the examination forming part of the general May Science examination will be held simultaneously all over the kingdom where local committees are formed to conduct them, the examination papers being supplied by the Science and Art Department.

V. The successful candidate will be classed as passed with honorable mention, third, second, and first grade certificates. In the three last, a certificate will be given to that effect. The grades of success may be improved at any future examination.

VI. The teacher will receive one, two, three, four or five pounds, according to the class of success of his pupils, on the condition that the pupil, if a boy, shall have received forty lessons, at least, from the teacher, and then goes to sea, and if an adult at sea, then he shall have received twenty lessons, at least.

VII. Should the pupil have been previously examined and payment made on his account, the twenty or forty lessons, as the case may be, must have been given since that examination, and the payment to the teacher will be the difference between that sum previously paid and the amount found due on the grade then taken.

VIII. A local committee must in all cases be formed, and from them the teacher will receive the necessary vouchers.

IX. The sum above fixed can only be considered experimental, and may be altered from year to year.

COLLEGE OF NAVAL ARCHITECTURE AND ENGINEERING.

The course of instruction at the Royal College of Naval Architecture and Marine Engineering at South Kensington was originally in subjects the same as at Portsmouth, but after careful observation of what could be accomplished in connection with practical instruction and observation in the dock-yards, the subjects have been redistributed, and the number of sessions increased.

The *first* year embraces mathematics, practical ship-building (laying off work), chemistry and metals, machinery, steam and its management, physics, drawing, and French.

The *second* year embraces the same subjects, with the addition of heat, and strength of materials.

The *third* year includes the same subjects still further pursued.

A *fourth* year was added to the course in 1868, and the whole scheme in its details has not yet been fully tested.

A portion of each year is spent in the dock-yards in practical work, under the superintendence of officers in charge of different departments of the local service.

At the close of each session of theoretical study, a rigid examination is instituted, and promotion from class to class, and final graduation with the diploma of Associate or Fellow is awarded on the results.

In 1869 there were 30 students (15 engineers and 15 shipwrights) sent by the Admiralty, and receiving their instruction free; and 10 outside or ordinary students (6 engineers and 8 in naval construction), a total of 40 students.

SCHOOLS AND PRACTICAL TRAINING FOR NAVAL ENGINEERS.

In addition to the higher theoretical instruction in Naval Construction, Steam, and Marine Engineering, and kindred branches, at South Kensington, and to the candidates for assistant engineers, furnished by the numerous marine engine factories, and ocean steamers, to which young men resort to acquire a practical knowledge of their duties, the Admiralty have established in the dockyard schools at Portsmouth, Devonport, and Sheerness, courses of study and practical training, and a system of test examinations, for the express purpose of securing a body of educated and skillful engineers, to meet the demands of this department of the service.

Boys between the ages of 15 and 16, can enter their names as applicants with the Superintendent of the dockyards, and if they can pass the medical examination and give evidence of good character, they are examined twice a year by the Civil Service Commissioners in Arithmetic, including fractions, square and cube roots; Algebra, including quadratic equations; Euclid (six books), spelling, writing, and correct oral use of the English language, translations from the French or Spanish language, and geography. A certain number, according to the vacancies, who stand highest in the competitive examination, are received for six years.

A portion of time is spent, by the boys, on their admission, in the factories and drawing office, the foundries, the smitheries, and other shops to acquire a general knowledge of the work done in them. They are instructed in the parts, construction and working of marine engines and boilers, and the practical use of the various instruments in the engine room, including the indicator. They attend regularly for a portion of the day the dockyard schools, and are examined twice a year by the Director of Naval Education; and in the final examination they must gain 2,000 marks out of the 2,650 (the aggregate of the marks assigned to each study), of which more than three-fourths must be in the properties of steam, mechanics, hydrostatics, plain trigonometry, and good conduct and industry, to obtain a first-class certificate of qualification. If his knowledge of steam-machinery, and his good conduct and skill as a workman, is certified to by the Chief Engineer, a first-class candidate is fully qualified for the appointment of assistant engineer. The most intelligent of this class are eligible for a four years' additional course in the Royal School in South Kensington, where they study seven months in the year, the other five being spent in practical application of principles in the drawing rooms and workshops of the dockyards. Thirty-two students entered this school from the Dockyard Schools in 1870–71.

The Royal School of Naval Architecture and Marine Engineering issue two grades of diplomas. To gain the lowest, that of *Associate*, the candidate must obtain a certain minimum of marks in the aggregate of all the subjects, in practical engineering; the proportions and arrangements of engines, boilers, and propellers; strength of material; heat and steam, as well as in arithmetic and mensuration, algebra, plane trigonometry, elementary mechanics and hydrostatics, and engine drawing. To obtain the second (the diploma of a *Fellow*), the candidate must produce designs and estimates for building simple and compound engines; calculate the power of engines and performance of vessels; strength of material and principles of ship-construction, &c., as well as pass a satisfactory examination in higher mathematics, physics, and natural philosophy.

TRAINING SHIPS FOR SEAMEN IN THE ROYAL NAVY.

The entrance to the Royal Navy is now limited to boys between the ages of 15 and 17, who present themselves at certain recruiting stations on board of Receiving ships stationed in the principal ports of Great Britain, and who are found on examination to be in sound health, not below a certain standard of height, weight, and circumference of chest, of good character, and with a rudimentary knowledge of reading, writing, and arithmetic. After passing satisfactorily the required examination, with the written consent of their parents and guardians they are entered and bound to Her Majesty as sailors until they arrive at the age of twenty-eight, and then sent to one of the five Training Ships at Devonport (*Impregnable and Implacable*), Portsmouth (*St. Vincent*), Falmouth (*Ganges*), and Portland (*Boscawen*).

In each Training Ship the boys are divided into two classes—the First and Second. The First class is the upper division, into which those pass who have been twelve months on board. Here they receive 7*d.* per day (instead of 6*d.* in the Second), and if they have passed a satisfactory examination in seamanship, gunnery, and school work, they wear a badge, and are called Badge Boys, and enjoy the privileges of a Petty Officer,—extra liberty on shore and exemption from dirty work, as well as increased pay.

The work on board of a Training Ship, consists of (1.) School duties, and (2.) Instruction and training in the practical work of a sea-going vessel.

(1.) The school work is conducted by the Head-master and his assistants, under the general control of the Chaplain and Naval Instructor. The boys are put into four divisions, irrespective of the classification of First and Second, which has reference to the time they have been on board. Having a knowledge of reading and writing when they enter, they are taught arithmetic and geography, and become quite expert in elementary studies. Each division is subjected to a searching examination four times a year, by the Captain, and twice a year by the Inspector of Navy Schools, who reports direct to the Admiralty.

(2.) The Training work, includes all branches of the service required of a sailor, and a familiarity with every part of the vessel and her rigging; the names and uses of the masts and yards; knotting and splicing; the use of the helm and needle; the compass; all the various niceties of rigging; the way to reef and furl; to make, shorten, and shift sails; and the meaning of the various words of command. To go through with quickness and precision all these various subjects, the boys are divided into sections, each under a regular teacher. The lessons are short, but frequent, and the repetition is continued till the right way becomes a habit. A portion of the boys are taught flags, and the various systems of signaling. All are taught swimming, and how to rescue a man overboard, before they go to sea. To perfect the boys in rowing, sailing, and managing boats, a number of different descriptions is attached to each Training Ship. A Brig is also provided which is placed under the command of a lieutenant, to cruise daily with a party of boys, who perform all the work, under an experienced sailor. Those who have been at school for six months are sent off for two or three weeks at a time to get accustomed to real sea work. After an experience of two months in a Brig, the boys return to the Training Ship for further drill as a preparation for sea service on board of naval vessels.

Boys who show an aptitude for the use of tools are formed into a special class to be trained for ship-carpentering. And to give the practical knowledge, a small ship (the *Circe*) is fitted up as a work-shop, and is attached to the *Impregnable*, at Devonport.

The training of the British sailor is not limited to seamanship, but each boy is now conducted with great attention through a complete course of gunnery instruction. This course is divided into four sections.

1. The Handspike drill, and manning boats' sides.
2. Pointing, sponging and loading. Rifle drill.
3. Pointing, dismounting and mounting. Sword Exercise.
4. Independent firing; quick and broadside firing; shifting, breechings, trucks, and trigger lines, bow and quarter firing; and securing a lower deck gun.

On leaving a Training Ship about half the boys go through a course of Practical Gunnery, to enable them to aim and accustom them to firing shot and shell, on board of a ship specially fitted up for their use.

In few schools of any grade is the occupation of the pupils more incessant, but the routine is so diversified, that the lads are in high health and spirits during their entire training.

SCHOOL SHIPS FOR DESTITUTE CHILDREN IN SEAPORTS.

In 1856 the frigate *Akbar* was handed over by the Admiralty to a Board of Managers in Liverpool, and in 1858, the frigate *Venus*, to the Marine Society in London, to be fitted up and occupied by a class of boys, who were found hanging about the docks, and were fit candidates for police and reformatory treatment. In these ships successive classes of lads—in the former an average of 70, and in the latter, of 140, each year have received the ordinary elementary school instruction, and in addition, have been trained to the ordinary routine of a seaman's life. In due time a majority of them, rescued from bad influences, and lifted on to a higher plane of intelligence, have been put on board of merchant vessels, to work their way up into positions of good pay and responsibility.

In 1870 the Admiralty turned over to a Board of Management (charged by the Poor Law with providing schooling for destitute and pauper children) in the Forest Gate District, composed of three of the eastern parishes of London, a fine wooden man-of-war, the *Goliath*, of 84 guns, rendered powerless for the service, by the progress of modern naval construction. The ship was fitted up as a nautical and industrial school, at a cost trifling compared with that of a new building, site, and equipment for the same number, and, with its complement of 400 lads born to poverty and almost predestined to vice and crime, anchored off Gravesend. Fortunate in its superintendent, Captain Bourchier, of the Royal Navy, and his staff of industrial and book instruction, these lads (increased during the year to 450) have been subjected to a daily nautical drill and school course, which give great satisfaction.

From an official statement published in the London Times (Oct. 11, 1871), it appears that out of 449 boys received on board since the *Goliath* took up her station, 16 have gone into the Royal Navy, and in a few weeks 40 others will be in readiness; 13 have gone to sea in merchant ships, and more berths are promised shortly; 25 have found desirable situations on shore or been discharged to their friends. Besides the regular elementary school studies in which all engage for four hours, and seamanship which

is taught to all, 115 are under instruction in the bands, of which there are four on board, in addition to a drum and fife band. There are 160 treble and second singers; and concerts, vocal and instrumental, are given by the young performers. For young musicians there is a demand in the army, and a list of 30 adepts have been sent to the Horse Guards. There is a swimming bath attached, and 185 have been taught to swim. Out of a fund raised by subscription, prizes are given, the first distribution of which is thus described:

The prizes, of which about 100 were given away—and Captain Bourchier said he wished heartily that he had a prize for every boy, for "there was not one black sheep among them"—were awarded according to a system calculated to stimulate the better feelings as well as the intelligence of the boys. Thus, while there were prizes for seamanship, for smartness aloft, for the best sail-makers, best coxswains of boats, best tailors, shoemakers, carpenters, painters, buglers, &c., there were also prizes for the best swimmers, the best captain of messes, for the boys who kept their clothes or band instruments in the best order, one for the boy who had attended most carefully to the sick, and two for the most popular boys in the ship. The latter prizes had been awarded according to a species of informal and unconscious *plébiscite* on the part of the boys themselves. There were five "popular boys" nominated; for one of these—a small, dark, round-faced urchin—every boy in the ship voted; the next on the list had a little over 50 per cent. of the crew in his favor; and if names be any guide to nationality both these boys ought to hail from the sister island. To five of the boys silver medals were given for special good conduct, and these enjoyed the distinction of standing in the front row and having their honors fastened on by Miss Bourchier, daughter of the Captain Superintendent, the general distribution of books being made by Mr. Brushfield, chairman of the Board of Managers. As the little fellows came up to the table it was impossible not to remark what a difference existed between recent arrivals in the school and those who had been a few months or even a few weeks on board the *Goliath*. The school records show that, though commonly feeble and stunted in growth when they embark, numbers of them have since grown two and three inches in height, and as much as two inches round the chest. At Gravesend mariners know that the salt water mingles with the fresh; the process is silent, but not the less real. And in the *Goliath*, as in the tide itself, a change may be traced, working quietly but just as surely, in the *physique* and characters of the boys on board. The constraint, depression, and helplessness lurking in all pauper boys lifts and melts away by little and little. In its place come the frankness, courage, and love of adventure natural to English boys who live near the sea. Every thing on board encourages a cheerful, self-reliant tone: the music, good food, good air, alternate hours of work and play, care, and strict discipline—these are the elements in the midst of which they live. The boys make every thing for themselves. Even the neat Hussar uniform in which band No. 1 plays on the quarter-deck has been cut out and made on board. The form of punishment held in most awe is to be forbidden to row in the boats. Moreover, they one and all feel that they have a future. Taking into account the advantages, physical and educational, which the boys receive, it would not be placing too high a value upon the training in the *Goliath* to estimate it in the case of each boy at 50*l.* a year. Yet the actual charge made to other unions is 6s. 6d. a week.

The editorial notice of this enterprise concludes as follows:

Thus, beside the regular supply of trained sailor boys who may be expected to take to the navy—we are told the punishment most dreaded on board the *Goliath* is being forbidden to row in the boats—there will be a considerable residue brought up to steady work on shore, to skilled labor and occupations which ought to secure them in after life a decent subsistence, and a position far above the slough of hopeless and helpless poverty in which they were born.

SPECIAL SCHOOLS, AND INSTRUCTION

FOR THE MERCANTILE AND MILITARY MARINE.

INTRODUCTION.

The necessities of the maritime service in France, public and private, military and commercial, have created a system, or at least a series of special schools for children whose parents are occupied on the sea, or youths preparing for the exigencies of naval affairs, several of which we will proceed to describe, with the aid of official documents,* without reference to the chronological order in which they have been instituted. The system includes

1. Nautical School for the Orphans of Sailors.
2. The Inflexible and other School-ships.
3. Naval Apprentice Schools at the government naval stations.
4. School for Boatswains and Shipmasters.
5. School for Naval Engineers and Stokers.
6. Naval Drawing School.
7. Schools of Navigation and Hydrography.
8. Naval School at Brest.
9. School of Naval Architecture at Paris.
10. School of Marine Artillery.
11. School of Hydrography.
12. Naval School of Medicine and Pharmacy.

In addition to the schools above enumerated, several of which will be described in detail, the French government has now under consideration the establishment at Paris of a Central School of Commerce and Navigation. The instruction, while it will be special, will not be technical, and will be designed for young persons who propose to enter either the military or mercantile marine, leaving the practical details of the particular branch of the service to be acquired elsewhere.

A system of maritime conscription for recruiting the navy, and strict regulations requiring special instruction in masters and mates of all mercantile vessels, are in force in France.

* Official Report on Paris Industrial Exhibition of 1866, group X. Official programmes of the several schools noticed.

NAUTICAL SCHOOL FOR ORPHANS OF SAILORS.

Formerly, when the children of sailors were obliged at the age of seven to leave the asylums (*salles d'asile*,) which are open to them with such liberality, they had to stay for six years in the primary schools before they were admitted to the "school for young sailors" (*école des mousses*,) where their professional education commenced. This state of things, entirely satisfactory when the child belongs to a family, is different when it is an orphan. Then there is a void to be filled.

An imperial decree, published Nov. 15th, 1862, at the suggestion of the Marquis of Chasseloup Laubat, provides for this want by furnishing at Brest an institution for the orphans of the navy, and placing it under the especial protection of Her Majesty, the Empress. Vice-Admiral, Count de Gueydon, gave all his care to the organization of this especial school, which was intended to gather the orphans of seamen, to place them under the protection of the navy, to educate and instruct them that they might follow in the steps of their fathers. They were placed under the supervision of lieutenant Picard of the navy. Their general instruction was confided to the *Brothers of the Christian Schools*, and the "Daughters of Wisdom" (*filles de la sagesse*) were intrusted with all the cares which such young children require.

We have nothing to say in this place of the excellent primary instruction given in this school, and will only notice briefly the special or professional instruction, which is imparted in a military style by divisions, subdivisions, companies, sections, squads commanded by masters, second masters, quarter-masters, and naval instructors. There are three sizes (the low, middle, and high,) each of which is commanded by a pupil.

The lessons which they receive consist of instruction in the management of sails, sailor's practice, (*école de matelotage*,) the whistle, fife and drum, rowing, swimming, military practice, gun-practice, bayonet-practice, bats, *eillon*-drill, principles of music, gymnastics, and boxing. There is likewise given to them a physical and military education, which developes their strength and gives them the ability to study more closely.

On the 1st of January, 1867, there were in the school 415 pupils. Most of them are sent to the Seamen's School (*école des mousses*,) when they have attained the thirteenth year of their age; those who are not considered fit to serve in the navy are struck off the lists and returned to their families.

Name of School.	3d Degree.	2d Degree.	1st Degree.
School of maneuvering on the naval gymnasium.	40 learn to mount to the mast-head and to hold themselves on the sail-yards.	185 are just learning to take in the sails and the reefs, and to make knots and splices.	190 take in the reefs and make knots and splices.
School of whistling.	20 learn to whistle.	10 give almost all the blasts of the whistle.	20 give all the blasts of the whistle.
School of rowing.	30 learn to row.	90 are just learning to row.	90 row.
Infantry school.	255 are drilled without arms.	20 are not fit yet to join the battalion.	140 are drilled in the gun-practice, bayonet-practice, and form a battalion.
School of the fife and drum.	8 commence.	10 do pretty well.	7 do well.
School of gymnastics.	50 commence the elementary movements.	10 do pretty well.	30 do well.
School of music.	125 commence.	140 do pretty well.	150 do well.

The following table shows the number of pupils that had entered and left the school, up to Dec. 31, 1866:

	1863.	1864.	1865.	1866.
Number of pupils on the 1st January,	—	224	256	420
Entered during the year,.....	247	102	235	157
Total,.....	247	326	491	577
Left during the year. Sent to the school ship,..	15	53	42	93
Sent back to their families,	6 (23	15 (70	25 (71	67 (162
Died in the hospital,.....	2	2	4	2
Present on the 31st of December,.....	224	256	420	415

THE INFLEXIBLE AND OTHER SCHOOL-SHIPS, AT BREST.

For a long time the children of sailors were placed on board the vessels of the fleet, where they lived in a state of servitude, and frequently arrived at a mature age without being able to read or write, while the gasket of the sailor formed characters which would not yield to any moral suasion. It is only since 1822 that they received, before being placed on board the vessels, an elementary and professional instruction, and since that time the school-ship has

become the principal seminary for naval officers. The children must be at least twelve years old and their parents pledge themselves not to take them away from the school till they have reached the age of eighteen.

The school-ship, first established at Brest in 1823, was transferred to a corvette in 1836, to a frigate in 1851, and finally, in 1861, to the man-of-war, "*l'Inflexible*," where it numbers at present 900 pupils from the age of 13 to 15. They remain here at least one and not more than two years, and receive a primary and professional instruction. After leaving the school they are placed on vessels of the fleet, where they continue to be under the special superintendence of the naval department. Even here they go through a regular course of instruction, given by one of the officers, and have thus an opportunity to continue the studies commenced on board the school-ship.

It would lead us too far here to enumerate in detail all the exercises performed on board the *Inflexible*. It will suffice to say that besides school instruction, the pupils are progressively accustomed to the practice of their profession, and learn every thing which a sailor can be taught on board a vessel; the washing and cleaning of the vessel and of their linen, the rigging of the mast, the maneuvering of sail-boats and row-boats, which occupations fill the morning hours. After dinner, which takes place at 11 o'clock, they go on board two brigs, where they study and execute alone all that constitutes the practical art of the sailor.

It is not to be wondered at that these young sailors on board the *Inflexible* get a liking for their occupation. Always in the open air, with good clothes, varied bodily exercises and abundant food, they acquire robust health and a thorough knowledge of their profession. Whilst two companies tack, two others go through military exercises with rifles or guns, taking them to pieces, lashing the pieces, and in various ways maneuvering with the mountain howitzer, bayonet-fencing, &c. Some go to the sail-maker's room and make hammocks. In 1857 there were selected 16 sail-makers and 20 steersmen from those in each company who showed most aptitude and taste for these specialties. This classification of the young sailors according to their professional ability, has produced very excellent results.

More recently still (by an imperial edict of Aug. 11, 1868,) a special section of sailor apprentices has been formed on board the "*Inflexible*" for children, who have not the required size and strength, (*taille;*) they are received into the school as apprentice sail-makers,

carpenters and calkers. Pupils, after having reached the age of sixteen, are transferred to the school-ship *La Bretagne.*

The following table will give the statistics of this school to 1866.

Date of Admission.	Number Admitted.	Left.					
		Chief of the Topmast.	Topmen, (*gabiers.*)	Flying Topmast, (*gabiers volantes.*)	Supplementary.	Left the Navy, or died.	Total.
Present April 1, 1861..	493	....	....	....	....	....	....
Admitted in 1861....	275	10	32	32	12	10	96
" " 1862....	712	30	202	66	157	54	509
" " 1863....	579	30	183	115	205	38	571
" " 1864....	580	31	173	152	212	28	596
" " 1865....	545	33	191	115	186	64	589
" " 1866....	540	39	190	110	158	72	569
Total.....	3,724	173	971	590	930	266	2,930

The chambers of maritime commerce at Bordeaux, Cette, Marseilles, Ajaccio, Havre, &c., have established similar nautical schools and placed them under the supervision of the government.

NAVAL APPRENTICE SCHOOLS.

There have been since 1824, in every one of the five naval stations of France, elementary schools, intended to give to the apprentices in the various workshops a degree of elementary knowledge, on the system of monitorial or mutual instruction. After some years of prosperity they were abandoned, in consequence of the great aversion then generally manifested against this method. The only one that remained was the school at Rochefort, which was under the superintendence of the Brothers of the Christian Schools. But in 1828 and 1829, under the ministry of Martignac, the Baronet Hyde de Neuville ordered their reëstablishment. Every one of these schools organized itself in its own way, and it was only in 1851 that a decree of April 7th prescribes uniform regulations.

We have nothing to say here on these apprentice-schools, which are simply primary schools for adults, to which are added special schools for rowing. Their professional instruction is given in the various workshops of the port, to which they have been assigned; the apprentice school has had during the year 1866, 954 pupils.

SCHOOLS OF BOATSWAINS.

The navy maintains schools called "*école de maistrance*" (*maistrance* corps of under-officers of a ship,) where a certain number

of workmen from the arsenals, chosen by open competition, receive the special theoretical instruction required for the boatswain and foremen of the various workshops.

The origin of these establishments goes back as far as 1819. A circular from the Secretary of the Navy, the Baronet Portal, of Aug. 17th, decreed the establishment, at the ports of Brest, Rochefort and Toulon, of special schools, in which a certain number of young workmen, destined for the "board of shipmasters" (*maistrance*) and chosen from among the most intelligent ones, should go through a theoretical and practical course of ship-building. The same circular contained a provisional regulation, giving the rules to be observed in these schools. The number of pupils in each was limited to 12, of which 8 should be carpenters, 1 pulley-maker, 1 blacksmith, 1 locksmith, 1 cooper, &c. These pupils should be chosen from among the most intelligent and best-behaved apprentices and young workingmen. They must know reading and writing, have served two years in one of the ports, and be at least eighteen and not more than twenty years old. The supervision of these schools was confided to a naval engineer.

We have just given an outline of the programme of admission required in 1819, because it is an official indication of the state of primary instruction at this period; but the same regulation proves that it was too high yet, for the minister allowed, for the first two years, the limit of age to be extended to 25 years.

The course of instruction which was to be given, comprised the first elements of mathematics, elementary geometry, the first elements of rectilinear trigonometry and the first elements of statics, &c. This course of studies was to last two years, and a system of examination and prizes was organized.

It was generally supposed that such an organization would obtain great success, and that the advantages which it presented would attract many pupils. But such was not the case. The working classes at that time were very much neglected, and there were very few who could read or write. Moreover the working men did not receive any pay whilst attending the school, and thirdly, there was no opportunity for these young men to perfect themselves in the practical exercises of their profession during the two years they studied the theory. The necessity of making some modification became clearer every day, and this was done by a royal decree of Feb. 9th, 1833.

Instead of choosing the pupils, competition was substituted, and as the primary instruction had advanced, candidates were required

to be able to read fluently, to write neatly and correctly, and to be acquainted with the rudiments of arithmetic; they must be workingmen of the first or second class, must be 21 years old and have served for three years in some port; finally, they must furnish a certificate of their professional capacity, given by the foreman of their workshop, and countersigned by the director.

The course of instruction was to last two years, but the theoretical studies were confined to the first year; the second year was exclusively devoted to the practical application of the various professions of the pupils, the number of whom was increased, the recruits coming to a great extent from the naval ports. Brest was to receive 24, Rochefort 14, and Toulon 14; 52 in all, instead of 36.

In spite of the abolition of the limit of higher age, which gave a larger number of pupils access to the school, the recruiting of pupils still presented great difficulties. These were partly obviated by admitting assistant boatswains, and even boatswains, who were paid by the day. This measure was productive of very happy results; the number of pupils was soon increased and the studies were persued with greater vigor.

The republican government, likewise, devoted its attention to these schools. A decree ordering a reörganization, was published April 23, 1856, and is to the present day in force. The conditions of admission were retained and extended to workingmen of the third class; the number of pupils assigned to each post was somewhat changed; the course of instruction was to last two years; during the first, the pupils spent the whole morning at the school, and during the second, only three mornings per week. Finally, it was agreed that the pupils were to be paid for the time which they devoted to the school, just as if they had worked in the dockyard.

PROGRAMME OF INSTRUCTION.

In order to make the scientific instruction of more practical use, the following programme was fixed for each year.

First year.—Arithmetic, logarithms, square cube roots; 2, geometry; 3, elements of descriptive geometry; 4, elements of algebra up to equations of the second degree; 5, linear drawing; the course of arithmetic and algebra lasted a month and a half, from 10 o'clock till noon, instruction in drawing from 8 till 10. The two last months of the year were employed in reviewing all that had been taught during the year, and in preparing for the examination.

Second year.—1, Common mechanics; 2, workshop accounts; 3, drawing. The course of mechanics and workshop accounts lasts

two months. The half-day spent at the school is divided into three parts; the first is occupied in drawing, and lasts two hours; the second (either mechanics or workshop accounts) also two hours; the remainder of the time is devoted to optional studies. When the course of mechanics and workshop accounts is finished, the pupils are divided into two sections; the first comprises the carpenters, and workmen of similar rank; the second the mechanicians and workers in metal. During two months and a half the professor of mathematics teaches the section that works in wood the application of geometry to the drawing of working plans, explains to them all the details of the drawing of the frame, the stern, the bow and pieces, &c. He teaches them to calculate the *deplacements* from the centre of the keel, or metre-centre. Finally, the pupils are taken to the molding-loft, in order to trace there a vessel in its true dimensions under the directions of a drawing-master. The metal-workers receive instructions from the professors of mathematics, on the property and application of steam; the functions of the various parts of a steam-engine; the applications of descriptive geometry to the drawing of the different parts of the steam-engine, &c.

The instruction in drawing receives in these schools all the attention which the development of naval construction demands. During the first year the pupils learn successively shading strokes of different thickness, simple and dotted; the construction and use of ladders. After this preparation, which applies to all, they execute professional drawings; the carpenters, plans of vessels after a copy; the mechanicians, plans of steam-engines and steam-boilers, &c. The time devoted to drawing during the second year is employed by the carpenters in drawing a fair copy of the complete furnishing material of a vessel, the details of the masting, the capstan, the helm, &c.; by the metal-workers in drawing a fair copy of the various machines. All these courses of instruction have been attended with satisfactory results; most of the pupils who have not been able to draw a straight line before entering the school, on leaving can draw in a creditable manner the working-plan of a vessel as well as of the most complicated machines.

From its foundation in 1819 till the end of 1862, the *Echo de maistrance* at Brest has been attended by 429 pupils, viz.:

275 pupils actually in the service, viz.: 34 pupils; 60 workingmen; 57 assistant boatswains; 100 boatswains; 24 paid boatswains.
59 pupils died in the service, viz.: 5 pupils, 15 workingmen, 7 assistant boatswains, 22 boatswains; 7 paid boatswains; 1 naval storehouse-keeper.
95 pupils left or were discharged.

To get an idea of the manner in which the pupils pass the examination on leaving, it will be seen from the following table, which shows the results in the school at Brest during the last five years, that the instruction given has not been lost. The same is the case at Rochefort and Toulon.

Years.	Number of pupils who have attended the school.				Total number of pupils.
	With great success.	Successfully.	With good results.	Without result.	
1862	6	5	13	3	27
1863	3	4	20	—	27
1864	5	5	15	4	29
1865	3	6	14	1	24
1866	6	9	14	—	29
Total,	23	29	76	8	136

SCHOOL FOR NAVAL ENGINEERS, STOKERS, ETC.

Since the introduction of steam into navigation, it is indispensable to have well-trained stokers and mechanicians, men who enjoy robust health, great presence of mind, prudence and an inventive genius when facing difficulties, skill in working metals, a knowledge of elementary mathematics and its application to their labor. In order to prepare such men, two special schools have been established by an imperial edict of Sept. 24, 1860, one at Brest, on board the *Urania*, and another at Toulon, on board the *Jena*. To be admitted to these schools, the conditions must be fulfilled which are required for the various grades in the *personnel* of a steam vessel.

In order to recruit these schools, all the blacksmiths, braziers and weighers, (*ajusteurs*) who belong to the annual contingent of the army, may be sent officially, or at their own request, to the ports of Toulon and Brest, to be incorporated in the companies of mechanics of the navy. Civilians are admitted by contracting a voluntary engagement as stokers. All, however, must undergo an examination in manual labor, to show their physical capacity.

The course of instruction for stokers who are candidates for the grade of quartermaster, comprises, 1, arithmetic up to and including the rule of three, and square roots; 2, common geometry up to and including spherical bodies; 3, a concise knowledge of mechanics, and physics; 4, description and classification of steam-engines for vessels; the adjusting of their various parts, a concise knowledge of the property of metals and their use; 5, the practical management of machines and steam-boilers; 6, the repairing of machines.

It is evident that this instruction attracts to the service of the navy many intelligent and industrious young mechanics who would not enter it, because, not possessing the special knowledge required, they would not run the chance of remaining for a long time in the lowest grade, viz.: that of working stoker, the only one to which their attainments would allow them to aspire. In following this instruction, however, attentively and passing their examination successfully, they obtain the rank of pupil mechanicians, and even of quartermasters. In continuing their studies, they can rise still higher; their schools furnish them with the means, if they wish to become second boatswains. To the knowledge already acquired are added: 1, arithmetical progression; 2, the whole of planimetry; 3, theoretical mechanics and physics; 4, theory, description, regulation, and construction of steam-engines and steam-boilers; 5, the working and repairing of machines. By further pursuing their studies and working diligently, they can rise from second to first boatswain, and may ultimately obtain the position of principal mechanician, with the rank of lieutenant on men-of-war, and even of captain on corvettes, if they became chief mechanicians. The following table, giving the statistics of the school at Toulon, will show the success with which these schools have been attended.

Designation of the different grades.	Number of pupils who have attended the school during the half-year.						Number of pupils prepared at the school, who underwent an examination.						Number of pupils who were successful at the examinations.					
	COMPETITION OF						COMPETITION OF						COMPETITION OF					
	May, 1864.	Nov., 1864.	May, 1865.	Nov., 1865.	May, 1866.	Nov., 1866.	May, 1864.	Nov., 1864.	May, 1865.	Nov., 1865.	May, 1866.	Nov., 1866.	May, 1864.	Nov., 1864.	May, 1865.	Nov., 1865.	May, 1866.	Nov., 1866.
For 1st Boatswain,	38	31	35	23	19	13	29	24	26	10	14	13	15	1[illegible]	1[illegible]	8	8	10
2d Boatswain, (theoretical,).	49	41	44	31	13	22	31	37	31	22	11	22	18	2[illegible]	16	9	7	19
2d Boatswain, (practical.)..	25	29	12	4	3	3	23	15	7	4	3	3	16	1[illegible]	7	4	3	3
Pupil Mechanic,.....	6	5	23	3	—	1	4	5	14	2	—	1	1	5	2	2	—	1
Quartermaster, (theoretical.).	129	124	67	36	32	19	115	108	35	34	—	12	99	97	27	26	—	11
Quartermaster, (practical.)..	4	2	—	—	—	—	3	2	—	—	—	—	2	2	—	—	—	—
Total.....	251	225	181	97	67	58	205	191	113	72	28	51	151	149	64	49	18	44

Note.—Since the 1st January, 1865, the number of candidates being too great, the number of pupils has been reduced, but may again be increased, when occasion demands it.

NAVAL DRAWING SCHOOL.

An edict issued by Napoleon I, Sept. 27th, 1810, established at Brest and Toulon, on board the *Duquesne* and the *Tourville*, drawing-schools for those who wished to enter the naval service, where theoretical and practical instruction was given. At the foundation

of the naval school at Angoulême in 1816, these drawing-schools were transferred to the shore, became less exclusive, and admitted to their gratuitous course all young men from these two great naval stations who wished to adopt the naval profession. They have always been very largely attended.

SCHOOLS OF NAVIGATION AND HYDROGRAPHY.

Long before the navy had acquired any importance, maritime commerce had been immensely developed. The coasting and ocean trade required experienced and well-informed sailors. There were therefore in the principal seaports, gratuitous schools of navigation, whose aim was to disseminate theoretical knowledge. These schools were well conducted from the year 1584, when Henry III issued the first ordinance on the subject, by which boatswains and captains of merchant vessels had to undergo an examination of qualifications; but opportunities of instruction were wanting at that time, and it was reserved for Louis XIII to fill this void.

During the memorable siege of La Rochelle, Cardinal Richelieu became convinced that the knowledge of a captain, to whom the State intrusts a merchant-vessel, ought not to be confined to the most simple rules of the art of navigation. He consequently, in January, 1629, published a decree, ordering the establishment of schools of hydrography, open to all who intended to study navigation theoretically. The king himself engaged to maintain, at his own expense, a certain number of such schools, and encouragements were held out to all cities which would found such schools. The professors of hydrography were detained to assist at the examinations of captains, boatswains and coxswains.

Such was the origin of the first professional instruction in navigation. Here, as in all institutions of learning, the instruction of manhood succeeded that of youth. If the orders of Louis XIII were not as generally executed as they deserved, they were instrumental in producing a certain number of learned hydrographers, some of whom became the authors of the first treatises on navigation ever published in the French language.

A decree of Louis XIV, (August, 1681,) another by Louis XV, (September 14, 1764,) and third by Louis XVI, (January 1, 1786,) show that the ancient monarchy did not lose sight of this branch of instruction. In the last mentioned decree, the Marquis of Castries, Secretary of the Navy, united under one common law all these establishments, whose organization was far from uniform. The professors were in future chosen by competition. Two chairs of

"hydrographic examiners" were created, charged with the superintendance of the instruction, to assist at the examinations.

A decree of the National Assembly, which became a law, August 16th, 1791, decided that gratuitous schools of hydrography should be established at the expense of the State, in thirty-four different places. This decree was supplanted by others published a few years later, further regulating the course of instruction.

During the wars of the first Empire, Napoleon I never forgot to extend the benefits of French institutions wherever his armies were victorious. To this circumstance several foreign seaports owe their excellent schools of navigation.

The hydrographic instruction was completely reorganized by a royal edict of August 7, 1825, under the ministry of Count de Chabrol. This is still in force with but few modifications. One professor is charged with giving instruction in each of the 42 schools of the Empire; two examiners have charge of the general supervision of these schools, and hold the annual examinations.

Instruction is gratuitous, and sailors can enter from the age of 13 upwards, but they rarely attend them before they are 22 or 23 years old. The professors, on five days of the week, impart instruction for four hours a day. There are two different courses; one superior and the other elementary; the first theoretical and practical, the other essentially practical. Wherever there is an observatory, the pupils are practiced in observations.

The programme of the theoretical instruction comprises: for ocean voyages, elements of arithmetic, algebra, geometry, trigonometry, elements of astronomy, navigation, use of instruments and nautical tables, elementary knowledge of steam-engines, as applied to navigation, French composition; for the coasting-trade, elements of practical arithmetic, geometry, practical navigation, elementary knowledge of steam-engines, nautical calculations. The examinations are annual, and no one is admitted to the practical examination, unless he has reached the age of 24, and has served five years on a French vessel. It comprises rigging, management of sails, a knowledge of coasts, currents, tides, and gunnery. After the practical examination has been successfully passed, the pupil must undergo the theoretical one.

For the results produced by these establishments, the average attendance of the schools of navigation, and the number of sailors, who have become captains or boatswains, we refer to the following tables.

Number of sailors who have attended the schools of hydrography from 1849 *to* 1866; *of candidates who have obtained the rank of "captain" for sea voyages, or "boatswain" for the coasting trade.*

Scholastic Year.	NUMBER OF SAILORS.			
	Pupils of the Schools.	ADMITTED AS (of the sea voyage.) Captains.	(of the coasting trade.) Boatswains.	Total.
1849–50	1,307	163	331	494
1850–51	1,347	187	369	556
1851–52	1,344	156	325	481
1852–53	1,324	168	317	485
1853–54	1,255	208	292	500
1854–55	999	151	178	329
1855–56	1,116	148	182	330
1856–57	1,804	253	493	746
1857–58	1,907	252	426	678
1858–59	1,568	258	354	612
1859–60	1,525	234	278	512
1860–61	1,424	253	263	516
1861–62	1,422	213	244	457
1862–63	1,424	229	252	481
1863–64	1,571	279	276	555
1864–65	1,410	309	260	569
1865–66	1,205	270	278	548
Total, ...	23,952	3,731	5,118	8,849
Ann. average,	1,409	219	301	520

Ports where schools of hydrography are established, with the average number of pupils who annually attend every school, collected from official documents since the year 1849.

Ports.	Number of pupils.	Ports.	Number of pupils.
Dunkerque,	58	Saint-Nazaire,	24
Calais,	8	Nantes,	77
Boulogne,	7	Les Sables-d'Olonne,	37
Saint-Valerie-sur-Somme,	21	La Rochelle,	11
Dieppe,	11	Rochefort,	86
Fécamp,	24	Blaye,	27
Le Havre,	39	Bordeaux,	50
Rouen,	5	Bayonne,	17
Honfleur,	11	Saint-Jean-de-Luz,	16
Caen,	19	Narbonne,	29
Cherbourg,	70	Ogde,	42
Granville,	37	Cette,	24
Saint-Malo,	116	Arles,	16
Saint-Brieuc,	30	Martigues,	13
Paimpol,	28	Marseilles,	50
Morlaix,	19	La Ciotat,	8
Brest,	74	Toulon,	72
Douarnenez,	9	Saint-Tropez,	20
L'Orient,	94	Antibes,	16
Vannes,	34	Nice,	9
Le Croisic,	27	Bastia,	30

THE NAVAL SCHOOL AT BREST.

NAPOLEON, in 1810–11, established the first naval school-ships in France, the *Tourville* being chosen for that purpose at Brest, and the *Duquesne* at Toulon. These schools were placed under the orders of the maritime prefects of the two ports. In 1816, these two schools were abolished by decree, and a royal marine college was established at Angoulême. Several other changes took place, and in 1830 the college was replaced by a naval school on board the *Orion*, an old 74; this vessel was succeeded by several others, all of which have received the name of the second school-ship, the *Borda*, named after Captain Borda, a naval officer of great scientific and practical ability. The present ship is a noble three-decker, pierced for 120 guns, was launched in 1847, and took part in the Crimean war.

The *Borda* is stationed at Brest, and its rigging has been reduced to that of a frigate. The forepart of the second gun-deck of the vessel still retains something of its old character, and is provided with six guns on each side for practice. The other parts of the vessel have been completely altered; the decks have been cut away, so as to form two large lecture-rooms and two school-rooms. Not only the pupils but also their professors and most of the officers are lodged on board the vessel. On deck are specimens of various kinds of guns in use in the French navy, and a gymnasium. The quarter-deck, which is continued to the mainmast, is divided, the forepart being appropriated to the pupils, and the aft to officers.

Candidates are admitted to this school after a public examination, which occurs annually. For admission to the examination the applicant must prove his French birth—his being at least fourteen years of age and not over seventeen years, and his having no infirmity that disables him for marine duty.

The requirements for admission are a knowlege of arithmetic, algebra, geometry, plane trigonometry, applied mathematics, natural philosophy, chemistry, geography, the English language, drawing. The candidates must prepare a composition in French, a translation from Latin, an exercise in English, a numeral calculation in trigonometry, a geometrical drawing, and an off-hand sketch of a head. There are two oral examinations on the above studies, the second of which is not attempted if the first, which is elementary, is unsatisfactory.

The commander of the *Borda* is a full captain, and the instruction, which is practical as well as theoretical, is confided to eleven

professors, of whom five belong to the hydrographic department, eight are full lieutenants, and one a principal engineer. The duties of the five hydrographic professors are thus divided:—Two teach astronomy and navigation, two analytical and mechanical science, and the last natural philosophy and chemistry. The duties of the other professors are thus arranged:—Two for literature, history and geography; two for the English language; and two for drawing. The lieutenants direct four courses of instruction, namely, naval architecture, the theory and practice of managing a ship, gunnery and small arms, with practice, and nautical calculations. The engineer professor teaches the theory and management of steam-engines and mechanics. The other officers are a captain of a frigate, (second in command,) a chaplain, a financial and an administrative officer, and two medical men. Besides these, there is a captain of gunnery and several under-officers of the marine and artillery.

The school sessions commence on the first of October, and on that day promotions of the pupils are made in the various classes. Those who have passed two years of study in the ship are called *grand anciens*, rank with naval aspirants of the second class, and are eligible to make a voyage of circumnavigation in another vessel appropriated to that purpose; pupils who have been one full year in the *Borda* are called anciens, and the rest new boys, or in French naval language, *fistots*. The boys have each a number, and in all the ordinary routine of the school-ship, this takes the place of a name.

The elder pupils are employed as monitors over the younger, and each of the former has one or more allotted to him, not as a fag, but as a scholar, whom it is his duty to teach all he himself knows. It is said that the system succeeds admirably, and that for the first few months the instruction of the new comer is left almost entirely to his *ancient;* the new pupil thus escapes without difficulty many errors of discipline into which he would otherwise inevitably fall.

The discipline of the school is severe; the boys rise every morning, all the year round, at five o'clock, stow away the hammocks in which they sleep, attend prayers, and then commence their morning's work.

They are well fed, having coffee or chocolate in the morning, dinner (old style) at 12 o'clock, a lunch of bread (*goûter*) at 4.30, and supper at 7.45, with bread *à discrétion*, and about four-tenths of a pint of wine at each of the two principal meals.

The morning studies are devoted to science; those of noon to practice with guns, or practical study, marine machinery, or draw-

ing; and the evening to literature, the English language, or naval architecture. All the studies are pursued on board, with the exception of natural philosophy and chemistry, the professor of which has at his command in the town the collection of instruments and chemicals, as well as the lecture-room and laboratory of the central pharmaceutical establishment. At times, also, the pupils are taken to visit the vessels in process of construction, and the workshops in the arsenal, and to practice with small arms on shore.

There are eight boats attached to the *Borda*, and the pupils are practiced almost every day, and in all weathers, in rowing and sailing, under the eye of an officer, who watches the exercises from on board a small steam-gunboat attached to the school. The ordinary studies of the school end between six and seven in the evening, and the pupils turn in at nine o'clock for their eight hours' rest.

Thursday and Sunday, as usual in France, are exceptional days, when, after nautical calculations, (which are never omitted,) the elder pupils or ancients practice with small arms on shore, and the juniors are drilled in the use of the sword, musket, and bayonet. After this they have six hours' hard work in maneuvering two small corvettes, provided for the purpose, that belonging to the ancients being a screw-steamer.

The boys, as a rule, are at liberty on alternate Sundays, and the most advanced every Sunday afternoon. This is a recent innovation; the pupils used to be free scarcely more than once a month; but this gave rise to much discontent and some disturbance, and the rule has, therefore, been made less severe. In addition to this liberty, however, all the lads are allowed to see their friends for a short period during the exercises on shore on Sunday and Thursday mornings, and those who are not free on Sunday are taken on shore for a change in the afternoon. During the summer months the boys bathe in the sea.

A peculiar custom exists in the school—the boys are allowed to smoke during the hour of recreation after dinner, and at certain other times; and for this reason, that as it was found utterly impossible to stop the practice entirely, it was deemed better to recognize it in moderation, and thus stop its secret indulgence and the attendant danger of fire.

The punishments inflicted in the school are extra drill and confinement, either in a small cell or in a dark hole, with a regimen of bread and water; for very grave offences, boys are dismissed or expelled. On the other hand, the marks for good conduct are numerous; there are several examinations in the various classes during

the nine months of the school year, and those pupils who gain the greatest number of marks are called *élèves d'élite*, and wear a gold anchor on their collars, or, in the case of the first twelve, two anchors; the pupil who has gained the largest number of marks bears the high but merely nominal rank of first brigadier, and he who enters the school with the greatest success at the examination is called major. A general examination takes place at the end of the year, when the ancients who pass become aspirants in the navy, and the juniors are raised to the upper class in the school; those who fail in the examination are either sent back to their class, or rejected as unfit for the naval career. The first and second prizemen, on quitting the school, receive each a quadrant in the name of the Emperor, and the third a telescope.

The elder pupils have nearly three months' holiday, but the junior pass a month on board another vessel, the *Bougainville*, for what is called the summer campaign. This vessel, which was constructed specially for the school, is a screw dispatch-boat with engines of 120 horse power; the summer voyage is settled by the Minister of Marine, and includes a visit and examination of the ports of L'Orient and Cherbourg, touching at some remarkable points of the French coast, sometimes casting anchor off the English coast, and sometimes running as far as Ferrol in Galicia.

The *grand ancients*, when their holidays are over, that is to say on the first of October, join the *Jean Bart*, which makes an annual voyage of several months' duration. This boat was built in 1852 and made its first voyage of this kind in 1864–5. She is an 80-gun ship, of the mixed class, having engines of 450 nominal horse-power. In August of the present year she will have completed her fourth and last voyage of circumnavigation, another vessel, the *Donawert*, now being prepared to succeed her. The upper gun-deck of the *Jean Bart* is disarmed, and converted for the use of a part of the officers and the pupils, who number about a hundred, and occupy eight cabins, each with two portholes; here the young men eat, and drink, and sleep, as well as pursue their studies.

The officers of the *Jean Bart* consist of a full captain in command, a second captain, a chaplain, ten lieutenants, one having charge of each pupil's cabin, or *poste*, as it is called, and two giving instruction in sailing and gunnery; a surgeon-major, who gives instructions respecting the means of keeping a crew in health; two assistant-surgeons, an engineer, a drawing-master, and some others.

The Minister, as in the case of the summer cruise of junior pupils, settles the course to be taken by the *Jean Bart*. Generally

the West India islands are visited in the months of March and April, when the pupils are principally exercised in hydrographical works off St. Pierre and Fort de France; in gunnery on board, and small-arms on shore; in the daily management of boats for embarkation and disembarkation; and in the management of sails in the intricate channels of the archipelago. They are shown, moreover, how to perform difficult operations, such as the unshipping of the rudder and bringing it on deck for examination, lifting a mast, &c. The pupils are required to keep written records of all such operations, and to illustrate the narrative when necessary with drawings. When they visit foreign yards and arsenals, they are expected to give minute accounts of what they have seen there, and besides a daily journal, to write critical notices of all the different machines, methods of rigging, and maneuvers, which they have witnessed.

The difficult channel of the Isle St. Sebastian, off the coast of Brazil, that of the Bermudas, the river Hudson, and the coast of Newfoundland, are among the places selected to initiate the pupils in the difficulties of navigation. At Annapolis, in the Chesapeake, a visit is paid to the National Naval School of the United States at the season when the general examinations take place in that establishment. The voyage usually terminates with a visit to Cape Breton and some points of Newfoundland; the fisheries and drying-houses of St. Pierre and Miquelon are generally visited, and the *Jean Bart* returns to Brest between the 1st and 5th of August, having been absent ten months. A sailing brig named the *Obligado* has lately been attached to the *Jean Bart* as a supplementary vessel.

SCHOOL OF NAVAL ARCHITECTURE AT PARIS.

The construction of ships and engines in the French naval service is intrusted to the Corps of Marine Engineering, (*Corps du Génie Maritime*,) consisting of 121 officers, viz., 1 inspector-general, 10 directors of naval construction, 40 marine engineers, and 70 assistant engineers.

This corps is recruited from the graduates of the Polytechnic, and having passed satisfactorily the required examination for the public service, are sent to the School of Application of Naval Engineering at Paris, and to the dockyards, to learn their special business. The usual number in attendance is 30, and the annual cost of the school is about 100,000 francs.

The course occupies two years and a-half—three winters in Paris

and two summers in the dockyards. The pupils having a good general education and a complete special knowledge of mathematics and geometrical drawing, the courses are from the start eminently practical.

The instruction in Paris during the first session consists of: 1, a course on construction; 2, on displacement and stability; 3, on strength of materials; 4, English; 5, free-hand drawing; 6, plan-drawing of vessels. During the second session it consists of: 1, a practical course on steam-engines; 2, a theoretical course on steam; 3, applied mechanics, machines in general; 4, English; 5, accounts; 6, plan-drawing, ships and engines; 7, pictorial drawing. During the third session: 1, course on stability, (2d part;) 2, on naval architecture; 3, naval artillery; 4, technology of workshops special to the navy; 5, accounts; 6, English; 7, plan-drawing, projects for ships; 8, free-hand drawing.

In the first year ship-building is taken up; in the second, the steam-engine, and in the third the two are combined and completed. When in the dockyards, the pupils are placed under the order of the engineer in charge of works in execution, who sees that they are attentive to their duty, and have proper instruction. He also examines and certifies the journals which the pupils have to keep. The director of the school gives each pupil detailed instruction to guide him in the choice of the practical work he shall attend to. The first summer is devoted to the construction of ships, the second to that of engines. The pupils select the ports to which they will go, according to their standing in their class.

At the end of two years and a half, the pupils are examined by a board, and if found qualified, they are appointed assistant engineers of the third class. If they fail to pass, they may be allowed another year—but failing in that, they are definitely rejected.

The private pupils, natives or foreigners, who to the number of eight are allowed to attend the course in Paris, may obtain permission to go through the whole practical course in one of the imperial dockyards, but are not subjected to the same discipline as the regular pupils. On leaving, they receive from the director a certificate of the course gone through, their talent and diligence.

The school is under the immediate orders of a Director of Naval Construction, who is also one of the professors, and is assisted in the several branches taught by other professors, who are marine engineers, and a special teacher of drawing, and another of the English language.

MARITIME CONSCRIPTION.

The French naval service is supplied by a system of conscription analogous to that for the army. All persons, who reside on the coast, whose labor is on the sea, or on navigable rivers reached by the tide, are enrolled on arriving at the age of eighteen, and are liable to be summoned to the naval service until they are fifty, for an aggregate period of seven years.

SCHOOLS OF MARINE ARTILLERY.

There is at Brest, Toulon, and L'Orient, schools of marine artillery, besides floating schools at Brest and Toulon, for practice at firing at a mark at sea.

BOARD OF HYDROGRAPHERS.

The Board of Hydrographers is located at Paris. Pupils who have completed the polytechnic course enter the corps with the rank of *élève hydrographe*, with the same rank and advantages as naval architects. They are sent to the coast to make surveys, and after two years service in the field, and in office work under special instruction, become assistant hydrographers without further examination.

NAVY AND NAVAL EDUCATION IN FRANCE.

I. MILITARY AND COMMERCIAL MARINE.

The progress of the French Navy is represented in the following statistics taken from the Statesman's Year Book for 1871: In 1780 the war fleet consisted of 60 first-class ships, 24 second class, and 182 smaller vessels,—total 266 ships, with 13,300 guns, and 78,000 sailors. In 1805, the number was reduced by casualties and neglect to 18 men-of-war, with 1,352 guns. In 1844 the whole force amounted to 226 sailing vessels, and 47 steamers, with 8,639 guns and 24,513 sailors. In 1855 the navy was reorganized, by the introduction of every new appliance of naval architecture, construction, and ordnance, with the following results, in 1869–70:

Classes.	Number.	Horse-Power.	Guns.
1. Iron-clads,	62	28,150	672
2. Screw Steamers,	264	55,812	1,547
3. Paddle Steamers,	62	8,665	154
4. Sailing Vessels,	113	....	672
Total,	401	92,627	3,045

The iron-clads *Magenta*, *Solferino*, *Couronne*, *Normandie*, *Invincible*, and the cupola ship *Taureau*, are plated, with rifle breech-loading guns, and are not surpassed in strength and destructive armament by the ships of any other navy.

Eleven of the smaller iron-clads, besides the ordinary floating batteries, are so constructed that when out of service they can be taken to pieces, packed up and stored away at the arsenal of Toulon.

The navy is manned by a marine conscription, which dates back to 1683. For this purpose the maritime population is divided into five grand divisions, the centres of which are the five great Naval stations, with 12 subdivisions, including all the great seaports. Within these divisions all men and youths from the 18th to 50th year of age, devoted to a sea-going life, are enrolled, to the number of about 170,000. Except in a national emergency the government dispenses with the services of all under 20, and over 40, as well as pilots, captains, fathers of large families, and seamen ready for long voyages in merchant ships.

The navy was officered in 1869 by two admirals, 16 vice admi-

rals in active service, and 10 on the reserve list; 30 rear admirals in active, and 19 on reserve list; 130 captains of first class; 286 captains of frigates; 825 lieutenants; 600 ensigns; and 300 midshipmen, or aspirants;—total, 2,218 officers, and 39,346 sailors, who, together with engineers, dockyard laborers, surgeons, chaplains, brought up the number in actual service in 1869 to 74,403, which did not include 28,623 marines.

The commercial marine of France embraced in 1867, 15,259 vessels, with a tonnage of 1,042,811, ranging from 30 tons to 800 tons each, and employing over 150,000 seamen, including 40,000 officers, whose duties required special professional training. Of these, 607 were steamers, with an aggregate of 129,777 tons and 55,160 horse power. The value of the commerce of France for 1867–8 was 7,500 millions of francs.

II. NAVAL AND NAVIGATION SCHOOLS.

The French government was among the earliest to provide special schools for the officers of its merchant service as well as for its war-vessels. Prior even to the establishment, under an ordinance issued by Cardinal Richelieu, of schools for the study of navigation in 1629, Henry III., in 1584, had instituted examinations for boatswains and captains of merchant vessels, for which preparation had to be made with private teachers. In 1791 free schools of hydrography were authorized in thirty-four sea-ports; out of 24,000 pupils of these schools, from 1850 to 1866, 3,731 qualified themselves as captains of vessels in the foreign trade, and 5,118 for service in the coasting trade. Prior to 1800, in fitness of design and skill in construction, French naval architecture was superior to that of other countries.

The system of education for the mercantile and military marine embraced in 1866 the following schools:

1. Nautical School for the Orphans of Sailors.
2. The Inflexible and other School-ships.
3. Naval Apprentice Schools at the government naval stations.
4. School for Boatswains and Shipmasters.
5. School for Naval Engineers and Stokers.
6. Naval Drawing School.
7. Schools of Navigation and Hydrography.
8. Naval School at Brest.
9. School of Naval Architecture at Paris
10. School of Marine Artillery.
11. School and Board of Hydrography.
12. Naval School of Medicine and Pharmacy.

NAVAL AND NAVIGATION SCHOOLS IN GERMANY.

INTRODUCTION.

The organization of the North German Confederation, and more recently of the German Empire, and the necessities of its position, have already led to the rapid development of a military marine, and the unity of the commercial interests of the different States will soon expand its navigation as well as its naval armament.

1. KINGDOM OF PRUSSIA.

Long before Prussia was largely interested in either a military or commercial marine, the government had provided for the systematic training of all concerned in the construction, equipment, and running of ships, whether destined for the defense of the country or to its commercial interests. After enjoying opportunities of studying the theory of their business, as well as the practical application of its principles, they must pass an examination to test their knowledge both of the theory and practice—with a provision that no one shall assume the responsibility of the life and property of others without holding a certificate of proficiency.

NAVIGATION SCHOOLS.

There are six schools, situated at Memul, Dantzic, Pollau, Grabow (near Stettin), and Stralsund, devoted to the education of young men who propose to become mariners and masters of merchant vessels. A single director, residing at Dantzic, has the superintendence of all these schools, which have each two professors, each in charge of a division of the school, and an assistant who devotes himself to drawing in connection with the construction of vessels, and of charts. The principal has charge of the higher division, in which navigation and geography, both of the sea, and of the natural productions and commercial facilities of different countries are taught. The lower division deals with subjects which concern pilots—their professional and legal duties.

Candidates must have mastered the subjects of elementary instruction, and are examined as to their ability to read, write, and compose in their native language, and to go through ordinary arithmetical problems with facility and accuracy. An examination of

candidates takes place every year at each school, which is conducted by the head professor, in the presence of the director of this class of schools.

To be admitted to the examination the candidate must bring a certificate of good character, that he is over 14 and under 40 years of age. The school fee is ten thalers per quarter for the highest or navigation class, and six thalers for the lower or pilot's class. There are 32 lessons per week in both divisions.

The subjects taught in the lowest division are:—arithmetic, plane geometry, carpentry, plane and spherical trigonometry, navigation, territorial and astronomical observations, drawing of sea charts and astronomical maps, and the English language.

In the highest division, in addition to the studies of the lower, in which the pupils are carried further on, rigging and other points of practical seamanship, drawing the different parts of a vessel, the commercial requirements respecting a ship's papers, and the course of exchange at the principal commercial ports, are taught.

A final examination is held in which diplomas are awarded to those who have completed the whole course, and of proficiency in certain studies, either of which are of practical service in obtaining situations, and without which certain positions can not be obtained.

NAVAL ARCHITECTURE.

In the Trade or Polytechnic School in Berlin, provision is made for instruction in naval construction:

First—In the mathematical foundation of the most important physical laws; in physics, drawing, modeling, and the general principles of construction; in practical hydraulics; the theory of machinery, and the steam-engine.

Second—In the application of these principles to the business of ship-designing and construction, and particularly to designs for vessels, and the different parts of a ship in detail; to the art of ship-building; the general displacement of water and stability; hydrostatic calculations; general principles with regard to the form of vessels, and the theory of sailing and steam-ships; details of construction of wooden and iron vessels; practice; and planning and calculating the cost and capacity of vessels.

There are reviews of the ground gone over at the close of each term, which is obligatory only on those who enjoy free places, and each student receives a certificate at the end of his course, setting forth all his lectures and practical exercises, with an opinion as to his practical judgment.

II. AUSTRIA.

Under the new army organization of 1869, the military forces of the whole empire are divided into the Standing Army, under the control of the Imperial Minister of War; the Landwehr, whose duties are limited to the respective divisions from which it is drawn, under the control of the Austrian and Hungarian war ministers; and the Landstrum, or general levy, which is compulsory in the Tyrol and Military Frontier, and voluntary in the rest of the empire. The Emperor is supreme chief of the military and naval forces, and from him must emanate all concentrating movements of troops. In 1871 the Standing Army consisted of 278,470 men on the peace footing, and 838,700 on the war footing.

The naval forces of Austria consisted in 1871, of 46 steamers and 10 sailing vessels, viz.:

	Horse-power.	Guns.	Tonnage.
2 Iron-clad Line-of-battle Ships,..	1,800	22	11,138
7 Iron-clad Frigates,.....	4,550	88	25,452
4 Screw Frigates,.....	1,500	149	9,407
3 Screw Corvettes,.....	860	50	4,703
7 First class Gunboats,.....	1,610	30	4,311
3 Second class Gunboats,.....	270	9	999
16 Paddle Steamers,.....	2,381	51	9,442
10 Sailing Ves'ls, viz.: 2 Frigates,..	....	35	3,032
2 Corvettes,.	....	30	1,416
4 Brigs,....	....	40	1,176
2 Transp'ts,.	....	4	283

The navy is officered and manned by 2 vice-admirals, 4 rear-admirals, 24 captains of steamers and frigates, 14 captains of corvettes, 106 lieutenants, 343 ensigns and cadets, and 3,803 sailors, besides 875 officers and men in the marine corps. On the war footing the sailors number 3,743, and the marines 1,410. The men are recruited by conscription from the seafaring population, although the voluntary enlistments in the province of Dalmatia renders its enforcement unnecessary.

The total commerce of Austria, comprising imports and exports, exceeded $400,000,000. The commercial marine includes 7,830 vessels, of 324,415 tonnage, and 27,979 seamen. The Austrian Lloyd, a trading society established in Trieste in 1833, owns a fleet of 70 steamers, of 12,500 horse-power.

To provide officials, well instructed and trained in the administration of each department of the public service, military and civil—war by land and sea—both for military and commercial purposes, the government establishes schools, with studies and practical exercises adapted to each branch.

SCHOOLS FOR THE MILITARY AND COMMERCIAL MARINE.

1. *Military Marine.*

There are in Austria several kinds of naval schools, as follows: One each for sailor boys, for marines, for quartermasters, for naval pupils of the first class, for naval pupils of the second class, a theoretical school for naval cadets, and a superior establishment for naval officers.

1. The school for sailor boys is intended to train, as petty officers for the navy, young men from the Slave and German provinces, admitted between 12 and 14 years of age into the naval service. The instruction lasts until the pupil has attained the age for the conscription; he is then entered as a sailor and becomes a petty officer as soon as he gets sufficiently used to the sea. The highest post he can attain is that of upper boatswain (*Hochbootsmann.*)

2. The schools for marines (*Zeugscorps*) receive men drawn from different corps of the army. They are trained as petty officers, and a part receive the uniform. Those who are fit to become officers receive their promotion when they leave their corps to enter the school.

3. The school for naval cadets of the first class is kept on board a war vessel selected for the purpose. The object is to prepare for the naval service youths of 16 or 18 years of age, who, on entering the school have already received a complete civil technical education. The teaching here consists, therefore, chiefly of practical seamanship, and also of the application of previously acquired scientific knowledge to navigation and nautical astronomy. The course occupies a year; on leaving, the pupil is received as a naval cadet. After passing two or three years at sea these cadets enter the theoretical school for naval cadets.

4. The school for naval cadets of the second class is intended solely to prepare them to become officers. In this school, beside the pupils placed there at the cost of the State, there are others maintained by endowments, and also others who pay for their instruction. The sons of officers and State functionaries are entitled to enter this school at the public expense, and any Austrian subject who has the necessary qualifications is admitted on payment. Foreigners are also admissible as paying pupils, provided they can obtain authorization from their own government to enter the Austrian service. To be admitted, candidates must be between 12 and 14 years of age, of sound health without bodily defect, and able to pass a previous examination. The instruction is given in accordance with a determined plan, on board a vessel prepared expressly to receive the pupils. After three years' instruction the pupils leave the school as naval cadets and are sent to sea. At the end of two or three years' active service the cadets are admitted to the theoretical school. This school receives from 40 to 50 pupils. The chaplain on board is charged with the religious instruction; the other teaching is given by professors from the hydrographic schools. The naval officers of the school-ship give the instruction in practical seamanship.

5. The theoretical school for naval cadets is on shore, and its course occupies a year, after which the pupil undergoes the examination prescribed for his commission as an officer. On leaving this theoretical school the pupils are still naval cadets, but become officers when appointed to a ship.

6. The superior school for naval officers is intended for the further improvement in mathematical and hydrographic studies, of such young men as have shown decided talent and taste for those sciences.

III. GERMAN EMPIRE.

The jurisdiction of the German Empire, by treaty concluded at Versailles, and ratified by the Diet of North Germany Dec. 10, 1870, embraces among other national interests, the Army and Navy, and the protection of German navigation.

The war-fleet of the Empire, which embraces all that had been constructed by Prussia since 1848, consisted in June, 1870, of 38 steamers and 7 sailing vessels, with 42,415 tonnage, and 480 guns.

		Horse-power.	Guns.	Tonnage.
5	Iron-clads,	3,700	62	15,846
9	Steam Frigates and Corvettes,	3,200	200	14,210
8	" First class Gunboats,	640	24	5,858
14	" Second " "	840	28	5,858
1	" Yacht,	160	2	445
2	Paddle-Steamer Corvettes,	600	13	1,750
3	Frigates (sailing vessels),	...	114	3,736
4	Brigs, "	...	46	1,927

The German navy was officered and manned by 1 admiral, 1 vice-admiral, 1 rear-admiral, 27 captains and 217 lieutenants, and 3,283 seamen and boys, besides 2,760 in the marine corps. The sailors of the fleet and the marine corps are recruited by conscription, from the seafaring population, which numbers 80,000.

The provision for naval expenditure in 1870, was for—

Ministry of Marine,	81,250	*thalers.*
Administration officers,	65,557	"
Pay of seamen and marines,	1,086,990	"
Repairs of ships,	890,000	"
Marine hospitals,	71,820	"
War material,	1,221,317	"
Miscellaneous,	179,796	"
Total ordinary expenses,	3,596,730	"
Extraordinary expenditure,	4,403,460	"
Grand total,	8,000,190	"

The artificial harbor and dry-docks at Wilhelmshaven, in the Bay of Jade, on the North Sea, which was opened by the King of Prussia in June, 1869, have cost over $10,000,000.

The system of professional training for officers of the Imperial Navy is not yet matured. The Naval School at Kiel is still recognized. Aspirants enter as naval cadets after passing an examination equivalent to the requirements of a gymnasial maturity certificate, which in general education is superior to the requirements of graduation of either our Naval or Military Academy. Before entering on their professional studies, the cadet is first sent on a cruise to test his aptitude for sea-service. He then studies eight months at school and one year at sea, to pass as midshipman; and one year more at school, and three years at sea, to become sub-lieutenant.

MARINE ACADEMY AT KIEL.

The German Marine Academy established in 1872, at Kiel, is designed not for the education of cadets, but for the professional training and improvement of officers already in the naval service of the empire—and is of the same character as the Staff School of Berlin for officers of the army. Those only will be received as pupils, whose conduct and talents seem to qualify them for superior scientific attainments, and, hereafter, for the filling of the most important posts. These officer-pupils will be required to give proofs of their diligence and progress by the production, from time to time, of theses and dissertations on scientific subjects given to them by the professors. At the same time, all naval officers will be permitted to attend the courses of instruction when their professional duties do not call them away.

The course of study is to occupy two terms, each of twelve months' duration, with a vacation of three months for practical exercises.

The subjects for the first term are:—Mathematics, natural philosophy, chemistry, the theory of naval war in all its branches, military tactics in as far as disembarkations are concerned, coast surveying, the theory of the formation of coasts, coastal defenses, field fortification, the constitution of military courts, the principles of international, military, and naval law, the system of administration, sanitary science, especially with reference to life aboard ship and in different climates, the elements of logic, ethics, &c.

The following subjects will be included in the second term:—Nautical astronomy, geodesy, theory of maps and charts, the history of war, with especial reference to naval war, artillery, shipbuilding, the construction of steam-engines (with practical exercises), the position and construction of naval ports, physical geography, the elements of geology, marine botany and zoölogy, and the general history of modern literature and civilization, &c.

PART IX.

MILITARY SYSTEM AND SCHOOLS

IN SWITZERLAND.

MILITARY SYSTEM AND MILITARY INSTRUCTION IN SWITZERLAND.

[Extract from "A Plan for Military Education in Massachusetts." By E. Dwight.]

1. OUTLINE OF MILITARY SYSTEM.

In the year 1847 seven of the cantons of the Swiss Republic seceded from the Confederacy. Among them were the three forest cantons, the original nucleus around which the whole Republic had been formed, the birth-place of William Tell and Arnold, of Winkelreid. The seceders held the strongest military position in Europe, but the loyal cantons put on foot an army of 100,000 men, well armed, drilled, and officered. The city of Friburg was taken, and in thirty days from the first proclamation of the commanding general the war was ended and order was restored.

In 1856, a quarrel having arisen with the king of Prussia, Switzerland placed on foot an army of 200,000 men well provided with artillery. Thus the military system of Switzerland has proved itself effective; and as there is no standing army whatever, and the state is a confederacy of cantons under democratic forms of government, we may find something in their system applicable to our own case.

Switzerland covers an area of about 15,000 square miles, equal to that of Vermont and New Hampshire together, of which a large portion is covered by lakes, forests, mountains, ice and snow, leaving only thirty-one per cent of the land fit for agricultural purposes, not including the mountain pastures. Possessing a population of only two millions and a half of people, it is surrounded by military powers of the first class, and must needs be strong to be free. France, Austria, and Prussia are not always as good friends as they are near neighbors, and the little Republic must ever be ready to ward a blow and return it. The constitution of Switzerland declares that every citizen is a soldier. "Tout Suisse est soldat." Military service is required between the ages of twenty and forty-four. The substitution of one man for another is forbidden, but exemption from service is allowed to certain persons, such as officers of the government and of public institutions, clergymen, students of theology, members of the police, pilots and others. In some cases a man is excused from the more active service, but required to pass through the regular course of mil-

itary instruction and to serve in the reserve of the army when called upon. Such are the only son, or one of the sons, of a widow; or of a widower, provided the father be over sixty years old, and the son necessary to his support; a widower, the father of children in their minority, who has no resources except the work of his own hands; one of two or more sons when they make common household with their parents, if the family could not be supported by other brothers not subject to service; married men, or widowers having at least two children. These exceptions do not apply to officers.

The Council of State of each canton appoints yearly a "Commission on Furlough and Discharge," consisting of ten members, of whom two are medical men, two officers, one a corporal, one a soldier, and the others members of the council. The commission acts under oath; grants exemption for physical defects or want of height; or passes men from the active service to the reserve. A man who at the age of twenty has not attained the height of five feet and one inch can be furloughed for two years; and if, at the end of the third year, he has not reached this height, discharged from all service. Men who have been convicted of disgraceful crimes, or have suffered penal sentence, are declared unworthy of bearing arms; and if once deprived of their civil rights can not hold a commission.

The militia is divided into the federal contingent and the landwehr. The federal contingent consists—*First*, of the elite, which includes three per cent of the whole population, taken from those between the ages of twenty and thirty-four. The time of service in the elite is eight years. *Second*, the reserve, being one and a half per cent of the population and not above the age of forty. The landwehr includes men up to the age of forty-four. The landsturm, or *levy en masse*, consists of the whole male population, capable of bearing arms, between the ages of twenty and fifty, and not included in the classes before described. The male population of Switzerland is 1,140,000, of which thirty-seven per cent, or 422,000, are between twenty and forty-four years of age. One-fourth of these are exempt or found unfit for service, leaving 316,000 perfectly fit. In 1853 the number of men required for the federal contingent was 104,354,* but according to official statements the number of men in all branches of the service, well armed and instructed, amounted to 125,126. The excess of men supplied, over those required, arose from the public spirit and general desire for military instruction existing among the people. Add to these 125,000 the landwehr, which numbered 150,000, and we have a total of 275,000 effective men, well armed, drilled, and officered.

* Infantry, including Rifles, 89,366; Artillery, 10,366; Cavalry, 2,869; Engineers, 1,530.

The federal army is composed of the following arms: engineers, including sappers and pontoniers; artillery, including rocket batteries; cavalry, riflemen, light infantry, and infantry. There is besides a medical corps for the service of the ambulances and hospitals. But as uninstructed men are of little or no value, the federal law upon military organization provides that the cantons shall see to it that the infantry of their contingent is completely instructed according to the federal rules, and though the application of this principle in its details is left to each canton, yet the following rules are laid down: recruits are not received into the federal elite until they have gone through a complete course of instruction which lasts at least twenty-eight days for infantry, and thirty-five days for light infantry. The confederation charges itself with the instruction of the engineers, artillery, cavalry, and riflemen. This course lasts twenty-eight days for riflemen and forty-two days for the three other arms, but these recruits have previously been drilled in the school of the soldier by their cantons, and the riflemen have received preparatory instruction in firing at a mark.

In the larger cantons—that of Zurich for instance—divisions of recruits in succession are put into barracks and well drilled practically and theoretically for fifty-six days, either consecutively or at two periods of the same year, as may best suit the youths. In the second year after entering the elite, and for each year afterwards, the infantry is called out for drill during three days, by half battalions at least, with preparatory drill of three days for the "cadres,"* the commissioned and non-commissioned officers forming skeleton corps. Days of entry into service are not counted as days of drill, and in case of interruption the days of drill are increased by two days. The reserve is called out for drill during two days of each year, with a preparatory drill of one day for the "cadres."

In the corps of engineers, artillery, cavalry, and riflemen, the elite is called out every alternate year for the engineers and artillery, and every year for the cavalry and rifles. The drill lasts four days for the "cadre of engineers and artillery, and immediately after ten days for the cadres and companies united, or twelve days for both together. For the cavalry the drill lasts seven days for dragoons and four days for "guides;" for riflemen, two days for the cadres, and immediately afterwards four days for cadres and companies united. The reserve is called out for a drill of half the length of that of the elite.

To complete the instruction of the soldier the cantons in their turn send their men yearly to the federal camps where the troops to the

* The officers, non-commissioned officers, and corporals, constitute what is called the "cadre."

number of three or four thousand, are kept under canvas for two weeks. Larger numbers of men, forming bodies of 5,000 and upwards, are also mustered and cantoned in the villages, and during several days exercised in the grand movements and manœuvres of war, chiefly for the instruction of commanders and officers of the staff.

To keep up the efficiency of every department of the service the whole is subjected to the yearly inspection of colonels of the federal staff appointed by the central government. The inspection of infantry is confided to ten colonels who serve for three years. There is also an inspector in each of the arms of engineers and artillery, the latter having under his direction an administrator of materiel charged with the inspection and surveillance of all the materiel of the confederation. This administrator directs and superintends the workmen employed in the factories of the confederation for the manufacture of powder and percussion caps, as well as arms, gun-carriages, &c. The colonel of cavalry and the colonel of rifles direct all that relates to their respective arms, and recommend the necessary improvements. If these inspectors detect in the contingent of any canton any want of perfection in drill, they have the power to order such additional drill as may bring the men up to the proper standard.

Great care is taken in the instruction and selection of officers. The officers of infantry, up to the grade of major, are appointed by the cantonal authorities; the higher officers by the federal government. But no officers can be appointed to the special arms of engineers, artillery, and cavalry, except such as have gone through a course of instruction at a military school appropriate to each arm. No one can become a non-commissioned officer who has not served at least one year as a soldier, nor a commissioned officer except after two years' service. Candidates for promotion must pass a public examination, before a commission, both in theoretical and practical knowledge. Promotion is given, according to seniority, up to the grade of first lieutenant. Captains are chosen from among the lieutenants without regard to seniority. To be appointed major, eight years' service as an officer is required, of which, at least, two years as captain. For a lieutenant-colonel, ten years' service as officer, of which, at least, four as major of the special arm. For a colonel, twelve years' service as an officer is required, of which, at least, four years as "commandant," or in a higher grade. In the Swiss service there is no higher rank than that of colonel. When a colonel has been appointed commander-in-chief of the army, he receives for the time being, the title of general, which he afterwards retains by courtesy.

We are indebted to Professor L. Simonson, of Trinity College, Hartford, Conn., for the following communication respecting the cadet system in schools not specially military and the practice of target shooting in Switzerland, by which a military spirit is fostered throughout the entire population and the highest skill in the use of the rifle is attained by a large number of individuals, who are thus prepared for any sudden call to arms.

2. THE CADET SYSTEM.

The Swiss boy learns target shooting and practices gymnastic and military exercises at a very early age. He imbibes with his mother's milk the thought that his first duty is to become a defender of his country.

These boy-soldiers are styled *Cadets*, and are a fruit that can spring up and ripen on democratic soil only. The first armed corps of the kind we find in Berne near the end of the 16th century. But the general practice of military exercises among them dates back only about eighty years, when the HELVETIC MILITARY ASSOCIATION began to advocate the formation of *Corps de Cadets* in all parts of Switzerland. From that time the most efficient and eminent officers devoted themselves enthusiastically to this cause. The first corps sprang up in Aarau, Sursen and Olten. Aarau possessed for a long time the best drilled, largest and finest corps, and in the canton of Argovia generally the system has struck deeper root than elsewhere; but well drilled corps can be found in any of the larger places, as in Zofingen, Lenzburg, Brugg, Baden, and a dozen other places. It was an old custom for the cadets to parade in the federal cities—Zurich, Berne and Lucerne—in honor of the assembling of the Swiss Diet, (Tagsatzung.) As far back as 1770 we find a boy-corps of infantry and artillery in Zurich, yet towards the end of the last century the organization was partially broken up, until the political renovation of the canton in 1830 re-organized the corps anew. Besides in the capital, we find corps in Winterthur, Uster, Wald, Stäfa, Meilen, Horgen, Wädenswyl, and other towns on the lake shores. Berne, Biel, Thun, Burgdorf, and many other Bernese villages, for thirty or forty years have practiced their school-boys in the exercise of arms. The state takes special care to give the students of the University of Berne and of the two normal schools a thorough military training. The cantons of Lucerne, Solothurn, Basle, Schaffhausen, St. Gall, Appenzell, Glarus, Tessin, Friburg, Neufchâtel, and the countries of Vaud and of the Grisons, possess each of them one or more cadet-corps. Military drill, as well as gymnastic exercises, forms part of the regular

school routine of all middle and higher schools of the above-named cantons. Provision is now made to extend this discipline over all schools, making it obligatory on every pupil who is not disabled by bodily defects. Military practice commences at the age of eleven and is continued to the age of eighteen or nineteen. Federal or cantonal officers and instructors drill the youth two afternoons in the week, the more advanced only once a week. The youth thus disciplined, learn not only to obey but also to command. The officers of every corps are promoted from the rank and file, and in this manner are excellently fitted to become afterwards officers in the federal army. All cadets when they are enrolled at a later period into the militia, are by law exempted from drill. The arms are furnished by the state or community; the uniform, which the pupil may wear in or out of service, must be procured by himself.

Most of the cadet-corps consist of infantry, (sharp-shooters and musketeers;) many have, however, artillery also, as in Zurich, their guns throwing balls of two and four pounds weight. In Argovia and some other cantons there are even grenadiers and sappers. Cavalry exist in theory only. A gun with bayonet and cartridge-box, here and there also a knapsack and sword form the equipment of the foot-soldier. The uniforms are various and fanciful. The Zurich Cadets distinguish themselves by their simple and tasteful appearance; they wear a dark blue coat with white metal buttons, grey pants, and dark blue cap with the cockade. Every corps has one or more smaller or larger flags. Many cantons have excellent bands of music; others, as Zurich, have only drummers and their indispensable drum-major, and sing martial songs while marching.

It is a universal custom to close the school year in autumn by a festival, the shining point of which is the military parade and field manœuvre. The Swiss juvenile festivals have gained quite a reputation at home and abroad. In the Argovian communities all the school children, the females as well as males, festively adorned, participate. The corps of the whole canton and even of several cantons are often united in the field manœuvre; on such an occasion the enthusiasm and emulation of youth reach the highest pitch. Thus the Bernese Cadet Corps in 1821 had a common drill parade in the neighborhood of the capital, and many others have since come off. In 1816 about 1,000 Argovians went into camp at Lenzburg, and all of them will joyfully remember this merry festival. A still greater notoriety was gained by the hot sham fights at Wettingen, which came off in 1821, and in which the Argovian, Zurich and Winterthur cadets operated together.

Two brigades consisting of 1,560 men, all told, with seven cannon fought there for the positions between Wettingen and Baden; the most glorious affair of the day was the heroic defense and final storming of the Wettingen bridge. Yet all other manœuvres of that sort have been thrown into shadow by the great Swiss cadet feast in September, 1856. It will not be forgotten by the thousands, who participated either as actors or spectators, even if there should be at some future day a re-union of all the corps of Switzerland. Ten cantons participated in that festival. Argovia furnished 974 men; Zurich, 805; St. Gall, 472; Schaffhausen, 186; the Grisons, 166; Ausserrhoden, 155; Lucerne, 148; Thurgovia, 111; Glarus, 60; and Tessin even sent over the St. Gothard a contingent of eighty-four. Thus 3,161 young heroes, in various but generally tasteful uniforms, with bands of music, one hundred and twenty-four drums, numerous banners, and ten cannon, entered the festively-adorned Zurich from all sides. Divided into two little armies drawn up in battle array between Oerlicon and Schwamendingen, they fought over the celebrated battle of June 4th, 1799, in which the French under Massena, were defeated by the Austrians under Archduke Charles.

The youths in Zurich as well as in other cantons, have no reason to complain that their physical development is neglected in favor of the mental; nay, we might rather fear that the first is at times too much exaggerated, considering the tender age of the majority of the boys. The pupils of the canton Gymnasium and Industrial School, many of whom are foreigners, Germans especially, practice gymnastic exercises throughout the whole year; the military drill is limited to the summer course only. In the month of August, from time immemorial, the boys, all and every one, practice target-shooting. The smaller boys only are allowed to rest the gun on the stand; the older must shoot without any support whatever. The cities and individuals furnish prizes for those who hit the centre of the target. In September the cadets—the infantry as well as artillery—hold their target-shooting; in October they drill in the field, ("Vorkämpfli,") and then comes off the annual School Festival with its gymnastic exercises and the combined manœuvre in field.

At the sham fight on the 1st of October, 1860, the enemy as usual existed in fancy only; they fired, however, as if he were flesh and blood. They had the task of pursuing the imaginary foe from Windicon to the Höckler. The division marched over the covered bridge at Aussersihl, detached then a column to the woody heights in order to outflank the enemy, while the principal body marched along the

Sihl and drove the enemy from the clearings into the thick woods. Both divisions re-united at the Höckler Bridge and marched to the great "Wollishofer Allmend," where they practiced firing. This is a beautiful spot for the deployment of troops; the sound of every shot is returned in manifold echoes from the surrounding heights. The Zurich and federal troops also encamp, practice, and shoot on this "Allmend."

The annual festival of the canton school came off on the day for gymnastic and military exercises. The printed programme distributed among the pupils contains the order of exercises, the plan of the manœuvre, and some useful hints in large type, as, "Clear the road"—"Smoking is prohibited to the pupils during the festival"—"Not too fast"—"Do not forget the ramrod"—"Always 120 paces distance." At 6 o'clock, A. M., the drummers beat the reveille, proceeding from the guard-house in three different directions. If the weather is unfavorable, the reveille is not beaten, the school begins at the usual hour, and the next fair day is chosen for the feast. The beaming sun dispersed, however, on this occasion, the autumnal morning mists, and universal joy beamed from all faces. On the first day the public gymnastic exercises came off, and after supper the decisions of the umpires were proclaimed and prizes distributed.

The second day the whole corps, numbering about five hundred, hastens at 7 o'clock, armed and equipped, to the barracks, and marches from there to the open space near the railroad station, where from 8 to 10, Colonel Ziegler, the Secretary of War, accompanied by members of the Board of Supervisors, is occupied with the general inspection of "his young comrades." At 12½ the corps assembles again near the barracks, where they receive their ammunition, and at 1 o'clock they turn out to the manœuvre. The corps is divided into two small armies, each of which consists of a centre, right and left wings, and a reserve. The enemy under the command of Lieutenant-colonel Von Escher, marches over Riesbach and Zollicon into his position. The federal troops under Commandant Nadler, take their way over Hirslanden and the Balgrist. The left wing of the enemy, meanwhile, had taken possession of the heights above the Zollicon, and his main body is marching on the right bank of the lake upon Zurich. The enemy makes a halt, and receives the report of his scouts, that the "Burghölzli" and the heights of the Balgrist have been taken possession of by the federal army for the purpose of impeding the further advance of the hostile troops over Hirslanden. The federals at 3 o'clock attack the enemy in his position on the mountain, but they

are beaten back, notwithstanding their heroic endeavors, and are compelled to retreat since the enemy changes his defensive position into a general charge. The federals retire in good order, and the enemy purchases every inch of ground at a great sacrifice. Though he succeeds in cutting off a side column, his losses must be great until he can silence the murderous fire of the federal battery which has taken a very favorable position on the "Oberrieder Heights," and after having done so he advances to the lowlands.

The fight offers many a picturesque scene. Nowhere such a diversified, broken battle-ground can be found as in the Swiss fore-lands. Especially in the neighborhood of Zurich one is at a loss which to choose. There are every where covers and ambuscades for riflemen; the infantry find numerous advantageous positions, and many heights easily accessible which command vales and plains are at the command of the artillery. The leaders have hard work to restrain the ardor of the boy-soldiers, especially of those in the broken chain of the sharp-shooters. Finally the signal shot is fired, followed immediately by many others. It is a real feast to observe how the skirmishers, while running from one cover to the other, crouch together as much as possible; how skillfully they take advantage of every little mound, and how they endeavor in their attack to avail themselves of every protection. This or that one seems a perfect little Zouave; some even show the disposition of a Turcos. One loads his rifle lying flat on his back, another springs forward like a tiger. To be commanded to the chain of the skirmishers is considered special good fortune, for there the individual is something by himself, can move at will, and is supplied with plenty of ammunition. Yet, the main body also of the army, which is obliged to fight in closed lines and strict order, is allowed to vent its fury in firing by single files and by battalions in thundering vollies. At the command to fire a hundred muskets at once, but a single peal as of thunder is heard, and the smoke of the powder fills the air with the sweetest of savors. For a change we turn to the artillery. Though they do not possess any rifled cannon, they are nevertheless intent upon aiming their guns accurately, and the little self-possessed gunners who serve the pieces would prove dangerous adversaries to any foe. They mount and dismount a piece as quickly as any trained artillery-man, and where the ground offers great impediments, one can see the stronger boys carrying their own pieces.

The "Father of the Cadets," Colonel Ziegler, is present at the sham fights as an impartial umpire, walking continually on the battle-

field, and smiling as one or the other section makes a good hit. As soon as the retreating federal troops have gained a favorable position, they stop short, concentrate their forces, and brave any further advance of the enemy who, after he has made some further unsuccessful attempts, is convinced that the federals are a match for him, and even stronger than himself, makes a halt, and the battle ends. The white cross in the red field (the federal banner) remains, of course always master of the field.

Many a manœuvre has ended without any accident, yet sometimes a hot-blooded cadet forgets the ramrod, and wounds a soldier from the hostile lines or a spectator, for the people mingle without fear among the combatants. Every Swiss is a soldier, and the crack of the guns is a congenial sound to him. The European diplomatists who met in Zurich in the Fall of 1860 for the settlement of the peace of Villafranca, were all present at the manœuvres, and undoubtedly depicted the cadet system to their respective governments in glowing colors, recommending the general adoption of the system. We now ask our governors and our people in general—"Shall we be the last?" A noble ardor may accomplish a good deal, yet *strength* combined with will can accomplish far more—almost every thing.

After the parties have fought an hour and a half in the sight of the Alps and the glittering lake, and rested a little while, they march in brotherly union with glowing faces, to the sound of the drum, or singing patriotic songs, from the heights down to the shore road, enter Tiefbrunnen, and stack their arms in pyramids on the green sward of its hospitable pleasure-grounds. Then after the labor and heat of the day, the young soldiers hasten at double-quick step, and with Goliath-like appetite, to the garden of the neighboring inn, which stands on the shore of the beautiful lake, and give fearful battle to a second enemy in the form of loaves, sausages, etc.; the blood of the grape runs like water, and so indefatigable are they in continually repeated onslaughts, that in a short time the forces of the enemy have wholly disappeared. The state bears the expenses, in order that the poorest boy may be that day as rich as his upper-ten comrade. Shouts and hurras spice the good things still more. Meanwhile it has grown dark, the cadets take to their arms again, and by the light of numerous torches, Colonel Ziegler proclaims and distributes the prizes. The name of every victor is received with the beat of the drum and thousands of hurras. The results of the target shooting in 1860 were not so satisfactory as in former years. The artillery gained 65 prizes in one hundred shots, the foot 28; while in 1859 the former received 86,

and the latter 33, in the average of all distances. The first two prizes were again taken by Glarus boys. This little people, renowned through its marksmen, has for the last seven years monopolized the first prizes.

Finally the warlike band marches home and the officers and instructors meet again at a social supper, which lasts until after midnight. Thus ends the manœuvre of Swiss boys.

The Swiss militia system may be our model. It will insure our internal peace and national independence. It will unite the citizens of all states into one band of brothers. Every people rears troublesome individuals. Switzerland had to contend with internal difficulties, factions, etc., as we have now, but the majesty of the law was upheld by the masses, and while the rebels were beaten in the field, the people of the different sections met again in friendship. And so, we trust, it will be with us. The day may not be distant when we shall want the strength of our whole beloved Union to maintain our position among the great nations of the earth. United we need not fear the world in arms.

The Swiss are the most peaceable and industrious people, and at the same time the most warlike and ever-ready. In the idea of the Swiss, the citizen is inseparable from the soldier, lest the free man should become the slave of a domestic or foreign tyrant. The first advantage of this idea is, that Switzerland has not a standing army, and yet it can call into the field at any moment 200,000 well trained men in the flower of their age; a like number could be raised of younger men under twenty-one and above forty-five. 200,000 men is eight per cent of its population, according to which we could have about 2,200,000 citizen soldiers, not on paper only, but real soldiers. If we institute the cadet system the next generation will be a warlike one, and no American will even think of making a law, exempting the citizen from his first duty to appear in person for the defense of his liberties and independence. The whole amount of the Swiss military *Budget** is between four and five millions of francs, equal to ten millions of dollars for our 2,200,000 men—a trifle indeed.

From time to time the governors of neighboring states could unite the cadet-corps of different sections and invite the corps from distant states to send a contingent for a grand manœuvre. Such a proceeding would tend more to cement the band of brotherhood among the states than many artificial means. It would at the same time promote the good morals of the boys, if the governors were to select the

* Federal and cantonal.

best delegates from their states. Every obdurate, mischievous individual should be expelled from the ranks, since the state must not suffer a bad subject to enjoy the honor of serving his country. What a wonderful change will take place in the disposition of our youth; when accustomed to the discipline of a soldier, many a bad habit will disappear entirely. They will become punctual and orderly in the execution of their duties in general, their step elastic, their carriage erect, their bodies strong, their chests large, their cheeks rosy, a joy to their parents and a pride to our people. The lad who leaves his city or his state, if furnished with a regular certificate from his drill-master, can enter a company in the place of his future residence, and be no longer a stranger but a brother-soldier—the member of a mighty association. He enters the circle of well educated boys at once, and is thus saved from the danger of associating with such as might corrupt his good habits. There are thousands of advantages to him and the country, and not a single disadvantage. Why shall we not seize upon the subject at once? Let our small state have the honor to be the first, as we already have the best regulated system of schools —primary, secondary, and higher institutions. Forward! forward!

In a subsequent article we shall give a description of a "Swiss Shooting Festival." It is an ancient custom with the Alpine people, but since the system of cadet corps has become perfected, these festivals have come off with a splendor that had never before been dreamed of. They unite the men of all sections and have gained quite a fame in Europe.

We implore all statesmen and teachers to take the system of military drill and organization in schools into due consideration; not as a mere experiment, but as something that has proved an excellent success in a sister republic.

3. TARGET SHOOTING.

Having made military exercises a part of the regular routine of schools and the education of youths, and identified the vocation of the soldier with the privileges of citizenship and the safety of the state, the policy of the Swiss government, both cantonal and federal, has been directed so as to make the pastimes of neighborhoods and the national festivals minister to the general culture of a military spirit, and of the highest individual skill in the use of arms. To these ends target shooting is encouraged in various ways, and the festivals of the sharp-shooters are more generally and enthusiastically attended than any other national anniversary. We give below an account of a festival of this kind, which was held in Zurich in July, 1859.

A Festival of the Swiss Sharp-shooters.

The Frenchman has his rose festivals; the Italian his barcaroli; the Spaniard his bull-fights; the Englishman, since his cock-fights and boxing in the street are prohibited, has nothing left to him, for horse-racing as well as the Parliament belongs to the aristocracy only.* Germany has its popular festivals, though the potentates have suppressed even these harmless popular gatherings in several parts of the country.

In southern Germany and in the north-west you may still find the old-fashioned popular festivals. But Switzerland is their field; there in the land of freedom they flourish in the utmost freshness. They arouse and foster in the people the consciousness that they are a people—a nation; they awaken and strengthen the national spirit; they unite all citizens, whether they sit as legislators in the Diet, or till the ground in some unknown corner of the republic.

The festival begins at 6 o'clock, A. M., with the firing of cannon—one shot for each of the twenty-two cantons into which Switzerland is divided. The sharp-shooter festivals are the oldest of the Swiss popular festivals—the original fruits of a free warlike people. They are customary in every canton, in every community. But the *Swiss* sharp-shooter festival means that in which the whole country unites, and it has existed now for many, many years, always fresher and more beautiful, representing not only the united citizens of the Swiss cantons, but of Switzerland as a political power.

Such a festival takes place every second year. Then, thirty thousand free, warlike men, the best marksmen from all parts of the land, the "élite" of Switzerland's defenders, assemble with their rifles, which they handle with more skill than any other nation. They represent in fact the best men of their nation, the body guard of law and order, the rampart against hostile aggressions, and the stay of popular commotions. In such a noble assembly many a wise word is spoken, many an idea exchanged and corrected. The actions of the administration are subjected to a sharp but judicious and just criticism; you will not hear there ostentatious speeches, nor see noisy demonstrations. They do not pass resolutions such as we are wont to see in our country—a small clique of petty politicians announcing to the people that: *The People of the State, ... resolved, etc.*; but calmly they reason and reflect on what would be beneficial to all sections of the country, and after having reconciled the opposing interests of all,

* The rifle shooting, cricket matches, and other popular sports of England seems to be overlooked by Professor Simonson.

they go home and work each in his circle for the realization of their ideas. There is a principle—not of blind opposition to actions, whether good or bad, simply because they proceed from another party—but the principle of doing justice to all, of upholding the rights of all, and of reconciling opposing interests. A people that has been educated in such principles and acts in accordance with them has reached the perfection of republicanism, and need not fear either internal or external foes. Every American patriot may take example from this little Alpine race; and since every one, man or woman, is by nature an educator, whether as director of a household, or as a teacher of other men's children, let us all unite in educating the growing generation in the right way, and our beloved country shall never again see brothers in arms against brothers.

Many a corrupt official has feared the criticism of the assembly of the Swiss sharp-shooters, and whatever "the men have resolved at the festival," is usually adopted by the people and carried through in a judicious, constitutional way.

At the above-mentioned day Zurich was all in a glee; the city adorned with flags, triumphal arches and evergreens, the streets thronging with people in Sunday dress who had come from far and wide to participate in the popular feast. The shrill sound of an engine is heard, and soon after the first company of guests from abroad forms in line at the railroad station. It is the delegation from the Bremen sharp-shooters, who have come from the far north of Germany to meet their brethren of the south. They are enthusiastically received by the crowd, the mayor addresses them and gives them a cordial welcome to the land of freedom. After one of their number has replied to the speech, the mayor leads the guests to a tent and invites them to partake of some refreshments; the best of native wines from the "Rathskeller" are offered, and many a toast spices the nectar.

An hour later the flag of the Swiss sharp-shooters is received and unfolded, while shouts and the roar of cannon rend the air. As we stated before, the festival of the United Sharp-shooters comes off once in two years, city and canton taking their turns. Two years before, in July, 1857, it had been celebrated in Berne, and the flag had remained there until now, when a deputation from Berne delivers it to the sharp-shooters of Zurich, to be kept by them for the next two years; and so on.

As soon as the banner is unfurled the procession is formed, and the banner and guests are escorted to the City Hall, preceded by bands of music playing national airs. What a glorious sight! Man and nature

seem to revel together in joy. The bright morning sunshine gleams from the polished rifles and a thousand flags wave in the light breeze, while the procession is accompanied by crowds of men and women, boys and rosy-cheeked girls who, dressed in white and decked with red ribbons, in the national costume and colors, add an element of bewitching beauty to the scene.

Meanwhile other companies of riflemen have arrived, and the lake is still covered with festively-adorned gondolas that are continually adding to the crowd of guests. At 10 o'clock the procession is again formed. It leaves the city and moves toward the "Seefeld," a large meadow on the shore of the lake, a short distance from the city. Here an immense hall has been erected. Behind it are arranged the targets and shooting-stands, and opposite we see a neat structure in the form of a temple, with many large windows, in which are exhibited the prizes, disposed in the most attractive manner. These prizes are of the value of 104,407 francs, and are the contributions of all parts of the world—every corner where a few Swiss are to be found, having furnished some small gift in honor of the national festival.

The procession halts in front of the temple. The Bernese deliver into the hands of the Zurich delegation the flag of the Swiss Rifle Corps, and Colonel Kurtz, of Berne, thus briefly addresses them: "When two years ago this flag was delivered into our safe keeping, peace reigned all around us; and but just now our country has come forth victoriously from a crisis in which we have shown, as we had never done before, that we are *one* band of brethren.* What we have hoped for is now realized, and we can carry this flag—the banner of the largest association in Switzerland—to the beautiful lake whose blue waters play around our sister town. We of Berne have held this flag in peace. Who knows whether you will be as fortunate, or whether you will be forced to plant it on the highest pinnacle of your good city, as a sign that the fatherland is in danger and calls upon her sons to defend her. Relentless war rages now on our borders;† we know not whether the storm will pass over, or the thunderbolt strike in our midst."

Dr. Dubs replies in a brilliant speech: "We receive this banner and shall defend it. We are ready now for a joyous feast, and as ready at any time for the war-dance. Let the trumpet sound and

* He alludes here to the Neufchatel difficulty. This canton had been heretofore under the sovereignty of Prussia, and a handful of royalists made the attempt to sever it from all connection with the confederacy. The people defeated them and voted themselves independent. Switzerland assisted them and Prussia gave up whatever rights she might have had.

† The Italian.

Zurich's men will be the first in the field to lead you on to victory or death!" etc.

Thus was the festival opened. A dinner had been prepared in the hall, to which all marksmen, whether from home or abroad, were invited. This hall is a wooden structure of large dimensions, open at the sides, with a wide passage running through the middle, intersected by several narrow ones. In the middle of the building is a magnificent fountain. The whole remaining space is filled with tables and benches of unvarnished pine, at which 6,000 persons may be conveniently seated and served. A platform hung with Swiss banners is so placed that the speakers can be heard through the whole hall, and many a wise word has been thence spoken that met a ready response from both present and distant brethren. Behind this platform is raised a lofty gallery for the music. Here the bands play soul-stirring chorals and national tunes, and when the "Marseillaise," or other similar air is heard, a chorus of thousands of voices accompanies enthusiastically the instruments. It is in fact a feast of the people; unity, peace and joy reign every where. There may be seen men of different religious and political creeds, embracing each other in brotherly concord. Men whose language is Italian from the southern cantons, and men who speak French from the west, and German from the northern, eastern, and middle cantons, form *one* family, though their localities, institutions, and interests may differ widely. The words which Schiller, in his well-known historical drama, "Tell," causes Rösselmann to express—

> "By this fair light, which greeteth us before
> Those other nations that, beneath us far,
> In noisome cities pent, draw painful breath,
> Swear we the oath of our confederacy!
> We swear to be a nation of *true brothers*,
> Never to part, in danger or in death!

These words have become true in our age.

At 1 o'clock the firing of a cannon announces the commencement of the target shooting. The marksmen press to the stands, and their shooting continues from morning till evening, with only an intermission of an hour for dinner, for an entire week. As we have before said, the shooting-stands are erected at the end of the hall, but in a separate building. Ninety-six stands are arranged in one line, each with its own target, so that nearly a hundred shots may be fired at once. Behind each stand there is sufficient space for loading the rifles, and all the necessary apparatus. There are smaller buildings near by for the repairing of arms, and a regular field-hospital, completely furnished,

to supply medical or surgical aid to such as may fall suddenly sick or be wounded. The medical fraternity of Zurich have offered their services in turn, and two physicians of their number are always present day and night. The shooting is directed towards the lake and large quantities of firewood are piled up like a rampart around the grounds, so that an accident is almost impossible. Navigation on the lake within a certain distance is also prohibited. The safety of the people is thus secured, and an accident can happen only at the stands or to a careless target-man. Only two injuries in all have been reported—a finger-wound received by a marksman, and the loss of an eye to a target-man by a splinter from the target.

More than thirty thousand tried their skill during the ten days of the festival. On the 7th of July 74,000 shots were fired, and about 61,000 on the 11th, though many of the people had already gone home. The rifles and targets are of various kinds. The Swiss have rifles for field service, and also target rifles—the latter being much the heavier. No support whatever is used with either. The distance of the target is proportioned to the calibre of the rifles, the "field targets" being over a thousand, and the "stand targets" about six hundred feet distant. Both the stand and field targets are sub-divided into "Stich" and "Kehrscheiben;" the former a single fixed target, the latter made double and turned around after each shot, so as to be immediately ready for another marksman. The "Kehrscheiben" are designated by the letters in the order of the alphabet; the "Stichscheiben" have names attached to each, such as "the Stand," "Fatherland," "Industry," "Titlis," "Pilatus," "Rigi," "Gotthard," Jungfrau," "Splügen," "the Field," &c. No more than one shot may be fired by the same marksman at any of the "Stichscheiben," with the exception of the "Fatherland," at which two are allowed. The number of shots at the "Kehrscheiben" is not limited, but all must be paid for—the "Kehrscheiben" at the rate of about thirty centimes, (six cents;) the "Stichscheiben" a little more. Commutation tickets, however, may be obtained.

The prizes are very various, but the most valuable are appropriated to the "Stichscheiben." The first prize this year was a large silver basin, of exquisite workmanship, together with 2,500 francs ($500) in money, given by the Swiss in Paris, to be won at the target "Fatherland." The lowest prize is five francs, and this can be won only by those who succeed in hitting the bull's eye, the size of which varies in the different targets. In the "Stichscheiben" for the target rifle it measures ten inches in diameter, but in the "Kehrscheiben"

only two and a half, while in the "Kehrscheiben" for the field rifle it measures six inches. Every six hits in the centre of the "Kehrscheiben" gains a prize of five francs, to which is added on the twenty-fifth successful shot, a silver cup or watch. He who hits the bull's eye fifty times receives another prize of one hundred francs. Special prizes are also given to the best marksman *of the day*, for the first and last hits *of the day*, and for the greatest number of hits during *the whole festival*, etc. The prizes of the day may be obtained immediately; the others are distributed publicly at the close of the festival.

Let us now give a glance at the "Gift Temple." This neat structure is made wholly of glass, save the roof, in order that the rich prizes may be more conspicuously exhibited. Here are gifts and prizes for the successful shooters, consisting either in articles of value or in money, that have been contributed by the cantonal governments and communities, and by individuals at home or abroad. The government has also had new Swiss five-franc pieces coined for this purpose, bearing on their face the figure of a rifleman instead of Helvetia. There is many a piece of fine workmanship among the gifts, of which we can here only mention the silver basin with the 2,500 francs, the first prize of the "Fatherland," and a beautiful drinking horn of massive silver, richly embossed, presented by some friends in Leipsic. The Bremen sharp-shooters also brought with them twelve "Römer," large cups of massive silver, gilt within, which were admired and coveted by all the disciples of Bacchus. This was not, however, the only present from the old Hanse-town. The senate had opened the celebrated "Rathskeller" and sent some of their Hock of the vintage of 1684, the Nestor of German wines, to their brothers in Bacchus. The greater part of these gifts consisted in silver cups, and pitchers, and gold and silver watches.

During the festival the houses of Zurich continued adorned with flags, transparencies, and evergreens, which were every day entwined with fresh flowers. Near the festive hall a triumphal arch had been erected, on which stood a colossal figure of William Tell in the act of menacing Gesler with the arrow, after having shot the apple from the head of his boy. Some of the critics would have us believe that Tell is not Tell, that no such person ever existed, but that he is a purely mythical character—the creation of Schiller's imagination. Yet it matters little to the Swiss whether the hero was, or was not; all these thousands of marksmen who daily pass that triumphal arch are possessed by one thought, and many can not refrain from shouting, "Hurrah for Tell, father of the marksman! The Swiss of to-day is as

skillful an archer, as daring and as free as thou wast!" Myth or not, Tell is the man of the people, the Washington of Switzerland—or, rather, Washington is the Tell of America; and these words of the dying Attinghausen—

> "Hold fast together, then—for ever fast.
> Let freedom's haunts be one in heart, in mind!
> Set watches on your mountain tops, that league
> May answer league, when comes the hour to strike.
> Be *one*—be *one*—be *one*"—

are never forgotten in these days by the inhabitants of Switzerland.

Around the hall there has sprung up a village of wood and canvas, and while the men are engaged with their rifles, the women and children crowd to see the circus, the menageries, rope-dancers, puppet-shows, "the giant Kentuckian," "General Tom Thumb," &c., and while every one amuses himself, there is no rioting, no impropriety, no beggary, no placards bidding us to "Beware of Pickpockets;" the people are as sound as their institutions.

At 8 o'clock in the morning the target shooting commences, closing at 8 in the evening. The target and signal men are promptly at their stations, and the members of the different committees for keeping order, arrive one by one. The marksmen are impatiently awaiting the signal shot. Spectators gather in from all sides. The signal is given, and in a moment the sharp crack of ninety-six rifles is heard. The firing is kept up incessantly till noon, when the sound of the cannon again calls to dinner. At about 10 o'clock the first steamers have landed their passengers from "beyond the water," and the first trains have come in, bringing new guests to supply the place of those who leave, so that new faces and new acquaintances greet us every day. Here a fresh company of sharp-shooters from distant Ticino approaches, marching to the sound of music and preceded by their flag, and receive their welcome—there another company from Neufchâtel is escorted to the station and takes its departure homeward.

One of the most joyous occurrences of the festival—a silvery gleam in the general sunshine—was the reception of the marksmen from the four forest towns, Lucerne, Switz, Uri, and Unterwalden. They numbered full seven hundred men, noble specimens of the native Swiss, all picked men—"Kernmannen." They were preceded by four of their number attired in the ancient national costume, who carried the very same bugles that for the last five centuries had called their forefathers to arms. The ancient banners followed. As they passed under the triumphal arch and beheld their father, Tell, their shouts, hurrahs, and vivas, knew no bounds. Their ranks were broken and

each threw himself upon the breast of the nearest stranger—nay, brother. The very men that perhaps were adversaries in public life, or opposed to each other in political principles, were here united; the love of fatherland was a common bond of union. Thus, also, Schiller speaks through the mouth of Meier:

> "I know him well. There is a suit between us,
> About a piece of ancient heritage;
> Herr Reding, *we are enemies in court;*
> *Here we are one.*"

Thus is it in Switzerland. Will it ever be so with us? Come, ye educators of the people and of the young, preach this principle from the pulpit, and make it the corner stone of your instructions in the school and at the firesides of your homes!

At the signal for the noon intermission the firing immediately ceases, and in a few minutes 6,000 hungry and thirsty people are seated at the one hundred and fifty tables in the hall; the rest disperse to the eating-houses in the neighborhood and in the city. The dinner is enlivened by toasts which, however, are never of a personal character. No homage is done to the individual; to the country, to the fatherland alone, is homage due in a republic. Toasts are heard in German, in French, in Italian—yet all tongues unite in the glorification of a common country. Separate tables are set for the different cantons, but so arranged that the more distant cantons are usually the nearest together—Ticino near Berne, Geneva near Basle, Zurich near Vaud. In the middle of the hall are the tables for the committees and the honorary guests.

On the second day of the festival the delegations of marksmen hold a general conference, and though they enter the hall with opposing opinions and feelings, yet before they part all differences are settled, all contradictions are reconciled, and their resolutions are usually endorsed by the whole people. There is no tendency to disunion, no necessity for secession, for each one endeavors to satisfy the wishes of the other; the public weal is considered, not the interest or aggrandizement of the individual or of the canton.

On Sunday, the 10th of July, a public service was held on the meadow It was a solemn ceremony, attended by all the different creeds that hold fellowship together. On the next day the members of the Diet, which was then in session at Berne, visited Zurich. The banished duchess of Parma, who lives in the neighboring Swiss town, Pappenschwyl, was also the guest of the citizens. She and her children sat with them at the rough pine board and partook of the same

viands. After the dinner she said, with tears in her eyes, "The Swiss do not know how happy they indeed are."

On Tuesday, July 12th, the last shot was fired, and on the following day the prizes were distributed. This ceremony took place on the grounds before the gift temple. President Dubs opened with a speech, in which he said: "We are distributing now the prizes to those who have proved themselves the best marksmen. An equal chance is given to all; let all practice with their weapons and emulate their lucky companions. I am convinced that all who have hit the centre of the target will be able to pierce the breast of the enemy, should war be unavoidable." The first prize, the silver basin from Paris, with the 2,500 francs, was won by a manufacturer, Durrer, of Unterwalden; the second, the silver horn from Leipzig, by a farmer named Glogg, of Obermeilen; the third, the twelve silver cups from Bremen, jointly by Professor Dr. Hug, of the University of Zurich, and Mr. Baer, of Männedorf, the best shot in Switzerland, who had hit the target four hundred and eighty-seven times during the festival.

The whole was closed with a serenade, given by the marksmen to President Dubs, the chief magistrate of the confederacy, as well as president of the festival. The next day the remaining guests departed, the garlands and banners disappeared, the people returned to their business, all external show had vanished; but the feeling that Switzerland's sons have again renewed the bonds of their brotherhood still survives in the breasts of that simple, quiet people—our republican brethren of the Alps.

SCHOOLS OF INSTRUCTION FOR OFFICERS.

The Federal system of Military Instruction for officers, in 1871, embraced—

I. A Central Military School at Thun, to which all officers appointed to the General Staff repair to be instructed in their duties.

II. A School of Officers at Thun, in which all officers appointed to their respective regiments are instructed in their duties.

III. A School of Cantonal Instruction, held in Basle, to which the infantry instructors resort from every canton to learn their duties, undergo inspection, and preserve a common rule.

IV. A School of Young Officers, held at Solothurn and at St. Gallen, turn by turn, to which the several Cantons send their young officers who have just received their commissions, and to which all candidates for commissions repair for examinations.

V. Comissariat School, to which is joined a Medical and Ambulance School generally, at Thun.

VI. A Shooting School, for officers who give instruction to the Cadet Corps and other organizations in the several Cantons.

To these school organizations with their practical exercises must be added the opportunities afforded by the Cantonal reviews and field manœuvres, to which the young Swiss officer brings much valuable experience in his previous school and cadet drill.

The events of the late French-Prussian war tested the efficiency of the Swiss military organization and instruction. The French declaration was announced in Paris in the afternoon of Friday, July 15, 1870, and responded to by a counter declaration from Berlin on Tuesday, the 19th. But the Federal Council of Switzerland (which lay between the combatants, and might become the first theatre of belligerent operations), was summoned by President Dubs to consider the situation; and within an hour, the Cantons had been regularly summoned to complete their regiments with men, arms, horses, guns, and all stores and tools required for actual service, and five divisions of the Elite (the first, second, sixth, seventh, and ninth), were ordered to assemble in their several Cantons. The first division, under Colonel Egtoff, was to secure the bridge at Basle and occupy the two banks of the Rhine. The first news which the men of Aargau had of the impending war was late on Friday night. By noon on Saturday squads of men were falling into the ranks in front of the town-hall of the cantonal capital—companies were formed—guns were got out—sappers, engineers, and guards were in readiness—officers were at their posts. In the

afternoon the first Swiss troops were in march for Basle, and by midnight the first regiment of Aargau were on the bridge; and by Sunday night the first division, under Col, Egtoff, with 8,296 men, and 692 horses, besides the staff and guides; and the second division, under Colonel Salis, with 8,319 men, and 632 men at the same hour had assembled at Basle and held the roads and streams which led to Bonn. By Tuesday night, before the Prussian manifest was known in Bonn, the five divisions of the first Swiss army, with their eleven batteries of artillery mounting 96 field pieces, and a total force of 37,423 men, and 3,541 horses and 104 staff and guides, were under arms and at their respective rendezvous; and the President was authorized by the Council to announce to all concerned, "that any troops belonging to belligerent states, whether regulars or volunteers, who violate the territory of the Swiss nation, will be repelled by force."

Out of the officers whose men were first in the field, the Federal Council placed Colonel Herzog, of the Aargau detachment of the Federal army, in chief command, and by Saturday night the General's head-quarters were established at Alton (the center of the Swiss railways), where he organized his staff, issued his instructions to organize two hospitals, one for wounded men, and the other for horses, and at the same time ordered magazines of stores and clothes to be established in his rear, and the forces to be moved up to the front. All railway companies were ordered to report their stock of engines, carriages, and open wagons, and telegraphic communication was established for night as well as day service, and engineers were sent out to study every pass and point by which an enemy in any strength was likely to enter the territory of Switzerland. When all danger to the Cantons had passed away in the victories of the German arms, Gen. Herzog was directed to raise his camps, and send to their several Cantons their respective troops. Later in the war, when it was authentically known that Bourbaki was moving an army of 150,000 strong, to sweep across the Rhine; and still later, that the Germans meant to push the French, in either whole or part, across the Swiss frontier, and put them out of service for the rest of the war—General Herzog satisfied the President and the Council, and the Minister of War, of the impending danger, and on Thursday, Jan. 19th, the third, fourth, and fifth divisions, with two batteries of mountain guns, well prepared for winter service in a district lying under snow, were ordered out; and in one week from that date, these forces were distributed through the various passes in the Jura, from Basle to Geneva, with orders to repel, or

receive—to fight, or feed and lodge, according to the spirit in which the broken detachments of the French army should present themselves. For the enormous number (83,301), who laid down their arms, food and beds were distributed in the Swiss Cantons, by less than 20,000 citizen troops, without the forfeit of a single life. And when their work was done, these citizen soldiers laid aside their arms and uniforms and returned to their shops and industries of various kinds, to earn their daily bread, without forgetting for a moment their civic rights and household duties.

If the occasion had required it, as it did in the war of Secession in 1856, each Canton would have contributed 30 men from every 1,000 inhabitants, to the Elite, and 15 men to every 1,000 to the Reserve; and in case of danger to the Union, every male Switzer, from the age of nineteen to forty-five, not included in either of the above forces, would have obeyed the summons of the national authority for the Landwehr, adding 97,934 to the ranks, besides volunteering above and below the military age, to the number of 100,000 men, who, in case of a defensive war, could have been relied on,—all familiar with military tactics, and accustomed to obey as soldiers, as well as to the use of arms.

According to recent official statistics the strength of the several armies of Switzerland is as follows:

	Elite.	Reserve.	Landwehr.
1. Engineers,	900	630	.....
2. Artillery,	6,513	4,254	.....
3. Cavalry,	1,937	932	.....
4. Carabineers,	4,600	2,460	.....
5. Infantry,	55,994	26,448	.....
6. Sanitary Service,	144	78	.....
Armorers,		30	.....
Total,	70,088	34,832	97,934

The system of recruiting, drilling and brigading, is local—which brings neighbors and friends into camp and field companionship, and inspires a sense of trust and coöperation.

The cost of the reliable military force is as follows:

Cantonal expense,	4,508,901 *frs.*
Federal expense,	5,486,396
	9,995,297

Contrasted with the cost of education the figures stand thus:

Communal expenses,	5,000,000 *frs.*
Cantonal expenses,	5,157,756
Federal Polytechnic,	287,611
	10,445,367

And for this sum Switzerland makes a near approach to universal education in schools of different grades, adapted to all classes.

PART X.

MILITARY SYSTEM AND SCHOOLS

IN THE UNITED STATES.

MILITARY SYSTEM AND EDUCATION OF THE UNITED STATES.

I. MILITARY SYSTEM.

The Constitution of the United States grants to Congress the power "to raise and support armies," "to provide and maintain a navy," "to make rules for the government of the land and naval forces; and to provide for calling forth the militia," as well as "for organizing, arming and disciplining" the same, and for governing such parts of them as may be employed in the service of the United States—reserving to the States, respectively, the appointment of the officers, and the authority of training the militia according to the discipline prescribed by Congress. By the same instrument the President is made commander-in-chief of the army and navy of the United States, and of the militia of the several States when called into actual service of the United States "to execute the laws of the Union, suppress insurrections, and repel invasions."

By law of August, 1789, a department of war, and in 1798, a secretary of the navy is provided to aid the President in the administration of military and naval affairs; and the original rules and articles of war enacted by the Congress of 1776, were continued in force, and in 1806 made the basis of the military code which has since governed all troops mustered into the service of the United States.

In 1790 the rank and file of the regular army was fixed at 1,216 men. In 1796 this force was organized into one corps of artillerists and engineers, whose head-quarters was at West Point, two companies of light dragoons, and four regiments of infantry of eight companies each. This force was increased by additional regiments in the war of 1812, the Indian war in Florida, and the war with Mexico, till in 1861, the army consisted of 14,000 men, stationed in the different forts and garrisons, and mainly on the Indian frontier. In the war of the Rebellion the regular army was increased to 50,000 men.

By act of July 15, 1870, the number of enlisted men was reduced

to 30,000 by or before July 1, 1871. On the 20th of October, 1871, the army was composed as follows:

Two regiments of Cavalry,	8,800	enlisted men.
Five regiments of Artillery,	3,105	" "
Twenty-five regiments of Infantry,	23,742	" "
One battalion of Engineers,	314	" "
Ordnance Department,	444	" "
West Point Detachment,	202	" "
Signal Department,	199	" "
Hospital stewards,	310	" "
Ordnance Surgeons,	114	" "
Available Recruits, *en route*,	349	" "
Permanent Recruiting Parties,	904	" "
General Service Men,	420	" "
Total,	29,003	
Commissioned Officers,	2,105	
Retired Officers,	295	

When the insurrectionary movements and combinations of the Southern States in 1861, proved too powerful to be suppressed by ordinary civil powers, the President, April 15, called for 75,000 volunteers for three months, to defend the capital, and May 3, 42,000 to serve for three years or during the war. On the 22d of July he was authorized to accept the services of 500,000, which, within six months afterwards was increased to 1,000,000. This force proving inadequate, a levy of 300,000 men was ordered in 1863, and in 1864, another call for 500,000 men—making an aggregate of 2,653,062 mustered into the service of the United States, or nearly one fourth of the entire male population of the Northern States. This entire force was disbanded within one year from the close of the war.

The development of the naval resources of the country was quite as marvelous. In 1861 the entire navy consisted of 94 war vessels of all classes and in all conditions, capable when in service of carrying 2,415 guns. Only 43 of these ships were in commission, and the seamen and mariners numbered 7,000. In less than three years 200 war vessels were constructed and 418 merchant vessels were converted to military service, and over 50,000 men enlisted in the naval service.

The Southern States in rebellion put into the field over 500,000 men, and exhausted their pecuniary resources, with the loss of 300,000 soldiers on the field or in hospital.

The debt of the United States contracted in the prosecution of the war, stood in 1866 at the enormous sum of $2,783,425,879.

These extraordinary efforts were made under circumstances which are not likely to exist again, and such expenditures could not be repeated without national bankruptcy.

The Militia of the United States, by act of Congress of 1792, consists of all white male citizens between the ages of 18 and 45, who must be enrolled and arranged into brigades, regiments, and companies, as the legislature of each State may direct. Of the militia, as organized by state legislation, the governor is commander-in-chief, except when called into the service of the United States. To provide arms and equipments for the whole body of militia, arsenals and armories are provided by Congress, in different parts of the country, at an annual charge of $200,000 (since 1808).

In the absence of any official information respecting the number and condition of the Militia of the several States,* we gather the following statistics from a pamphlet by General J. W. Hoffman, of Philadelphia, on the subject of the National Guard.

State. Population. Military Organization.

Alabama—996,992.

Arkansas—484,167—78 companies of State Guard, with a total of 5,484 men.

California—560,247,—30 companies of infantry, 2 of artillery, 5 of cavalry; organized into 2 battalions, 2 regiments, 6 brigades, 1 division—aggregate, 2,686. Term of service one year. The State furnishes uniforms, and pays $50 per month to each company of infantry and cavalry, and $25 per gun per month to companies of artillery.

Connecticut—537,454,—40 companies of infantry, 2 sections of artillery organized into 4 regiments, 1 brigade; aggregate 2,906. Term of service 5 years; parade annually, by company or regiment, in the month of May; attend camp for six successive days once in every two years In addition, companies parade once in August or September, and drill not less than one hour in the evenings, not exceeding two evenings in each month, from October to April, inclusive. Compensation to all officers and men $2 per day for each day's duty performed, and 5 cents mileage to and from place of parade. Members of bands $2,50 per day and mileage; $2 per day for every horse used; rent of armories are paid by the State, and all citizens between 21 and 45 years liable to military duty, but may commute by annual payment of $2,00. Total moneys collected from this commutation tax, $62,000 per annum.

Colorado—39,864.

Delaware—125,015.

Florida—187,748,—96 volunteer companies organized with 3,360 men, out of a total of 21,854 enrolled (116,112 white, and 10,242 colored).

Georgia—1,184,109. No organization.

Illinois—2,539,891. No state organization; a few volunteer companies who provide their own uniforms and are furnished with arms and accoutrements by the State.

Indiana—1,680,637. No organization.

Iowa—1,191,792. No State organization.

Kansas—364,399. No state organization beyond the 2 companies to operate against the Indians.

Kentucky—1,321,011. No organization.

Louisiana—726,915,—37 companies of uniformed infantry, 3 of cavalry, 1 of artillery; organized with 6 regiments, 2 divisions—one of which has 2 brigade organizations; aggregate strength, 3,469 out of 107,821 enrolled militia. Term of service 2 years.

Maine—626,915,—10 companies, with an aggregate of 937; State furnishes arms, equipments, and uniforms.

* The Militia System was broken up by the Volunteer System introduced by the United States and encouraged by State Legislation, and now (1872) even formal returns as to enrollment are not complied with by a majority of the States.

Maryland—780,894,—the State provides arms, uniforms, and rent of armories, and exempts members from jury duty.

Massachusetts—1,457,351,—92 companies of uniformed infantry, 5 batteries of artillery, 5 companies of cavalry; organized into 10 regiments, 3 brigades, and 1 division; aggregate, 6,277; State pays nearly $200,000 per annum; at the annual inspection in 1870, 5,221 present.

Michigan—1,184,059.

Minnesota—439,706,—30 companies of infantry and 4 sections of field artillery.

Mississippi—27,922.

Missouri—1,721,295.

Nebraska—2,993.

Nevada—2,491.

New Hampshire—318,300.

New Jersey—906,096,—51 companies of infantry, and 2 batteries of artillery; organized into 4 battalions, 6 regiments, 2 brigades; aggregate, 3,146 out of 127,000 enrolled; every company parade at least 12 times in the year, one of which is by brigade; State appropriated in 1870 $26,126. Term of service 6 years, with exemptions from poll tax and jury duty.

New York—4,382,759,—398 companies of infantry, 12 of artillery, 28 of cavalry; organized into 41 regiments, 21 brigades, 8 divisions; aggregate, 24,585; the State furnishes arms and allows rent for armory and $5 per day for any enlisted man who has paraded 7 days in the year, which sum goes into a uniform fund. The State allows for head-quarter expenses, and appropriates annually over $200,000 for its National Guard. Term of service is 7 years, with exemptions from jury duty, and a deduction of $1,000 on the assessed valuation of taxable property.

North Carolina—1,071,361.

Ohio—2,665,260,—2 companies of uniform infantry and 2 sections of cavalry.

Oregon—90,923.

Pennsylvania—3,521,791,—311 companies, with an aggregate of 14,800; no general organization into regiments out of the county of Philadelphia.

Rhode Island—217,353.—State provides armories, or rent for same and pay of armorer, and $2,50 per day for two days' parade, and $3 per horse.

South Carolina—725,606.

Tennessee—1,258,520.

Texas—818,579.

Vermont—330,551,—4 regiments of infantry, 1 battery of artillery; the State provides arms, uniforms, armories, and $2 per day for each days' drill, not exceeding 4 days, and tents for a three days' muster in the autumn.

Virginia—1,225,163.

West Virginia—442,014.

Wisconsin—1,054,670,—8 companies, organized as First Regiment.

The above statement of the legal condition of the militia of the several States, which together constitute the army of Reserve of the United States, is not very creditable to all concerned—to the cities and local communities, whose exemption from riots and illegal combinations of bad men may depend on the fact of an organized force, which the voice of authority could in an hour summon to the protection of the threatened houses and workshops of the citizens;—to the States, whose quota to any national call can not now be depended upon except at the cost of extravagant bounties, and whose raw recruits thus furnished would be worthless till after months of drill and field manœuvres;—to the nation, whose strength should be its weakness for purposes of foreign aggression, and its ability to summon millions of willing men, familiar with military organization and duties, to the defense of their hearths and free institutions.

The Volunteer Soldiery in time of peace, does not hold the same distinct recognition in the armed forces of the United States, apart from the Militia of the several States, as in Great Britain; and yet the most efficient military organizations of the several States, and especially in our larger cities, are of this character; and in most of the States where uniform companies exist, they constitute a permanent and important force, whose services have proved highly valuable in quelling riots and protecting public property. Of the number of regiments or companies—their officers and men, distinct from the enrolled and organized State Militia, we have no official statistics.

MODE OF OFFICERING THE ARMY.

The commissioned officers of the United States army are drawn from three sources:—*First*, from the cadets of the Military Academy at West Point; *Second*, from civil life; *Third*, from the rank and file.

1. The appointment to the grade of lieutenant in either corps, follows regularly to any cadet on graduation, after having completed the course of instruction at West Point. From 1815 to 1832, the army was officered almost exclusively from the Military Academy.

2. The expansion of the military force consequent on the Indian war in Florida, from 1832 to 1837, and the Mexican war from 1845 to 1848, and of the Civil war from 1861 to 1865, was followed by the apointment of many persons from civil life, who had received no military training, and without any special qualifications beyond personal and political considerations.

As a stimulus and reward to special service, promotions are occasionally made from the rank and file, after a mere formal examination in the elementary branches of a common school education, and without the provision for professional training except such as can be got from observation and private reading.

PROFESSIONAL INSTRUCTION AND TRAINING OF OFFICERS.

In the organization and movements of the armed forces of the Colonies, the officers were trained in the military service of the mother country.

In the War of Independence, the general spirit of the people supplied for a time the want of trained soldiers and officers, beyond the small force which had been schooled in the French and Indian Wars; but the necessities of the service compelled Congress to authorize its accredited agents abroad to offer commissions, especially to engineer and artillery officers; and at the close of the war we find nearly all the prominent officers in the artillery and engineer

departments had been trained abroad. Nearly all the fortifications were planned by them and erected under their supervision. The names of Steuben, Kosciusko, Du Portail, Radière, Romans, Vincent, Rochefontaine, Toussard, Revardi, L'Enfant, Villefranche, and others of later date, will suggest to any reader of the military history of the country, the extent of our obligations to foreign military schools.

The sources of systematic professional instruction and training for officers of the armed forces of the United States, are—

I. The National Military Academy at West Point, for the general scientific instruction of officers of all arms.
II. The Practical School of Artillery at Fortress Monroe.
III. The Engineer Battalion School of Practice at Hunter's Point.
IV. The Company and Regimental Drill of various Volunteer Corps in the larger cities of the country.
V. The Cadet Corps in various Military and Scientific Schools in different States.

The gradual development of the military Academy at West Point, and the present condition of Military Education will now be given.

THE MILITARY ACADEMY AT WEST POINT.

I. ORIGIN AND HISTORY. PERIOD I.—1802–1812.

The influence of the United States Military Academy upon education, as well as its wide reputation as a school of science, render an inquiry into its rise and progress, a subject both of interest and profit. Since it is mind, rather than any system of forms and studies, which gives power to such institutions, a mere statement of dates and facts is insufficient to give us a just view of its character. We must, if possible, trace the spirit of the men who guided, and the principles impressed upon it. To do this, we shall resort, not merely to the record of events, but to our memory of men and acts, with which we were for years familiar.

It was not to be expected, that schools of refined, scientific art should be founded by small colonies in the wilderness of the new world. When even their clergymen must resort to Europe for education, and their lawyers for license, it was in vain to expect their soldiers to be accomplished engineers. When the revolutionary war came on, this fact became a painful experience. No man felt it more than Washington. With a people, whose patriotism was unquenchable; with soldiers, who rivaled the warriors of Leonidas, he found the best and truest of men, with the smallest possible share of military science. He was obliged to depend on European engineers for a skill which his countrymen did not possess; while their European ideas, and artificial habits were displeasing to his American principles.* He felt military instruction to be a primary want in the country. Accordingly, he was the real founder of the Military Academy; that is, he put forth the *germinal idea*. What the plan of it was to be, and what shape it should ultimately take, he did not state, and probably had not thought of; for Washington in the office of president, seldom meddled with the details of public affairs. What he meant to obtain, however, he distinctly stated, in his message, dated December 3rd, 1793; in referring to measures of national defense, he says an inquiry may be made: "whether

* Prepared by Major E. D. Mansfield, a graduate of West Point in 1819, for Barnard's American Journal of Educatioo, March, 1862.

your own experience, in the several states has not detected some imperfection in the scheme; and whether a material feature in the improvement of it ought not to be to afford an opportunity for the *study of those branches of the military art which can scarcely ever be obtained by practice alone.*"

In his message of December 7th, 1796, he said: "Whatever, argument may be drawn from particular examples, superficially viewed, a thorough examination of the subject will evince that the art of war is at once comprehensive and complicated; that it demands much previous study, and that the profession of it in its most improved and perfect state, is always of great moment to the security of a nation. This, therefore, ought to be a serious care of every government; *and for this purpose an academy, where a regular course of instruction is given*, is an obvious expedient, which different nations have employed."*

The views, always entertained, and repeatedly expressed by General Washington, were adopted by Mr. Adams, and Mr. McHenry, secretary of war, in his administration, made an elaborate report on this subject, which was transmitted to congress, on 10th of December, 1800. It is due to Mr. McHenry, to say that his ideas of what ought to be a course of military instruction, were far in advance of what were actually provided, till after the war of 1812—'15 proved his ideas to be correct. In 1794, prior to the last message of Washington, congress attempted to supply the want of a military academy, by attaching cadets to the corps of artillerists, and engineers. This corps consisted of four battalions, to each of which eight cadets were to be attached. This made the whole number of cadets thirty-two; and for this corps of artillerists, engineers and cadets, the secretary of war was directed to procure books, instruments and apparatus. The term *cadet* signifying in French, the youngest brother of a family, and in Spanish, a young volunteer officer, became naturally applied to young men, who were junior, volunteer officers. In England, the *cadet* of a family was a young son, who volunteered for the India service; and in the United States has been properly applied to the youth, who enter the military academy.

It seems from the message of Washington, in 1796, that the attempt at military instruction, was a failure. No place, no teachers, no studies, were appointed. It was on the 16th of March, 1802, in

* It is not meant to say that this subject was not mentioned before. It was by Col. Pickering, in 1783. But whoever reads the letters and memoirs of Washington, will see, that all the early ideas on the subject of military education and military science were derived from the experience of Washington.

the early administration of Mr. Jefferson, that congress established, by that name, the *Military Academy*. It was still made part of an army corps; the idea of making a separate institution for scientific studies not being yet matured. The artillerists and engineers were made two distinct corps, of which there were forty cadets of artillery and ten of engineers. The corps of engineers consisted of a major, two captains, four lieutenants, and ten cadets, making seventeen in all. *The corps constituted the military academy*, established at West Point, in the State of New York. So little idea was then entertained of the true objects and mode of scientific instruction, that the law required the cadet, as well as officer, to do duty in any part of the United States. In other words, the only idea of the military academy, at that time, was *a place appointed where the officers of engineers might give or receive instruction, when not on other duty.* The actual academy, such as it was, conformed to that idea. The major of engineers was the commander, or superintendent. The two captains were instructors, and the cadets were pupils. It was, as a school, an inchoate existence, without regular teachers, or limited studies, or proper discipline. Yet, even in this imperfect condition, it did, as we shall see, some service which ought to be gratefully remembered.

In the meanwhile, let us turn for a moment, to the *place* which is so memorable in the annals of this country, and is now so intimately associated with science. If Dr. Beattie is correct in saying that the character of the mind is much associated with natural scenery, no place in America could have been more wisely selected, as the site of a national institution. World renowned, as West Point justly is, there is that in its scenery and associations, more interesting to a poetic or a patriotic mind, than its famed Academy. Its green plain, hidden amidst its mountains; its craggy summits; its rocky barriers; its dark evergreens; its darker waters, flowing on forever; that beautiful view of town and country, seen through the frowning brows of Crow Nest and the Beacon; that quiet vale, where Washington oft bent his steps; those lonely little mounds, where the soldiers of the Revolution repose; these forts and ramparts now indistinctly seen, which once guarded these mountain passes; yon ledge of rocks, where Kosciusko once made his little garden; all these and other memorable things, call up whatever is sublime in nature, or noble in history. It is impossible to forget them. It is impossible for the dullest mind, not to have its sensibilities excited, or its character elevated by the contemplation of such sublime scenes, or such interesting events. When such a spot

becomes the place of our education, its memories become poetic; its associations mingle with the flow of life, and the structure of our minds.

To return. The law having authorized this ideal Academy, it was immediately instituted, by the appointment of officers. The Academy, it is seen, was on quite a small scale. In fact, so far as teaching was concerned, the Academy consisted of two captains of engineers and ten cadets. The two captains were WILLIAM H. BARRON and JARED MANSFIELD. Mr. Mansfield had been a teacher of mathematics, navigation, and the classics, first at New Haven, (Conn.,) and then at Philadelphia. He had written a volume of "Essays" on mathematics and physics, quite original, and distinguishing him at that time, as the first mathematician of his country. This was brought to the notice of Mr. Jefferson, who with no great love of military affairs, was a warm friend of science. When the act was passed authorizing the Military Academy, Mr. Jefferson wrote to Mr. Mansfield, that he would appoint him a captain of engineers, for the *very purpose of becoming a teacher at West Point.* Accordingly he was appointed, on May 3rd, 1802; Captain Barron had been appointed in April. Then, in May 1802, the actual Military Academy was constituted, Captains Barron and Mansfield being teachers of mathematics and philosophy, to some half dozen or more cadets and lieutenants. No professor of engineering or of any other department was appointed before 1812. In pursuing the course and growth of instruction at West Point, during this period of ten years, we can only refer to the services of the instructors and graduates. In fact, there were no graduates prior to 1815; but there were *appointments* made from the cadets of the Military Academy, after more or less study at West Point. To understand what was done, we must refer to the actions of teachers and cadets, rather than to history. Its teachers were few and its annals brief. Captain Mansfield, after a year's teaching at West Point, was in 1808, appointed by Mr. Jefferson, to a more responsible position. It was necessary to the correctness of our public surveys, that the meridian lines and the base lines (which are co-ordinates,) should be established with astronomical accuracy. For this purpose, Captain Mansfield was appointed surveyor general of the north-western territory; furnished with astronomical instruments, and taking his residence in Ohio, proceeded to establish and perfect that beautiful system of surveys, by which the north-western states are distinguished. Retaining his military bent, with a view to his original destination at West Point, he actually returned there in 1814, to

recommence, as we shall see hereafter, his career as an instructor in the national institution. Of Captain Barron, his co-teacher, we only know that he was relieved in February, 1807. At the same time, his successor, FERDINAND R. HASSLER, was appointed, and remained till he resigned in 1810. Mr. Hassler was, we believe, a Swiss by birth. He wrote a small treatise on mathematics, and had quite an extensive reputation, as a mathematician, but was said to be too analytical and refined in the character of his mind, for American practical habits. He was intended for the coast survey, and, we believe, actually commenced it.

In November, 1806, ALDEN PARTRIDGE, superintendent of engineers, was appointed *acting assistant* professor of mathematics, and retained that position till April, 1812.

The "Teacherships" of French and drawing were created, by the act of February, 1803, being a very important addition to the original scheme of the Academy. To the teachership of French, FRANCIS DE MASSON was appointed, March, 1804, and resigned in March, 1812. To the teachership of drawing, CHRISTIAN E. ZOELLER was appointed, September, 1808, and resigned in April, 1810. Mr. Masson was a Frenchman by birth; Mr. Zoeller, a Swiss. Mr. Masson was highly spoken of by Colonel Williams, a good judge of what constitutes a scholar. Mr. Zoeller was an amiable man, of no high attainments, whose instruction in drawing was wholly confined to the military part, fortifications and bridges.

From this brief history, it appears, that there were but six teachers at West Point, between 1802 and 1812. Of these, no more than four were ever present at one time, and that only between 1808 and 1810. The teachers present, each year, were as follows:

1802—1803, . . .	Captain Barron, Mathematics.
	Captain Mansfield, Philosophy.
1804—1806, . . .	Captain Barron, "
	Francis Masson, French.
1806—1807, . . .	Captain Barron, Mathematics.
	Francis Masson, French.
	Alden Partridge, Mathematics.
1808—1810, . . .	Ferdinand Hassler, "
	Alden Partridge, "
	Francis Masson, French.
	Christian Zoeller, Drawing.
1810—1812, . . .	Alden Partridge, Mathematics.
	Francis Masson, French.

This glance at the actual teachers of West Point enables us to

see at a glance, what was done. No continuous study was pursued at all, except mathematics. For the eight years, between 1804 and 1812, French was taught by an able professor, Mr. Masson, and from 1808 to 1810, drawing. In 1812, this inchoate existence of the Academy was ended by the act of congress, reorganizing the institution, and placing it on a permanent and extensive foundation. The next period of five years, from 1812 to 1817, was the *forming* period of the Academy. In some respects, its elements were chaotic. In others, its *personnel* was inefficient and inharmonious. In others, again, its materials of instruction were inadequate. From this condition it finally emerged, and attained its present high character and usefulness. The history of this change is important, if not interesting to those who would understand what are the true foundations of a great school of education. In the meanwhile, let us return to what the CADETS of the Academy had done. If they were few, and with small means of instruction, they may nevertheless have shown that the Academy was not altogether fruitless. How many cadets were appointed between 1802 and 1812, we do not exactly know, but we have the number appointed *from the Academy*. The number of cadets promoted from the Academy during that period were for each year, thus:

In 1802, . . . 2.
In 1803, . . . 3.
In 1804, . . . 2.
In 1805, . . . 3.
In 1806, . . . 15.
In 1807, . . . 5.
In 1808, . . . 15.
In 1809, . . . 7.
In 1811, . . . 19.
In 1812, . . . 18.

This makes eighty-nine in ten years. Let us look at their career, as stated in the brief annals of the army; or, as they are retained in memory. Of this number, comprising ten cadets of more than half a century ago, this is the result:

Killed in battle, . . . 10.
Died in service, . . . 21.
In service, ... 7.
Resigned, ... 33.
Disbanded, ... 10.
Dropped, ... 3.
Dismissed, ... 4.
Declined, ... 1.

This is no bad roll. If we were to search our college rolls for those who had been really useful, those who died in battle, or served to the end, or entered other fields of usefulness, or now live in the performance of duty, we should find a less grateful exhibition than this. The number of those who had been "dropped," or "dismissed," for incompetence, or vice, would be far greater. Alas! if we could read the secret history of the college roll, how sad would be that account! We know, that in times past, many of the officers of the army were addicted to dissipation. Happily, we can say, many less now. But since we would estimate the value of the Military Academy, even in its most imperfect condition, let us see *who* some of these men were.

The first cadet appointed was General Joseph G. Swift,* who having risen to the rank of general of engineers and inspector of the Military Academy, resigned, became surveyor of the port of New York, and is now a venerable and respected citizen of Geneva. Of those who were killed in battle, *Eleazer D. Wood*, (whose monument stands at West Point,) was killed while loading a cannon, in the sortie from Fort Erie. Five others were killed on the Canada frontier, and four in battle with the Indians. Of those who died in service, *two* reached the rank of general, and *eight* that of field officers. Of those who are now in service, (7,) one is General Joseph G. Totten, chief of the corps of engineers, who served on the Canada frontier in the war of 1812, and at the siege of Vera Cruz. One is Col. Sylvanus Thayer, who served in the war of 1812—'15; who was superintendent of the Military Academy from 1817 to 1833, and to whom it is indebted for a large part of its usefulness. Of these gentlemen, we shall have more to say, when we refer to the forming period of the institution. Another is Colonel Rene De Russy, who was distinguished in the battle of Plattsburg, and became superintendent of the Academy on the retirement of Col. Thayer. Of those who resigned or were disbanded, many died young; one became a member of congress and politician; and another, Col. William McRee, was a remarkable man, distinguished for gallant conduct in the battle of Niagara and Fort Erie, a member of the board of engineers, and of cultivated mind; he resigned from the army and became surveyor general for Missouri and Arkansas, and finally died of cholera at St. Louis. Of the whole eighty-nine, who were commissioned prior to 1813, but twenty-one were alive in 1850, and several others have died since. The few

* The *first* diploma, which we suppose was a manuscript certificate, was the one given to the then Cadet Swift, and signed by Captains Barron and Mansfield.

who now remain have seen more than half a century's service in useful employments. Perhaps it should be mentioned to the advantage of the Military Academy, as a school of physical education, that at the end of half a century, twenty of its pupils out of eighty-nine, should be yet alive. In twenty years of civil life, as appears from the United States census of 1830 and 1850, more than the same proportion of youth between ten and twenty years of age perished. The general strength and health of the pupils of West Point are beyond a doubt greater than that of the same number of young men brought up in the ordinary methods of education. This is not wholly due to physical exercises, but also to moral education, and to the care and comforts of their mode of life. Will any one deny that *discipline* is a part of moral education? Is not self-restraint, the regularity of habits, and the art of using the mind in intellectual pursuits, the most important elements of a moral education? It is to all these, and not merely the training and exercise of arms, that the eléves of the Academy owe so large a share of the health and strength of life.

In the period of its history which we have now examined, the Military Academy was really only in the germ of its existence. Like most other useful or remarkable enterprises, it was first thought of as a thing needed; then began without any clear idea of what it would become, and was then improved upon, till it grew to be of magnitude and importance.

PERIOD II.—1812—1825.

The Academy, in its germinal existence, whose history we have briefly traced, was obviously inadequate to supply the army and country with young men instructed in the art of war. Congress authorized the appointment of a large number of cadets. But the President did not act upon it, because there were neither professors, nor books, nor quarters, nor material at West Point for their training. In 1808, Mr. Jefferson recommended an enlargement of the Academy. In 1810, Mr. Madison did the same. In vain, however, were these recommendations, till the nation was roused from its indolent repose by the sudden shock of war. In 1811, the battle of Tippecanoe electrified the people. The war-whoop sounded on the north-western frontier, and the aggressive conduct of Great Britain became insufferable. War was an imperious necessity. Then it was that the use if not necessity of an institution for military training became obvious to all reflecting minds. In April, 1812, the act was passed which erected the frame-work of the pres-

ent Military Academy. As this legal outline has been little changed since, it is necessary that we should look to its provisions, for correct ideas of what the law intended, and what has been substantially carried out in its growth and development.

1st. It was provided, that the number of cadets might be increased to two hundred and fifty, and attached at the discretion of the President as students to the Military Academy at West Point, and be subject to the regulations thereof.

2d. That these cadets should be between the ages of fourteen and twenty-one, and previous to his appointment should be well versed in reading, writing, and arithmetic.

3d. That the Military Academy should consist of the Corps of Engineers, the Professors of Philosophy, of Mathematics, of Engineering, with their assistants, and the teachers of French and Drawing.

4th. That when any cadet shall receive a regular degree from the Academical Staff, he shall be considered a candidate for a commission in any corps for which he shall be deemed competent.

In addition to these provisions for education, money was appropriated for buildings and books, and for a band of music. The expenditure provided for was very small, compared with the need of the Academy; but it was enough for a beginning. It was far easier, as we shall see, to provide for all its material wants, than to bring it into that state of moral and intellectual discipline, which was essential to the attainment of great results. The institution, in its former period, was in an inchoate condition. A few young officers, raised up partly as teachers, and partly as pupils, without a course of studies, without regulations, and without discipline, could furnish no just ideas, from experience, of what a highly intellectual, well-ordered school of science should be; and accordingly the want of just ideas of education was precisely what first stood in the way of making West Point what it subsequently became.

For more than five years there was a wrestling between old and new ideas. There was a positive ignorance of what high education should be. In fact, the country had no models for it. Then there were old habits to overcome. Lastly, there was a willfulness on the part of some in authority, opposed as long as opposition was possible, to any new idea of things. For people are aware, in this day of change and novelty, how strongly the *vis inertiæ* of intellectual habits opposes intellectual improvement. This very *vis inertiæ*, at first, almost nullified the power of law itself to improve and enlarge the studies at West Point. How it acted we shall see. The first

difficulty at West Point was, (after preparing the accommodations and material) in complying with the spirit of the law, and placing the *academic instruction on the high ground really intended.* To understand this we must here advert to some provisions of the law which were either overlooked or neglected. First, the law expressly recognized an *Academic Staff*, who should confer *degrees.* Secondly, that the cadets of West Point should be *students*, subject to the *regulations of the Academy.* All this evidently meant that these two hundred and fifty young men should be placed, like students in college, under regular academic instruction, and that the professors and teachers should constitute an academic faculty, with power to regulate the education of the cadets, and confer degrees according to merit. Ultimately this was accomplished; but it took much effort on the part of the Professors to bring the military authorities into a just conception of this scheme. During the years 1812 and 1813, little was done except in commencing buildings, buying apparatus, appointing the cadets, and getting ready for the real business of the institution. Here we must record the first academic faculty organized at West Point. The professorship of Natural and Experimental Philosophy, which was higher in rank and emoluments than the others, was instituted expressly for Col. JARED MANSFIELD, who, having retained his commission in the corps of engineers, while he was surveyor-general in the north-western states, was now (October, 1812,) appointed to the same professorship which he held ten years before. ANDREW ELLICOTT, who had been astronomer of the United States, and had a wide reputation for mathematical knowledge, was appointed professor of Mathematics, in September, 1813, at which time, also, ALDEN PARTRIDGE was appointed professor of Engineering. The teacher of drawing was CHRISTIAN E. ZOELLER, reappointed; and of French, FLORIMOND DE MASSON. This was the first academic faculty. Subsequently, the principal professors were allowed assistants, and other teachers were at still later periods provided in the departments of Ethics, Tactics, Artillery, Chemistry, &c., as the institution was enlarged, and its wants were better known. The gentlemen above named were, however, the first professors and the first faculty. They had the real *labor* and responsibility of taking the initial steps, and to a large extent, of forming the Military Academy. At the very first step a difficulty occurred, which could not have been anticipated. Captain ALDEN PARTRIDGE, (who was professor of Engineering) was superintendent of West Point, from January, 1815, to November, 1816—nearly two years. He was a man of strong will; of in-

dependent and rather eccentric ideas, who quite naturally as a military man, long resident at the Point, wished to forget that the law required the education of the institution to be decided by an academic faculty, and governed by regulations. He chose rather to remember that it was a military post, governed by a military commandant, and sought to gratify his own ambition by grasping its sole direction. Professors Mansfield and Ellicott, who held no command in the army, took a different view of the subject. They justly thought, that the object of the institution was to give a thorough *scientific education*, especially adapted to the art of war; that this required discipline, and a course of studies systematic and complete; and that all this was evidently contemplated by the law, which said that the Academy should be governed by regulations, and hence an academic faculty. This difference of opinion was vital. It led to a controversy of two years, which belongs to the private rather than the public history of the Academy. Little of it was known to the public, and we are now concerned only in the issue. Had the views of Captain Partridge prevailed, the institution never could have become what it is.* Fortunately, the Professors had the law on their side, and also the good opinion of the administration, and eventually gave to the scientific college the cast and features which it now has. For three years, between 1814 and 1817, this internal controversy continued, gradually tending to give the Academy a systematic organization. General Joseph G. Swift, (head of the corps of engineers,) who was officially inspector of the Academy, took up his residence at West Point, in November, 1816, but remained only two months. While there, there could be no controversy, as to the government of the Academy, since the commander of engineers was legally its chief. After the removal of General Swift, Captain Partridge, as senior officer, again took command. It was determined, however, to remove him; and the Government most fortunately hit upon an officer, whose character, education, and accomplishments, most eminently fitted him for the post of governing, and disciplining the young men, who were in turn to become the *savans* as well as the ornaments of their country. This officer was Sylvanus Thayer, a native of Massachusetts, commissioner in 1808 from West Point to the engineer corps, and who had recently traveled in Europe, examining the military schools of France and Germany. The arrival of Colonel Thayer constitutes

* Captain Partridge, who was a useful and energetic man, had subsequently full opportunity of carrying out his popular views in the military schools of Norwich and Middletown, which he founded by his own efforts.

the most important epoch in the history of West Point. Why it is so will appear evident when we trace out the *scientific culture* of the Academy, and the discipline which it furnishes. Up to 1813, we have seen that the Military Academy was merely a small company of officers and cadets, who, being stationed at one post, were required while there to pursue certain mathematical and military studies. It had no one element of organization. From 1814 to 1817, professors Mansfield and Ellicott were struggling with no more than partial success, to give it organization and systematic instruction. But, in 1817, Colonel Thayer, who had seen in France what such institutions required, and whose enlightened mind realized the necessity of adopting better methods, at once coöperated with the Professors, in making a permanent and successful reform.

At this point we should notice the additions made to the academic staff, between 1816 and 1819, and the steps taken by the war department toward carrying out the views of the Professors, and Colonel Thayer. Claude Crozet was appointed professor of Engineering, in March, 1817; David B. Douglas was appointed assistant professor of Natural Philosophy, in January, 1815; Charles Davies was appointed assistant professor of Mathematics in December, 1816. Rev. Thomas Picton was appointed Chaplain, and professor of Ethics, in July, 1818. Thomas Gimbrede was appointed teacher of Drawing, in January, 1819. Major John Bliss, instructor of Tactics, in April, 1818; Lieut. George W. Gardiner, instructor of Artillery, in September, 1817. Claudius Berard succeeded Francis Masson, as teacher of French, in January, 1815; Joseph Du Commun was appointed second teacher of French, in March, 1818. Of the old professors, Captain Partridge and Francis Masson were gone; all the others remain. Thus, in 1817, when Colonel Thayer took charge of the Academy, the corps of teachers was composed of professors Mansfield, Ellicott, and Crozet; teachers Zoeller and Berard; and assistant professors Douglas and Davies, exclusive of the military teachers and of those appointed in 1818 and 1819. This was properly the Academic Staff, and Colonel Thayer was willing and pleased to have them take their proper part in organizing the institution, and raising it to that high standard of discipline and excellence to which it has since attained. In the meanwhile, the war department, under the enlightened administration of Mr. Crawford, had endeavored to supply some of the obvious defects of the Academy, by new regulations.

So far we have pursued the history of the Academy, as it progressed from a germinal idea to actual being and life. It is now

necessary to trace that system of *scientific culture* which is its essential element and peculiar character. In this the student of education may be more interested, and as we trace it still further, in its *fruits*, the education and services of more than two thousand young men, who have held the most important positions in all the departments of life, we shall be better able to pronounce a just judgment upon its merits and services.

Mr. CRAWFORD, one of the most enlightened men who have appeared in public affairs, was, we believe, the first to understand and attempt to remedy the defects and irregularities which Professors Mansfield and Ellicott had pointed out.* In March, 1816, "Rules and Regulations" were drawn up by Mr. Crawford. The main points in them were—

1. There shall be a Board of Visitors, to consist of five suitable gentlemen, who shall attend each annual examination.

2. There shall be a General Examination twice in each year; in July and December, and an annual vacation in July and August.

3. Cadets shall be admitted in September, and examined in spelling, reading, writing, and arithmetic.

4. A course of studies, embracing definitely all branches of science and instruction to be procured, and rules for classification shall be drawn up, and comprise a complete course of education at the institution.

According to the last regulation, a course of studies was drawn up by the Academic Faculty, and approved by Mr. Crawford, in July, 1816. This course comprised four years, and was substantially the same (although largely increased,) which has been pursued since.

The *first year* studies were English Grammar, French, Algebra, Geometry, and Logarithms.

The *second year* comprised French, Geometrical Construction, Application of Algebra, Mensuration, Plain and Spheric Trigonometry, the Conic Sections, and Drawing.

The *third year*, Natural and Experimental Philosophy, Astronomy, and Drawing.

The *fourth year*, Engineering, Geography, History, and Ethics.

In the first draft, Engineering was put in the third year; but since 1817, has been placed in the fourth. In a year or two afterwards was added the Calculus; and in a few years, Chemistry, Min-

* These defects and irregularities arose from not obeying the law, and not pursuing the ideas it pointed out. The great effort of Professors Mansfield and Ellicott, was to get the spirit of the law followed practically.

eralogy, and Natural Law. This course of studies is exclusive of the purely military part, which under the heads of Tactics, Practical Artillery and Gunnery, occupied several hours each day.

Thus, in July, 1816, the Academy had for the first time arrived at a course of studies, and a preparation for discipline. In the fall and winter of 1816, began an attempt to carry this course of studies into practical effect. We do not say there had been no studies and no attempt at classification before that, for there were, but that nothing had really been perfected in either, till after the "regulations" of 1816. If we could carry the reader back to the year 1815, and see the difficulties under which the professor of that day labored, the small material provided, and the undisciplined condition of the young men under their charge, we should give better views of the merits and services of its pioneer teachers. One or two reminiscences may possibly throw some light on the subject. Colonel Mansfield arrived at West Point in 1814, and immediately sought for his pupils. He was not like the professors of whom Gibbon speaks, remembering that he had a salary to receive, but forgetting he had duties to perform. On the contrary, he immediately asked for pupils to teach. What was he to teach? Philosophy and Astronomy. But these required prior training, and it was not till the winter of 1814–'15, that he could find any pupils. Then he found *five* young men who thought that they could go on in such studies. For want of any recitation rooms at the Point, he taught them in the parlor of his own house. As we shall refer specifically to the subject of text-books, we merely add, that the only work to be found at all suitable, was *Enfield's Philosophy*. There was no classification, and in a few months these five cadets were commissioned. They made the first class in Philosophy, taught at West Point.

Again, there are some who will recollect Professor Ellicott, sitting at his desk at the end of a long room, in the second story of what was called the Mess Hall, teaching Geometry or Algebra, looking and acting precisely like the old-fashioned schoolmaster, of whom it was written,

> "And still they gazed, and still the wonder grew,
> That one small head could carry all he knew."

The cadets were all "boys" to him, and his kind face was long remembered. In the other end of this room, or in the next, was seen his acting assistant, Stephen H. Long, then a young lieutenant of engineers; since distinguished as a traveler, an engineer, and a man of science. The text-book used was "Hutton's Mathematics," and

at that time the best to be had. Mr. Hutton had been a professor at Woolwich, England, and his treatises were plain, simple, easily understood, and therefore well adapted to beginners. It was, however, very deficient both in extent and analysis. It was a good text-book then, for there were no cadets trained to pursue deeper or more analytical works. With Hutton's Mathematics, Enfield's Philosophy, and plain right-lined drawing, and nothing which could be called engineering, did the cadets of the Academy get along, without roll, classification, or graduation, till the close of 1816.

In August, 1817, as we have said, Colonel Thayer became superintendent at West Point; and in the course of the next four or five years the Academy passed through the great changes which brought it from the inchoate to the crystallized state in which it now appears. The most important of these changes relate to scientific culture; and we shall best describe them by narrating the *actual work* the classes then pursued, and the change of text-books. The first step was taken, as we have seen, in March, 1816, by the regulations of Mr. Crawford, which required classification, a course of studies, and annual examinations. Some steps towards these were taken in 1816, but very imperfectly. In 1817 the system of classification was first systematically begun. CLAUDE CROZET, a French officer under Napoleon, and a pupil of the Polytechnic School, was appointed professor of engineering, in March, 1817. The annual examination coming on in June, the course of studies in his department did not regularly commence till September, and the second or junior class* of 1817—'18 was the *first* class which commenced thoroughly the severe and complete course of studies at West Point. The *labors* of that class in the years 1818 and 1819 may have been equaled, but certainly have not been surpassed. It was not a brilliant class, but its labors were not the less on that account. It had not merely to pass over the plain turnpike road of science which is now made so easy to those who follow; but, like the pioneers of an army, had to cut down the obstructions, make their own bridges, and to no small extent, furnish their own munitions. Let us look into the class-room of 1817, as Professor Crozet advances to instruct those

* The Class here spoken of graduated in 1819. Of its living members, are HENRY BREWERTON, late Superintendent at West Point; EDWARD D. MANSFIELD, Commissioner of Statistics for the State of Ohio; JUSTIN DIMMICK, late Commander of Fortress Monroe; DANIEL TYLER, a distinguished Engineer and General in the Army of the Potomac; WM. H. SWIFT, a distinguished Engineer, and President of the Illinois Canal Company; JOSHUA BAKER, a Civil Engineer, Judge, and Planter, in Louisiana; and Major TURNBULL, distinguished as a Topographical Engineer in the War with Mexico.

Among the dead was GEORGE H. WHISTLER, the most distinguished Civil Engineer our country has produced.

young men in studies, which were not only new to them, but entirely unheard of, and in which the language to which they were born and bred *furnished not a single text-book.* Professor Crozet was to teach engineering; but when he met the class, he found not one of them fit to learn engineering. These were branches of science, and its affiliations, essentially necessary to engineering, which they had never been taught. What was he to do? All he could do obviously was to supply these preliminary studies before he could commence in his own department. In other words, he must begin by becoming a teacher of mathematics, and drawing. The surprise of the French engineer instructed in the Polytechnique may well be imagined when he commenced giving his class certain problems and instructions, which not one of them could comprehend or perform. Among these preliminary studies was Descriptive Geometry, not an original and distinct science, but which by *projecting* geometrical figures and problems on co-ordinate planes, gave a more facile and practical mode of *representing* (as its name implies,) as well as solving many geometrical and practical problems. This, too, required an accurate knowledge of mathematical and perspective drawing, and its various minor but important arts. We doubt whether at that time more than a dozen or two professors of science in this country knew there was such a thing; *certainly* they never taught it, and equally certain, there was not a text-book in the English language. Perhaps this is not surprising, when we reflect, that this new application of geometry was scarcely thirty years old. Monge, a French savans, was, we believe, the author of this system, about the beginning of the French Revolution. Crozet meant to begin with Descriptive Geometry, but fortunately, the class was not in the last year of the course (in which engineering has recently been taught,) and could spare some time for mere mathematics. But, a new difficulty arose. There was no text-book in English, and none to be had just then in French. Geometry is not a thing to be taught orally. What is to be done? It was here at this precise time that Crozet, by aid of the carpenter and painter, introduced the *blackboard* and chalk. It is a very simple thing, and so is every thing which is useful; but we know of no mere adjunct of teaching, so useful as the blackboard. To professor Crozet, so far as we know, is due the introduction of this simple and useful machine. He found it, with many other things, far superior to the English methods in the Polytechnic of France.

We now see Crozet with his blackboard before him, chalk in hand, and animated, intellectual face, about to teach his class a new sci-

ence, without a text-book. Again he meets a new difficulty. He does not more than half understand the American language. This difficulty is only to be overcome by practice. With extreme difficulty he makes himself understood. With extreme difficulty his class comprehend that two planes at right-angles with one another are to be understood on the same surface of the blackboard on which are represented two different projections of the same object. But, at last it is done. The Professor labors with inexhaustible patience, and the pupils are pleased to receive into their minds entirely new ideas. The first problems are drawn and demonstrated on the blackboard, by the Professor; then drawn and demonstrated by the pupils, and then accurately copied into permanent drawings; and thus this class were taught in the most important and valuable method of imparting true knowledge, which has been given to mankind since the days of Socrates. Fortunately, professor Crozet had brought with him the complete drawings of the French Polytechnique, so that he was not, in this particular, obliged to depend upon himself. The path of his instruction soon became easier, and then this class completed their course in drawing, mathematics, and Engineering.

In the study of Natural Philosophy and Mechanics, the way was scarcely less difficult. We have already said, that Enfield's Philosophy was the first book on that subject. But this was not enough. Professor Mansfield looked around in vain for any suitable book on Mechanics. At last, *Gregory's Mechanics* was adopted. It was a book without any analysis, and probably written only for scientific men. Yet, it was the best to be had. For several years after, this work still remained the best book on Mechanics. Whether the class who first studied its mysterious pages acquired as clear and extensive ideas of the subject as those who have since passed over smoother roads, may be doubtful. It is certain they had more arduous labors. We have said there was *no* text-book on engineering, as a science. When the class which had commenced Descriptive Geometry, with professor Crozet, (then the second or the junior class,) had become the first class, they were instructed in engineering by drawings from oral teaching, on the blackboard. The various modes of laying out fortifications, of bridging, of defiling, of materials, ordnance, &c., were taught by professor Crozet. For several years no text-book in engineering was found. It was not till 1823 that a French treatise, entitled the Science of War and Fortication, was translated by Major O'Connor, and for several years used as a text-book. It will be seen that the class which, in 1817,

1818, and 1819, commenced the new culture and discipline of West Point, had an arduous and difficult task. It is, notwithstanding, quite probable, that this severe exercise of the mind, in making paths for itself, where there are no guide-posts on the way, no regal road, is a better discipline than that furnished by the more easy and systematic methods.

Perhaps no one step taken at West Point, has contributed so much to intellectual culture as the Merit-Roll. The effect at the Military Academy is totally different from what it would be at any civil institution. For there it determines *rank*, which is the great object of military men. Forty young men may be commissioned on the same day to the same grade, but through all their after life, even when they return to civil life, the distinctions of the merit-roll will follow them, and be counted for or against them. In the very first day of their commissioned service, the distinction is a practical one, for there are great and practical advantages in certain *arms* of the service over others. Thus the engineer officer, without any actual care of men, or responsibility for any movements, and almost always stationed at comfortable posts, has great advantages over other arms. The Artillery has advantages over the Infantry. Thus the cadet, commissioned from West Point, has determined for himself, by his position on the merit-roll, not only his rank in the army, but almost his position in human life. The merit-roll, as it now exists, graduated in all departments, and summed up at the close of the course, was not adopted at once, but was the work of several years.

In February, 1818, the superintendent of the Academy was directed by the Secretary at War to publish in the Army Register the "names of cadets who are distinguished for attainments, and meritorious conduct, not exceeding five in each class, specifying the studies in which they may excel."

We well recollect with what excitement and interest this communication was received by the cadets of that day, especially by those who thought themselves within the probabilities of that distinction. It unquestionably stimulated most of the young men to much greater exertions than they would otherwise have made. In a few months after, the merit-roll was fully established in the classes, and the rank of the graduating cadets determined by it.

There has been much discussion, and no small doubt, as to the real effects of emulation. There is undoubtedly a bad sense, and a bad effect attached to that term. But is that a necessary consequence of the merit-roll? Is not the merit-roll adopted, so far as it

can be ascertained, in all departments of human life? Who would risk himself with an ignorant engineer, if he could get a skilled one? Who would employ a poor clerk if he could get a good one? The objection made to emulation is that it excites wrong motives. However this may be, and however casuists may regard it, it is quite certain that the merit-roll is the strongest stimulant to intellectual exertion which can be presented to young men. Nor can we perceive, after much observation on its effect, that it has impaired the purely moral motives of action, or excited evil passions, to be remembered in after life. At West Point all the moral actions which are visible and tangible are brought within the scale of the merit-roll, and often the fate of a young man is determined far more by his standing in conduct, than in studies.

II. STUDY, DISCIPLINE, AND FRUITS.

Having thus sketched the historical progress of the Academy in the path of scientific culture, it remains for us to state what it *is*; what it has *done*; and what men have *conducted* it.

Without entering into minute details, we shall very briefly state the present methods of study and discipline. The leading studies in their order are Mathematics, Natural Philosophy, Mechanics, Astronomy, Engineering, Chemistry, French, Tactics, Artillery Practice, Mineralogy, Ethics, and History. This course is wholly scientific, the practical part being adapted strictly to military purposes. In the early period of the institution, some attempt was made to introduce the classics, but it was found impracticable, with the limited time allowed the cadets. Indeed, it may be doubted whether any institution can have more than one *tone*. All branches of human learning may be embraced in the proper schedule of university instruction; but has any university given equal attention to all branches of education? What are called colleges in our country, all aim at fitting young men for the civil professions—Law, Medicine, and Theology. They therefore make the classics the principal branch of study, and are right, since Law, Medicine, and Theology have their foundation deep laid in the classic ages. Literature also is a part of professional knowledge, necessary to adorn and illustrate the history and theory of professional science. Hence, in these lines of instruction specially have run the studies of the college, and from these is derived the *tone* of college education. The object of the Military Academy was totally different. It was not civil, but martial life, for which the young men were fitting. It was neither a metaphysical discussion, nor a hair-splitting argument

on the law, in which they were expected to excel. They were to learn the sterner arguments of the battle-field; to arrange squadrons for the hardy fight; to acquire that profound knowledge of the science and materials of nature, which should fit them for the complicated art of war; to defend and attack cities; to bridge rivers; to make roads; to provide armaments; to arrange munitions; to understand the topography of countries; and to foresee and provide all the resources necessary to national defense. This was the object of the Military Academy, and to that one end it was adapted. The method of education may be happily stated under the heads of Studies, Physical and Moral Discipline, and of Military Exercises.

1. The subjects and method of study we have already mentioned; Mathematical, Philosophical, Mechanical, Chemical, Military, and French, the military language. These being the chief topics of study, the students and the time were suitably divided into classes and hours. There are four classes, occupying four years, as usual in colleges. There are ten months of study, the intermission being in the hot months of July and August, when only military studies and exercises are pursued. The studies of a day are necessarily modified, by the introduction of military exercises which consume much time. The regular *study hours* (which include also the recitations,) are from 8 A. M. to 1 P. M., and from 2 P. M. to 4 P. M., making *seven hours* of study and recitations. Generally *four hours* more are consumed in military exercise and discipline, being the hours before breakfast, and after 4 P. M. Thus *eleven* hours are generally occupied either in study or exercises. The evening also after dark, is devoted to study in so far that with occasional exceptions, the cadets are required to be in the rooms. In this division of time we find a *continual alternation of study and exercise;* leaving the least possible time for idleness, or mere amusement. Indeed, the problem of education is to find the *maximum of development*, with the *minimum of idleness.* To this should be added, that the development should be co-relatively, intellectual, physical, and moral.* It is not merely ignorance, but *unequal* development, which is the great misfortune of mankind. How many great and glorious intellects have been lost, because there were no counter-balances to the

* We use the word *moral*, in preference to spiritual, because, in its comprehensive sense, including the latter; but by no means intimating, that in this Christian country, we should make any place of education a mere reproduction of Persian or Greek models. Our servile imitation of the Ancients, often makes us forget that we are neither Spartans nor Romans. The man who attempts at this day to revive the institutions of Pagan Greece, is as false to true Philosophy, as he is to true Christianity.

force which, inclined in only one direction, carried them off into a wilderness of fruitless objects!

In the course of studies pursued at West Point, the main feature is the *method* of study. We can give an idea of this in a few words. The very first thing done at West Point is to *recognize* the fact, that *intellects are unequal;* in other words, that of a given number of young men, commencing a severe and elaborate course of studies, there will be some who can not endure it, and can not get through; and others, who while they will come up to the requisites for graduation, can not equal a third class, who are capable and ambitious of receiving the highest style of education. This recognition is effected thus: a class enters the Academy, we will say *eighty* in number. This class enters on the 1st of September; and on the 1st of January there is a semi-annual examination. This four months of study by that class is regarded as a period of *probation*, which will furnish some test of the abilities of its several members. When the January examination is held, some are found deficient, and they are at once discarded. Then the remaining class are numbered, according to what is then their *apparent* merit, and they are divided into *sections* of from fifteen to twenty each; those highest on the roll being placed in the first section; those next in the second, &c. Usually there are four of these sections. The professor usually teaches the first section; his assistant the second, and so on. It is obviously a decided advantage to be in the first section, and there is usually a struggle to get there. But, a cadet may change his position in his class, at any time, by his own efforts. This he can only do, however, by more strenuous efforts. Then, if he be in the second section, he may at the end of the year be found to have a higher aggregate of good marks in study and conduct than some of those in the first section. In that case he will be transferred. Thus the ambition of the student has always placed before it the possibility of higher class rank, and if his talents and industry are capable of it, he will attain it.

The *method* of study at West Point, which in all institutions is the important point, is the *rigidly demonstrative*, in those studies which admit of it, and the *positively practical* in those which do not. The course of studies requires this, if the subjects of study are to be thoroughly understood. There is little of the purely metaphysical or transcendental known or pursued at West Point. No abstract speculations or merely theoretical inquiries occupy their minds. It is the actually knowing, and doing, in which they are engaged. As far as can be made practically useful, the *oral* method

is pursued. In mathematical and mechanical, engineering and tactical studies, this is largely the case. The blackboard, we have said, was first introduced into this country by Professor Crozet, at West Point. How largely this is used in all institutions of education now, our readers well know. It has proved one of the most efficient means of instruction at West Point: The student of the mathematical section, for example, begins with a text-book on Algebra, in his hand; but, it is on the blackboard where the workings of his mind are chiefly exhibited. He learns what he can from the book, but, on the blackboard the professor makes him trace out what he has done, not merely by telling what he knows, but what he don't know; detects his weak place, and forces his mind (so far as such force is possible,) to *think*, and think rightly on the subject before him. This *thinking*, we need not tell experienced teachers, is the great thing which education is to teach. If a student can not, or will not think studiously and industriously, he will not long remain at West Point. There is not, as in civil colleges, the great fallow field of poetry, history, and metaphysics, in which he may show his classical professor that he has acquired rich things, although ignorant of mathematics. It will not do to say that he has wandered with Greeks and Romans around the ruins of Troy, or by the waters of Babel. There is no such compensating principle in the system at West Point. The cadet must study what is set before him; must study it hard; must think upon it, and discipline his mind to systematic modes of thought.

2. This leads us to the Specific Discipline of the Academy. This is partially included in what we have already said. The intellectual discipline is mainly maintained by the method of study; but there is a grand and perfect system of discipline, which we may briefly describe. The term DISCIPLINE is derived from disciples, *discipulus*, and means originally *teaching* of knowledge; but this is not all, nor entirely its modern sense. Discipline is *training* in knowledge and virtue, in order and diligence, in good conduct, and good habits. To do this requires a control of the body as well as mind; of food and raiment; of time and exercise; as well as the imparting of facts and ideas. It was in the former sense rather than of the latter, that the word EDUCATION, (to lead forth,) was understood among the ancients, and so far as they went they were right. It was this *discipline* in virtue, temperance, courage, fortitude, and self-denial, which was taught in the days of Persian Cyrus, and Greek Leonidas. It was adopted among the early Christians; but, Cowper well said:—

"In colleges and halls in ancient days,
When learning, virtue, piety, and truth
Were precious, and inculcated with care,
There dwelt a sage called Discipline.
* * * * *
But Discipline, a faithful servant long,
Declin'd at length into the vale of years."

Nothing can be more certain than the decline of "discipline" in modern civil institutions. "Colleges and Halls" advertise a much enlarged course of studies; they call to their aid the most learned professors; and they proclaim "all the modern improvement," and yet it is quite certain, that a pupil can walk for years their learned halls, and at last receive the honors of graduation with a very small share of either learning, diligence, or virtue. Civil institutions may be most excellent for all, who either by early care or natural inclination are willing to use their opportunities for their intellectual or moral advancement. Nay, more, all open irregularities will be corrected, and all possible means afforded for spiritual improvement. But there are two things impossible to overcome—the popular and almost universal license allowed youth, (under the name of freedom) and the total want of any ultimate power to restrain it. These stand directly in the way of thorough discipline. At a Government Military Institution, this is directly reversed. The very first thing taught is *positive obedience.* The cadet can not be a week at West Point without knowing that he can not govern himself, but must be governed by others. If he is either not fit or not willing, the faculty meet the case in short and decisive language: "If you are either unable or unwilling to pursue the course of study and discipline, we direct you must instantly go. There are plenty more worthy to fill your place." There is, then, no alternative for the cadet but to go forward, and exert himself to the utmost, or not to go at all. There can be no loitering by the way, to slumber in idleness, or waste in dissipation, or pursue the pleasures of literature. There is no doubt that this stern and constant discipline is the great merit of West Point. It acts on the whole conduct and character. We have already said, that the class-standing determined by the merit-roll, determined their position relatively, and their rank in the army, and by consequence, great distinctions and differences in after life.

Let us see how this merit-roll is made up. The *first* thing done is to *mark* each cadet with a *figure* (having relation to an agreed scale of numbers,) for every act done or undone, in study, conduct,

drill, attention, &c. The *second* is to agree upon the *relative values* of each study, conduct, &c., in aggregating the whole positive or negative performance of a cadet, in his whole course at West Point. The summation of these for any one year gives his class-standing for that year, and the summation for the whole course gives his standing at the time of graduation, and his rank in the army.

Formerly, and we believe yet, the mode of marking and summing up for standing, was this. Each professor or teacher marked for one performance one of seven marks, from—3 to+3. This being purely artificial may be changed. But it is in this way the marking is made. Then in regard to *relative values* of study and conduct, the scale formerly was:—

Mathematics, ...	300.
Philosophy and Mechanics, . .	300.
Engineering and Military Science, . .	300.
Chemistry and Mineralogy, . .	200.
Moral and Political Philosophy, . .	200.
Conduct, ...	300.
Infantry Tactics, ...	150.
Artillery Practice, . . .	150.
French, ...	100.
Drawing, ...	100.

To obtain 2,100, the aggregate, a cadet must never have failed in a recitation, or been absent from a military duty, or derelict in the least particular. This most rarely if ever happens. Not to fall short more than 100, is evidence of very high standing.

It is evident, that under this system, emulation is highly excited, and, in fact, there must be a constant, unremitting effort to graduate at all. The general result is, that not more than one-half of all appointed are graduates. At the first semi-annual examination, many drop off; several more at the end of the first year, and more at the end of the second. Nearly all who survive the second year are graduated.

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 has also a great advantage as a means of Physical Education. This is a kind of education too much neglected, and for which civil colleges afford little opportunity, and no encouragement. The ordinary games, amusements, and walks in the field are relied upon to afford development to the body, and the natural tastes the only guide. So thought not Persian statesmen, Greek Philosopher, or Roman Senator. In contrast, a systematic

education of the body was a principle, and a practice, with all the civilized nations of antiquity. There was a constant attention to this in the training of youth; and the Olympian Games, the Gymnastic Exercises, and the Gladiatorial Shows, all had reference to this principle. If heathen nations could thus wisely attend to the healthy development of their bodies, can Christian people safely neglect it? There is no question that the Christian law of temperance, daily labor, good temper and amiable dispositions will do much to preserve health and strength. The health of the mind goes far to make the health of the body; but we must recollect that all students, properly so called—men who are set apart for the cultivation of learning and science—the *savans* of a country, are cut off at the very beginning, from that *daily labor* of the body, which in the dawn of human history was declared to be the necessity of man's existence. There is, therefore, a positive need of supplying by some system of salutary exercises, the place of that labor in which the farmer and mechanic are constantly exercised. What shall it be? Our common classical institutions have left this almost entirely to the student's own choice. Several hours of the day are left to the student to employ as he pleases. Does not experience prove, that he is quite as apt to employ this in novel reading, or playing cards, or visiting, or (in the case of an ambitious pupil,) in studying or reading the classics, as in any systematic method of exercise? Let the early dead of consumption, the victims of dissipation, and the unhappy subjects of chronic diseases, teach the living, that education consists not merely in spurring the mind on to intellectual feats, however admirable. The bird soars through the mid-heavens, but soars on the strength of his wings; and if he had the soul of Socrates, would still fall, when they are exhausted.

The military exercises, at West Point, accomplish some great results. They give an admirable exercise to the body, and they occupy time which might be wasted, and they compel the cadets to give up late night studies. Let us begin with the last. Nothing is more common among the ambitious students of colleges, than to sit up late at night. To burn the midnight oil, in order to accompany every thought in the realms of Plato, or fight with Hector on the plains of Troy, or pursue the phantom of metaphysics, or the genius of literature through the bright worlds of fiction, is the common boast of scholars. They have little thought, till too late, that life was shortened, and happiness impaired, by every hour taken from the natural period of rest. At West Point this evil is avoided, not so much by force of command, as by that of wise arrange-

ments. At the dawn of day, even in the shortest days, the shrill fife and rolling drum summon the cadet to his morning duties, and with the exception of the hours of meals, there is one incessant pressure upon him for bodily and intellectual labor, till ten at night. The results of this is, that when the hour of retirement comes, he must have more than human strength, who is not ready and willing to lie down and sleep. There are, of course, exceptions; but, at West Point, they are rare. The lights are put out at 10 o'clock, and the weary student is ready to retire. 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.

Having thus traced very briefly the history, studies, and discipline of West Point, it is only just to say something upon the fruits it has produced. These are divided naturally into two classes; the work of the *Professors*, and the performance of *Graduates*. The former is little noticed in the accounts of our colleges, except in the reputation of some distinguished men; but the latter, (the divines, lawyers, and statesmen who have graduated,) make the glory and the ornament of the triennial catalogue. Let us see if something has not been produced by West Point, which, in regard to the peculiar objects and teaching of the Academy, may bear a favorable comparison with the catalogue of any institution for the last half century. We do not mean in regard to the learned professions, for if West Point had excelled in these departments, it would have utterly failed in those for which it was made. But, we mean in the great field of science and of usefulness. First, let us look at some of the fruits produced by its professors, especially in the production of *text-books*. In the history of instruction at West Point, we have stated the total absence in the beginning, of text-books on some subjects, and the unfitness of those on others, even the common studies of Mathematics. The first text-book on Descriptive Geometry, published in America, and we believe, the English language, was prepared by Professor Crozet; but, as he then understood our language imperfectly, and had little taste for authorship, it was soon supplanted, by a complete treatise prepared by Professor Davies. On that subject, as on the subject of Engineering, there was no systematic treatise; and for a time, West Point got along by oral teaching, and such collateral aid as could be had. The utter deficiency of suitable books may be known by the fact, that the first really tolerable text-books on mathematics were translations of La Croix, Bourdon, Biot, &c., French authors. The French methods

of writing and teaching science are, on most topics, the best. Their style is clear and analytical. The English treatises are clumsy, being what is called in literature, elliptical, having vacancies in the reasoning, to be supplied by the student. The next great and permanent improvement in books, were the mathematical works of Professor DAVIES, a graduate of 1815, when the Academy was yet in a chrysalis state; he was several years a teacher before he conceived the idea of supplying a new series of mathematical text-books. His first plan was to adopt the best French works as a basis, and modify them, so as to be adapted to the American course of instruction. In this manner were prepared "Davies' Legendre," (Geometry,) and subsequently "Davies' Bourdon," (Algebra.) Other treatises were prepared on his own plan, and thus, for many years, Professor Davies pursued the quiet and laborious task (independent of other avocations,) of preparing an entire course of mathematical text-books. In time he modified these again, so as to fit them for the best colleges, and the higher schools. From the smallest mental arithmetic, to the profoundest treatise on the Calculus, he has produced clear and admirable text-books on every topic of mathematical studies. Many other good books have been prepared by professors in colleges, but there is no part of the United States in which some one of Davies' works is not taught in schools and colleges. Gradually, the civil institutions have been, in some degree, brought up to the standard of West Point, in mathematical studies.

In more recent years, Professor BARTLETT has published his treatise on Optics; Professor CHURCH, on the CALCULUS, and Professor MAHAN, on Field Fortification, and a treatise on Civil Engineering. Various other works on military subjects have been contributed to the stock of knowledge, by graduates of the Academy.*

Thus have the graduates of West Point, by disseminating in text-books, and teaching the higher knowledge, and better methods pursued there, in fact, and beyond dispute, *elevated the entire standard of education in this country.* Contrast, for example, the text-books of Day, Hutton, Enfield, Gregory, &c., which were the only ones to be had on mathematical science in 1818, with those now in use at West Point, New Haven, or Princeton. Contrast the methods of

* The authorship of West Point has been quite extensive; too much so to enumerate here. Among the works of its graduates, we may mention the "Political Manual," "American Education," and Statistical Reports by Edward D. Mansfield, the "Review of Edwards on the Will," by A. T. Bledsoe, and the Military Tactics of Generals McClellan, and Halleck. The Educational Works of Mr. Mansfield have been before the public for many years, and studied in all parts of the United States. In this class also may be mentioned the editorial labors of some twenty of the graduates, some of whom have had no small influence on public affairs.

study before the blackboard, the art of drawing, the system of rigid demonstration, and of exact scales of merit were introduced, with those now in use in the higher schools of science, and we shall be satisfied that West Point has done a great and most useful work in elevating the standard of education. This is one fruit of its production, which has been altogether too lightly estimated. If it be of importance to increase the number of blades of grass, it is of much more importance to increase the number of minds fitted to enjoy the works of God, and use beneficially the gifts with which he has intrusted them.

A more obvious and commonly remarked fruit of West Point, is the *men*, laboring in their vocations, which it has produced. It is impossible here, (though it would be a labor of love,) to note the individual examples of merit and usefulness, among those whom West Point has sent into the service of their country. We are here limited rather to a statement of general results. It may be done briefly; and since we have seen no Register later than 1850, we must deal in round numbers. These, however, will approximate the precise facts. They are there statistically:—

Whole number of Graduates, (about)	2,000.
Killed in battle,	80.
Died in service,	300.
In military service of the United States now,	800.
Have been in political service (ministers, governors,) mayors, and members of congress, and of legislature,	80.
Other civil and state offices,	100.
Lawyers,	110.
Clergymen, (including two bishops,)	16.
Physicians,	110.
President of colleges, professors and teachers,	100.
Authors, editors, and artists,	25.
Civil engineers, and officers of R. R. and canals,	180.
Merchants, financiers, farmers, and manufacturers,	140.
Officers of militia, and volunteers, (not of the army,)	110.

Numbers have resigned, and died young, not above enumerated, and numbers of these also have died in the civil service. We have made this classification to show how largely West Point has contributed to education, civil engineering, and the professions. These were not the direct objects of the Academy; but, when long years

of peace presented no duties but that of the garrison, and no glory to the profession of arms, it was natural and proper for active and ambitious young men to seek honor and usefulness in other pursuits. Nor did the government discourage this, for it foresaw what has happened, that these young men, so highly educated in science, would diffuse this knowledge throughout the country; elevate the standard of education, and be ready when their country needed their services. This has happened. A better knowledge of the exact sciences has been carried into the colleges; the railroads and canals have been built by engineers ready furnished by the government; and now when half a million of men have been suddenly called to war, they have been largely officered by the graduates of West Point. Here we may briefly allude to the most grave fact which has been urged against the Military Academy. The best officers of the rebel army were educated there. Why is this? Is there a want of sound morals? or, is loyalty no virtue there? Neither. A part, and *a part only** of the graduates born and grown up in the south, have gone with their friends, families, and connections, into the rebel service. This was on account of social ties, and had no more to do with West Point, than had other rebels from Harvard, or Yale, with those institutions. The noticeable fact is that they were educated at the government expense, and therefore under peculiar obligations to the country. But we find a parallel in the numerous officers of the state, as well as of the army and navy, who had been honored and rewarded at the public expense, but who thought it no shame to betray their country, and conspire against its life. We in vain attempt to account for such crimes, except upon the principle of common depravity, of which history has furnished similar examples in all ages of the world.

We have come to the end of the work we proposed. The rise, progress, and fruits of the Military Academy, we have briefly, and, we trust, justly delineated. Certainly, we have no end to serve, no prejudice to gratify. We knew the Academy in its early and immature period. We have seen it grow up to usefulness and honor. We see its graduates taking their places among those who have well served their country, and well deserved its laurels. In this we are *glad*. But our memory is filled with other images. We see West Point, in the now lengthening shadows of time. We seem to see those with whom we studied freshly present, as they

* We should not forget that a large number of West Point graduates from the south, (Maryland, Virginia, Carolina, and Tennessee,) have remained *loyal*, in spite of all the influences of social and political ties.

walk the green plain, or sit before the class, or strive to teach our dull and inattentive minds. They were men worth remembering, and when, in after times, we became their friends, rather than their pupils, still more pleasant memories gathered around them. We seem to see the venerable Ellicott, like Goldsmith's schoolmaster, alike full of learning, and of kindly humor; the placid and intellectual expression of Mansfield, whose abstracted looks seemed to be searching the higher philosophy; the courtly and dignified Thayer, whose graceful manners and attractive conversation can not be forgotten by any who knew him; and the amiable Courtnay, who though of later date, will long be remembered. He left the world in doubt, whether he was the better scholar or the better man.*

Of these, and of those like them, do we think, when we think of West Point. Nor of those alone; the place itself, where nature delights in the sublime and beautiful, rises before us. No imagination is necessary to clothe it with the hues of poetry; no books to recall the lost passages of history; no labored eulogy to bring up the memories of the dead. You can no more forget them, than you can the Pilgrims, when standing by the rock of Plymouth. Yon gray and moss-covered ruin was once the fortress of the Revolution. Yon scarcely perceptible pile of stones marks the spot where its soldiers were hutted in the winter. Yon slightly raised turf, beneath the dark shades of the cedar, was his grave, and soon, perhaps even now, that slight memorial will be gone forever. Yon little valley under the shadows of the mountain, recalls the illustrious name of Washington. Yon blue mountain-top tells of the beacon fires he lit. All around are memories; all around are sacred spots. If the Greek remembers Marathon; if the Jew lingers at Jerusalem, or the Christian pilgrim grows warm at Bethlehem, so should the American remember West Point; linger round the ruins of Fort Put, and gaze with delight on the blue summit of Beacon Hill.

* Mr. Courtnay was afterwards Professor of Philosophy and Mechanics in the University of Virginia. There he died, lamented by all who knew him.

DEVELOPMENT OF INSTRUCTION AT WEST POINT.

1. Down to 1802, the instruction of the Cadets attached to the Corps of Artillerists and Engineers stationed at West Point, according to Act of Congress (May 7th, which was all that repeated recommendations of Washington and other experienced officers could obtain), was confined to military drill and practical exercises in common with other members of the Corps; but as that Corps was made up of the scientific officers of the army, and as military works were in construction under their plans and superintendence, these exercises were of great practical value, and the appointment of these Cadets in 1794, and their gathering at West Point, may be regarded as the nucleus of the Military Academy.

2. The Military Academy, established with that name, by Act of March 16, 1802, in pursuance of a Bill reported in 1800, by the Committee of Defense in the House of Representatives, of which Harrison Gray Otis was chairman, and to which an elaborate report of the Secretary of War (James McHenry, of Maryland), had been referred—consisted of the Corps of Engineers, which by the Act was organized distinct from that of Artillery, and could not exceed in officers and cadets, twenty members. The Corps was stationed at West Point, and its officers and cadets were subject to duty in such places as the President should direct. The principal engineer was made superintendent, and down to 1808 he was instructor in fortifications, field-works, and the use of instruments. Two officers of the rank of captain, appointed without previous military experience, but with special reference to their knowledge of mathematics, gave instruction in that branch, "one in the line of geometrical, and the other of algebraic demonstration."

In 1803, two teacherships—one of the French language and the other of Drawing, was attached to the Corps of Engineers, and in 1804, F. De Masson was appointed to discharge the duties of both.

In 1808, the basis of the Military Academy, so far as related to the number of Cadets, was enlarged by the addition of two for each new company of Infantry, Riflemen, and Artillery, added to the military force; and the number in the Act of 1812, is limited to 250, which with the ten originally attached to the Corps of Engineers, fixed the strength of the Cadets at 260.

By the Act of April 29, 1812, the Corps of Engineers was enlarged, and was again constituted the Military Academy, and in addition to the teacher of the French language, and Drawing, provided in Act of Feb. 28, 1803, one Professor of Natural and Exper-

imental Philosophy; one Professor of Mathematics; one Professor of Engineering in all its branches; and for each an Assistant Professor taken from the most prominent characters of the officers or cadets, are provided for; and for the purposes of military instruction, it is ordered that the students shall be arranged into companies and officered from their own members, to be taught all the duties of a private, non-commissioned officer, and officer; and for instruction in all matters incident to a regular camp, shall go into camp for at least three months of each year, and erecting buildings and providing apparatus, library, and all necessary implements, the sum of $25,000 is appropriated. By this act the minimum of age is fixed at 14, and the literary qualifications of candidates on entering are to be well versed in reading, writing, and arithmetic.

III. CONDITION IN 1871.

1. GOVERNMENT AND ORGANIZATION.*

A MILITARY officer, not usually below the rank of colonel, is appointed by the President of the United States as *superintendent* of the Academy, who has supreme local control over both the studies and discipline of the institution. He renders all prescribed returns, and addresses his communications to the *inspector*.

The *inspector* of the Academy is an officer of rank in the army named by the Secretary of War, who has his residence at Washington, and through whom all general orders relating to the Academy are transmitted to the superintendent at West Point. He makes an inspection of the Academy at least once in each year.†

The general staff of the Academy consists of an adjutant, a quartermaster, a treasurer, one surgeon, and two assistant surgeons.

Although the system of the Academy as regards the training of the cadets both in and out of study is peculiarly and rigidly military, the staff of instruction is separate from the staff of discipline.

Military Staff.

The cadets are organized into a battalion of four companies.

The *commandant of cadets*, usually not under the rank of lieutenant-colonel in the army, exercises the immediate command of the battalion. He is also, *ex officio*, principal instructor in infantry, artillery, and cavalry *tactics* (signifying drill).

Under the commandant are six *assistant instructors of tactics*, viz.—one for artillery; two for infantry; one for cavalry; one for artillery and infantry; one for infantry and cavalry. The four senior of these officers command the four cadet companies respectively; the two junior officers being always available to perform the routine duties of the others in case of absence. The assistant instructors must be officers of the army.

The battalion is provided with a full complement of *cadet* officers, and non-commissioned officers, who are appointed by the superintendent from a list submitted by the commandant of cadets.

To each company are appointed

1 Captain,
3 Lieutenants,
1 First Sergeant,
3 Second Sergeants,
4 Corporals.

* From Instructions for government of the U. S. Military Academy, Report of Board of Visitors for 1871, and an account by Col. McDougall in Report of English Military Commission.

† The duties of Inspector are now (1871) discharged directly by the Secretary.

The battalion staff consists of

1 Adjutant,	1 Sergeant Major,
1 Quartermaster,	1 Quartermaster Sergeant,

The cadet companies are composed indiscriminately of the four classes into which the students are divided according to their respective years of residence, the period of residence being four years for all.

The cadet officers are taken from the first, or senior class; the sergeants from the second class; the corporals from the third class. The selection is not made with special reference to proficiency in study. Those are selected who have manifested the greatest military aptitude and respect for discipline in their own conduct; although *cæteris paribus* superior standing in study would be decisive.

Staff of Instruction

The general superintendence of the studies is exercised by the superintendent, acting with the Academic Board. The immediate staff of instruction is as follows:

One professor, One assistant professor, Two acting assistant professors,	Military and civil engineering.
One professor, One assistant professor, Two acting assistant professors,	Natural and experimental philosophy.
One professor, One assistant professor, Five acting assistant professors,	Mathematics.
One professor, One assistant professor, One acting assistant professor,	Drawing.
One professor, One assistant professor, Three acting assistant professors,	French.
One professor, One assistant professor, One acting assistant professor,	Spanish.
One professor, One assistant professor, One acting assistant professor,	Ethics and Law.
One professor, One assistant professor, Two acting assistant professors,	Chemistry, mineralogy, and geology.
One instructor, One assistant instructor,	Ordnance and gunnery.
One instructor, One assistant instructor,	Practical military engineering. Military signals and telegraphing.
One sword master.	

The Academic Board consists of the Superintendent, the Commandant of Cadets, the Professors of the Academy, and the Instructors of Practical Military Engineering, and of Ordnance and Gunnery.

All the professors and instructors, with their assistants and acting assistants, have been educated at West Point, with exception of the chaplain, the professors of French and Spanish, and the sword master. All are regularly enrolled in the military service of the United States, and subject to military discipline.

Professors and Assistants.

The professor or chief instructor in each branch is responsible for the efficiency and uniformity of the system of instruction in his own department. To this end he has no special class or section assigned to him for tuition. His time is devoted to general superintendence, and is chiefly spent in visiting the halls of study of his assistants. He does, however, take the instruction of the different sections, each in their turn, as he sees fit, and occasionally assembles all the sections of his department for lecture.

The assistant and acting assistant professors or instructors are always appointed from among officers on the full pay of their regiments who have graduated at the Academy, on the recommendation of the professor or chief instructor of the branch in which there is a vacancy to be filled. These assistants are carefully selected through means of the data of their proficiency, temper, and general character, afforded by their record of four years' residence as cadets. They are, thus, all of them previously well known to the professors to whom they are to act as assistants, and to whom they are naturally inclined to defer from old associations.

The term of duty at the Academy of the assistant and acting assistant professors and instructors is fixed at four years, at the end of which period they return to regimental service. Duty at the Academy is obligatory on every officer who may be selected for it, and is considered as part of the general service which every officer who has graduated at West Point, owes to the country; practically those only are selected to whom the duty is not disagreeable.

Admission

Each congressional or territorial district of the United States (*i. e.* each district entitled to return a member to Congress), is by law entitled to have one cadet receiving education at the Academy.

The nominations are made in each year by the Secretary of War, on the recommendation of the representatives in Congress of the several districts then unrepresented at the Academy, or whose

representatives are about to quit the Academy. In addition to these, the President of the United States may nominate ten cadets in each year, to be selected according to his own will and pleasure, from the community at large.

The number of vacancies at West Point in any one year varies according to the number of cadets who happen to complete their period of residence, and of those, who, not having completed their term, are yet discharged as deficient in studies or discipline, as hereafter explained. The number of yearly admissions varies from 50 to 70.

The date of admission in each year is the 1st of July, and the candidate for admission is required to report in person to the superintendent before the 31st of May, with a view to his qualifications being tested. But if sickness or any other unavoidable cause should interfere, he may present himself on the 28th of August. Except at the two periods above named, no admissions can take place.

Candidates must be over 17 and under 22 years of age, except in the case of any candidate who may have served faithfully as an officer or enlisted man in the army of the United States, either as a volunteer or in the regular service during the late civil war, who may be admitted up to 24 years of age.

Candidates must be at least five feet in height; free from any deformity, disease, or infirmity which would render them unfit for military service; and from any disorders of an infectious or immoral nature. They must be able to read and write well, and be thoroughly versed in the first four rules of arithmetic, in reduction, in simple and compound proportion, and in vulgar and decimal fractions.

Although the examination for entrance is not difficult, the prescribed tests, both medical and intellectual, are rigidly applied, and many candidates are rejected.

The examination for entrance is not competitive, but simply a qualifying examination. The competitive system commences after a cadet is once admitted; it enters into every branch of instruction, and continues in full force to the end of his residence.

Subjects and Course of Study.

The length of the course of study, for all who may succeed in graduating, is four years; its nature, after the first year, is principally professional, and the course of study is identical for all the students. The subjects are not all studied simultaneously, separate periods of the course being devoted to certain subjects, as shown by the time tables annexed.

The relative importance of the different subjects is indicated by

the maximum marks of merit assigned to them respectively, at the summing up of the results of each student's attendance at the end of his fourth year, according to the following scale:—

Subjects.	Maximum.	Period of Attendance.
Mathematics,	300	2 years
Natural and experimental philosophy,	300	1 year.
Military and civil engineering,	300	1 "
Chemical physics and chemistry,	150	1 "
Ethics and law,	150	1 "
French,	100	2 years.
Drawing,	100	2 "
Spanish,	75	1 year.
Mineralogy and geology,	75	1 "
Ordnance and gunnery,	75	1 "
Infantry tactics (theory),	50	1 "
Artillery " "	50	1 "
Cavalry " "	50	1 "
Discipline,	300	
General merit,	2,075	

Practical instruction in surveying; in fortification; in ordnance and gunnery, including the loading, pointing, and firing heavy guns; in drill, or, as it is termed, the tactics of the three arms; in interior economy and regimental duty; forms an important part of the training of the cadet at different periods during his residence. In addition, the months of July and August in each year are entirely devoted to practical instruction, the battalion being then placed under canvas and relieved from all study.

During his first year a cadet receives instruction in fencing three hours in each week, from 15th October to 1st April.

During his second year he receives instruction in riding three hours in each week, from 1st November to 15th March.

Throughout the whole of his third academic year, from 1st October to 1st July, he receives instruction in riding, excepting between the 1st February and 15th April.

Throughout the whole of his fourth academic year he receives instruction in riding, three days in each week.

Swimming is not taught at the Academy. There is a good gymnasium for the use of the cadets in recreation hours, but the practice of gymnastics is purely voluntary.

Classification for Instruction.

The cadets are ranged in four distinct classes, corresponding with the four years of residence. Cadets of the first year constitute the fourth class; those of the second year, the third class; and so on. Cadets are promoted from one class to another at the end of the academic year, 30th June; provided only that they shall have

passed satisfactorily before the Academic Board in the examinations which are always held during June, failing in which, they are either kept back in their then class for another year, or, in the case of decided deficiency, discharged from the Academy.

Each class is divided into sections convenient for instruction in the different branches of study. The method of division will be best explained by taking the fourth or lowest class as an example.

The members of the fourth class are, on their admission to the Academy, arranged in alphabetical order, and are then formed into sections, averaging about 12 cadets for each branch of study. After the lapse of a month, transfers are made at the close of each week from one section to another, according to the results of the past week's attendance in study, and so continue until those most advanced are found in the first section; the next in order, in the second section; and so on.

During the first six months of residence, cadets are on probation, and only receive their *warrant* as cadets, provided they shall have passed satisfactorily at the January examinations held before the Academic Board, and that their conduct shall have been satisfactory.

Before receiving his *warrant*, each cadet is required to sign an engagement of service in the United States army for eight years, and to take an oath of allegiance to the National Government and Constitution.

The hours allotted to study are divided nearly equally between attendance on the instructors in the halls of study—or *section rooms*, as they are termed—and independent study in quarters. The attendance in the section rooms is termed *recitation;* the independent study in quarters, *study*.

The theory is, that during each recitation, every cadet of the section attending it, shall receive a thorough *viva voce* examination illustrated on the blackboard, and there is not much practical variation therefrom. Where there is any departure from it, it arises from the number of cadets in a section being too large to enable them all to be examined during the same recitation, which lasts an hour and a half, or an hour, according to the subject. Recitations in mathematics, in natural and experimental philosophy, and in civil and military engineering, occupy one hour and a half; in all the other branches of instruction, only one hour. Thus, when it appears in the time table that a class attends mathematics, for example, from 8 to 11, it is to be understood that the sections forming one half of the class attend their respective teachers in the section rooms during an hour and a half, while the other half of the class

is engaged in study in quarters. At the end of the first hour and a half those sections which have attended recitation return to their quarters to study, while their places are taken by the remaining sections which have been up to that time engaged in study in quarters.

Each teacher, as a general rule, has two sections specially assigned to him for instruction, excepting the professor or head of each department who, as has been already explained, devotes his time to general superintendence, and takes the different sections for his personal instruction at such times and in such order as he may judge best.

Before proceeding to the section rooms the different sections parade in the barrack square by sound of bugle, under the superintendence of the cadet *officer of the day;* the roll is then called by the senior cadet, who is termed the *section marcher*, who reports absentees to the officer of the day, and marches his section off to the section room by direction of the latter. Arrived in the section room, the section marcher causes the cadets to take their seats in the order of their names on the roll, and then hands them over to the instructor. When dismissed by the instructor, the section marcher forms his section as before, marches it back to the barrack square, reports all infractions of discipline which may have taken place either in study or on the march to the officer of the day, and then dismisses his section by the latter's permission.

There is no system of private tuition recognized at the Academy. Each cadet must depend on his own exertions, aided by the explanations given by the instructors in the section rooms, and by the occasional assistance he may derive from his more advanced comrades.

The allotment of so large a portion of time to independent study is a great departure from the practice of military schools in Europe; and it is a remarkable feature in the West Point system that no continued supervision is exercised over the cadets when studying in quarters beyond that which is supplied by the discipline of the cadets themselves. The senior of the two cadets inhabiting each room is responsible for discipline and orderly behavior. The officer of the day (cadet) visits each room during the hours of independent study; and the *officer in charge*, who is detailed daily from the assistant instructors of tactics, also visits the rooms at his discretion.

Routine of Daily Work.

A full-dress parade of the battalion takes place every day at sunset, after which the cadets are marched to supper, the hour of which

varies with the season of the year, but is never earlier than 5.30 p. m. Half an hour after supper the evening call to quarters is sounded for study in barracks until tattoo at 9.30. All cadets excepting officers, the non-commissioned officers of the battalion staff, and the first sergeants, must be in bed and their lights extinguished at 10 p. m., the hour for the signal of *Taps*.

The arrangement of time on Sundays is as follows:

Breakfast at 7 a. m.
Full-dress parade and inspection at 8.
Call to quarters for *study in barracks* at 9.
Church call at 10.30.
Recreation after church.
Dinner at 1 p. m.
Recreation.
Call to quarters for study, 3 to 5 p. m.
After 5 p. m. the arrangement of time is the same as on a week day.

Cadets may obtain leave from the Sunday afternoon study in barracks to attend church a second time, should they desire it.

There is no yearly vacation. When a youth enters West Point, he is fixed there, unless discharged, for four years without intermission, with the exception of two months' furlough which he may obtain at the end of his second year on certain conditions, and which is subject to a scale of diminution graduated according to misconduct.

This discipline would be intolerably severe but for the relaxation afforded by the change from barracks and the section room to camp life. The battalion is encamped from about 20th June to 30th August, and during that period the time is exclusively devoted to military exercises, practical instruction, and amusement.

Proficiency in Study—Examinations.

The system of estimating proficiency in the different subjects studied is very elaborate. Each instructor keeps daily notes of the proficiency of the cadets forming the sections of which he has the charge; the degree of excellence shown by a cadet at any recitation being recorded by marks, 3 being the maximum for each lesson, which represents *thorough* proficiency; 2 · 5 signifies *good;* 2 *fair;* 1 · 5 *tolerable;* 1 *very imperfect;* any thing below 1 is recorded as 0, or complete failure.

A weekly report showing the daily credit of each cadet and the aggregate for the week, is handed in by each instructor to the professor or head of his department at the end of the last study on Saturday, and the professor personally delivers the weekly reports of his department to the superintendent at the office of the latter between the hours of 12 and 2 p. m. on the same day. The pro-

fessor at the same time recommends such transfers of students from section to section as he may think proper. The aggregate weekly credits of each cadet in all the branches of instruction are then recorded in the superintendent's office.

From the weekly class reports, and the monthly record of discipline, a consolidated report of the progress of the Academy is made up monthly and forwarded to the inspector of the Academy, who transmits an abstract of the same to the parent or guardian of each cadet.

The weekly class reports form the most important element in determining the relative standing of the cadets in their class at the period of graduation, but a verifying test, or corrective, is supplied by the examinations which take place in January and June, the method of conducting which is as follows:

The January examinations commence on the 2d of the month. The examination of the 4th or lowest class is conducted by the whole Academic Board, the constitution of which has been already detailed. The relative standing of the members of the fourth class, up to that time arranged alphabetically, is then determined by the summing up of the weekly class reports, verified or corrected by the results of the examination. A large proportion of the cadets of the fourth class, usually from one-sixth to one-eighth of the whole, are yearly pronounced to be *deficient*, and removed from the Academy at this their first examination, which on account of its importance is required to be conducted by the whole Academic Board. The examinations of the three other classes take place before committees of the Academic Board, the whole Board being divided into two committees for this purpose.

The June, or *annual* examinations, commence on the first of the month. The first or graduating class alone is examined by the entire Academic Board, and the final relative standing of the cadets determined. The remaining classes are examined before the two committees of the Academic Board.

The June examinations take place in the presence of the *Board of Visitors*, the members of which are specially appointed in each year by the President of the United States, and whose duty it is to report to the Secretary of War, for the information of Congress, on the state of discipline, instruction, &c., &c., of the Academy.

The senior assistant professor or instructor of the branch under examination is *ex officio* a member of the Academic Board or of the committee thereof which conducts such examination; and the immediate instructor of the section to be examined is likewise associ-

ated with the Board or its committee so far as relates to the examination itself and the arrangement of the section in order of merit.

Classification according to Marks.

To assist the Academic Board in determining the accurate classification of any section about to be examined, the immediate instructor of that section hands to the Board, before the examination commences, a roll in the order of merit in which he considers the members should stand, based on the weekly credits which he had himself assigned.

At the close of the examination the same instructor hands to the Board a second roll in the order in which he conceives the members of the section should stand, judging by the result of the examination. The instructor then retires and the Board proceeds to deliberate.

Each member of the Board having kept careful notes of the examination, the relative standing of the cadets of a section in proficiency is determined by discussion.

The question next arises, who, if any, are to be pronounced *deficient?*—a dictum which inevitably entails discharge from the Academy, or putting down to a lower class.

The different sections composing the class, having been arranged in one class list in order of merit; one of the Board, usually the professor of the department concerned, supposing *e. g.* the class to consist of 50 members, may move that No. 50 be declared deficient. If the motion is negatived on discussion, the salvation of No. 50 proves also the salvation of all standing above him. But if the motion be carried, Nos. 49, 48, 47, &c., may be pronounced deficient in like manner, and so on, until a number is reached which is not condemned.

The examinations are entirely *vivâ voce*. Each cadet is subjected to a searching oral examination of from seven to ten minutes, illustrated on the blackboard where the subject admits of it. The daily record of the proficiency of a cadet in any subject forms, as already stated, by far the most important element in fixing his relative standing among his classmates: it is only exceptionally that the public examinations alter materially the order of merit which has been previously framed from the weekly class reports.

At the close of each examination the Academic Board reports to the Secretary of War the names of all cadets who are pronounced deficient in studies or discipline, to be discharged from the Academy unless otherwise recommended by the Academic Board.

The rule of discharge for deficiency, even in one solitary subject,

is very rigidly enforced; unless where exceptional circumstances, such as loss of time on account of illness, or having been unavoidably prevented from joining the Academy until some time after the rest of his class, induce the Board to recommend that the cadet shall have another trial by being put back to the next lower class.

Some detail is necessary to explain how the marks obtained by a cadet at the daily recitations are employed to determine the credit he is to receive in any given branch of study at the period of his graduation.

Where a subject is studied for two years, the maximum time allotted to any branch of study, the marks gained during the first year help only to fix a cadet's relative standing in his class for the year next ensuing. The credits shown by the weekly class reports of the second year alone are taken into account in determining the credit due to a cadet at the end of his residence.

The exact method of fixing the credits due for any one subject is as follows. The professor makes out a roll of the class in the order of merit finally fixed by the Academic Board at the June examinations. The first on the roll then receives credit for the maximum number of marks allotted to the subject; the last on the roll receives a credit of one-third of that maximum only. The *common difference* for all the members of the class between those limits is then calculated, and the remaining members receive credits varying from the first cadet and from each other by the amount of that common difference. The figures thus determined represent the credits assigned for any one subject at the period of graduation, and the figure of general merit for each cadet is made up of the aggregate credits obtained by him for all the branches of study, with one column included for discipline.

Proficiency in drill or riding does not affect the figure of general merit, except indirectly. Inattention or carelessness at these exercises would be noted by a certain figure of demerit, and would thereby diminish, as will be hereafter explained, the credit to be allotted for discipline at the final examination.

Graduation.

The qualifications required for obtaining an appointment to the army are simply *graduation*, or in other words that a cadet shall have passed through the four years' course at the Academy without being found *deficient* in any one branch of study or in discipline. The proportion of cadets who fail to graduate is very considerable—nearly one-half. The present first class is a fair sample. It num-

bered 74 on entrance, and its members are now only 39, and of these three had belonged to the next higher class, and were put back for deficiency. From 1842 to 1852 the exact proportion who succeeded in graduating was 0 · 510. From 1852 to 1862 the exact proportion was 0 · 523.

Although the ultimate consequences of idleness in being declared *deficient* at the half-yearly examinations are generally sufficient to insure diligence, an immediate penalty is attached to any adverse report against a cadet for want of attention to study, or any misconduct in the recitation halls. The instructor of any section notes on his weekly class reports any cases of decided idleness and all infractions of discipline, and to each reported instance a double penalty is attached, as to every instance of misconduct at the Academy; the one immediate, in punishment according to the scale of the offense; the other prospective, consisting of a certain figure of demerit, which will rise up in judgment against the delinquent at the end of his residence, and diminish his credit for *discipline*.

The *certainty* of the penalty which attaches to idleness, both in the immediate punishment it entails, and its more serious ultimate consequences, is found to be sufficient, as a general rule, to attain the desired object; hence the character of the cadets for diligence is decidedly high.

The members of the graduating class have their choice of the services to which they shall be appointed according to their standing on the roll in order of merit. The order of precedence of corps of the United States army is: 1, Engineers; 2, Ordnance; 3, Artillery; 4, Cavalry and Infantry; and that is, as a general rule, the order of choice. The Secretary of War may sanction subsequent transfers from one branch of the service to another, but such transfers are very rare.

Beyond the privilege of choice, the only direct inducement held out to distinction among his classmates to any cadet, is one which is purely honorary. By an order from the Secretary of War so early as the year 1818, the five cadets most distinguished in studies and discipline in each class at the June examinations, are published each year in the United States Army Register (Army List). The distinction is highly prized.

The advantages resulting from a degree or peculiar distinction at West Point after appointment to the army, in respect to professional advancement or the obtaining staff employment, are very small. No special qualification is required by law or regulation for admission to the staff. When a vacancy occurs any one who desires may

make application for the vacant appointment to the Adjutant General of the army. The decision rests with the Secretary of War or the President. The head of the department in which the vacancy exists is the proper person to insist, if he thinks proper, on the possession of certain qualifications by the officer who is to be employed as his subordinate. Even graduation at West Point is not insisted on as a necessary qualification for staff employment.

Discipline.

Every young gentleman who passes his probationary examination in the January after his admission, receives his *warrant of cadet*, and signs an engagement to serve in the military force of the United States during the eight years next ensuing. He thus becomes amenable to the articles of War and to trial by court-martial.

The discipline of the Academy has no resemblance to that of an ordinary civil college, but is peculiarly and essentially military. The cadets are required to clean their own rooms, make their own beds, and clean their own arms and belts.

The staff for the maintenance of discipline is distinct from that of tuition. The professorial staff simply report infractions of discipline in study, but have no power to punish. All professors and instructors, however, as well as all military officers who may be stationed at West Point, are expected to report to the superintendent any improper conduct on the part of a cadet which may come under their observation.

The punishments to which a cadet is liable are comprised in the three classes following, viz.:—

1st. Privation of recreation, &c.; extra duty (not guard); reprimands; arrests or confinement to barrack room or tent; confinement in light prison. *Inflicted only by the superintendent or by his authority.*

2d. Confinement in dark prison. *Only by sentence of court-martial, and seldom or never resorted to.*

3d. Suspension; dismissal with privilege of resigning; public dismissal. *Only by sentence of a garrison or general court-martial, which must be approved by the Secretary of War.*

"Breach of arrest" is treated as a military offense of the worst nature, and is classified with "mutinous conduct."

All offenses are classified under five heads, and are recorded according to the following scale:

An offense of the	1st	class counts.....	5	demerit.
"	2d	"	4	"
"	3d	"	3	"
"	4th	"	2	"
"	5th	"	1	"

All offenses reported or to be reported against cadets, are read out at evening parade on the day after commission, excepting offenses in the section rooms reported by the instructors, which are read out on Monday evening's parade; so that every cadet may have the opportunity of presenting a written explanation, or plea, in extenuation, of the offense charged against him.

The commandant of cadets attends at his office, in the square of the cadet barracks, between the hours of breakfast and the first study every morning to receive reports of offenses.

Explanations in writing, on paper of prescribed uniform size, may be taken to the commandant by any cadet charged with an offense not later than the commandant's second orderly hour after publication, as a general rule from which any departure requires to be explained.

If the commandant considers the excuse satisfactory, he erases the offense and tears up the excuse, but forwards an abstract of all offenses which have not been explained to his satisfaction, with the written explanations, for the decision of the superintendent.

The superintendent may, on further inquiry, find the explanations of some of the offenses forwarded satisfactory, in which case he erases such offenses. To the remainder he allots such immediate punishment, and such marks of demerit in addition, as the cases respectively justify; or he may consider the demerit marks sufficient without any immediate punishment.

Thus the offenses of which a cadet may be guilty during his residence are recorded against him by a very elaborate and just method, and rise up against him at the period of his graduation. No instance of carelessness or inattention to orders is too trifling to be taken notice of.

If any cadet has more than 100 demerit recorded against him in any six successive months, he is immediately discharged from the Academy as deficient in discipline.

But during the first year's residence, offenses count one-third less than those committed during the subsequent three years; a cadet of the first year would therefore only be discharged as deficient in discipline who had obtained a demerit of 150 within any period of six successive months.

The marks of demerit of all the fourth class cadets who have not proved deficient in discipline, are wiped out entirely at the end of their first year, and do not therefore affect their relative standing at the period of graduation. The demerit of the first year is only taken into account, so as to determine, in combination with the

credits received for progress in study, the relative standing of the cadets in their class for the year next ensuing.

At the final examination, the credit to be allotted to any cadet on the score of discipline is made up by means of the demerit rolls as follows.

Each cadet receives a credit of 16·67 for every month during his residence, in which he has had no demerit recorded against him, to be deducted from his aggregate marks of demerit at the end of his residence. The monthly credit is fixed at 16·67, because that number forms the sixth part of the 100 marks of demerit, which if recorded in six months against any cadet would have occasioned his discharge.

Notwithstanding that the demerit marks of the fourth class are wiped out at the end of the first year, and do not count against the cadets at their final examination, the credit of 16·67 is still allowed to cadets for every month of their first year in which no demerit was recorded against them and deducted from their aggregate marks of demerit at the end of their residence.

The positive marks of merit for discipline due to any cadet at the end of his residence are thus determined. The cadet of the graduating class having the lowest aggregate demerit recorded against him is placed *first* in discipline, and is credited with the maximum of marks due to that subject, viz., 300. The whole class is then arranged in the same sense, the cadet having the highest demerit being placed last, and receiving only one third of the maximum, viz. 100. The common difference between these limits is then calculated for each cadet of the class, and applied as already explained.

Although the nominal value placed on discipline is represented by the same number of marks only as are allotted to each of the more important branches of study, in fixing the relative standing of cadets at their final examination; it should be remembered that no candidate can reach that period at the Academy who is not fairly well conducted. It would be quite impossible for any cadet to remain at the Academy who had earned for himself the sentence "deficient in discipline," even though the marks of demerit required for that sentence might have been earned by a succession of minor infractions of discipline. And a cadet who might be guilty of any serious willful offense would be at once removed from the Academy.

Owing to the very limited time allowed for recreation, games are almost unknown; and almost the only athletic amusement indulged

in is boating on the river, for which, however, Saturday afternoons afford the only available time.

No difficulty is found to arise from the difference of age among the cadets in maintaining an uniform system of discipline. The same rules are applied to all during the whole period of residence.

The cadet officers and non-commissioned officers greatly assist in maintaining discipline. A daily abstract of offenses show that out of 15 offenses recorded therein, 11 were reported by cadet officers or non-commissioned officers.

The daily duties are assimilated as much as possible to those of a battalion in quarters, and are as follows:

The officer in charge, detailed daily from the assistant instructors of tactics, is responsible for the proper performance of all the military duties of the battalion during the day. His tour of duty commences at guard mounting (7.30 a. m. in barracks, 8 a. m. in camp), at which time he reports for orders to the commandant at the office of the latter. He has an office adjoining that of the commandant where he must constantly be present from *reveillé* to *taps* (the signal for putting out lights at 10 p. m.), except when absent on duty or at meals. He is present in the cadets' mess hall during all meals, and superintends every parade and roll call. He visits the sentries at his discretion. On being relieved, he includes in the usual morning report of his company, all offenses which may have come to his knowledge as having occurred during his tour of duty.

The officer of the day, is detailed usually from the roster of the cadet officers, although every cadet of the highest class is appointed at least once to perform this duty. He is present at guard mounting and receives his guard in the usual military manner, after which he reports for order to the commandant and is generally under the orders of *the officer in charge*. His post of duty is the guard room, which is in the same building as, and immediately beneath, the offices of the commandant and the officer in charge. He causes all calls to be sounded at the proper time; is present at all parades and roll calls; and receives reports of all absentees, whom it is his duty immediately thereafter to seek and to order when found to repair to their respective duties unless properly excused. He reports to the officer in charge all absentees whom he may not be able to find, and all cadets who fail to obey his orders. He directs the formation of all the class sections before marching to the section rooms; receives reports of absentees from the section marchers, and requires the latter to march off their sections in a proper military manner. He is responsible for the suppression of

all irregularities in quarters or their vicinity during his tour. He visits the quarters during the hours of independent study and receives reports of absentees. He visits all the quarters at *Taps*, and reports absentees to the officers in charge. He afterwards visits the room of every cadet absent every 15 minutes until the return of the absentee, or until otherwise directed by the officer in charge. On the back of the guard report which he forwards next morning to the commandant, he records all offenses which come to his knowledge as having occurred during his tour; and presents with it all permits and passes that have come into his hands, all of which are required to be deposited with him. The officer of the day is relieved from study during his tour of duty.

Daily Guard.—A cadet guard, consisting of one sergeant, four corporals, and 24 privates, is mounted every morning at 7.30. The cadets of the guard remain in the guard-room during the day, excepting the hours of study.

Sentries are posted during the hours of recreation, the most important posts being the different entrance halls of the cadet barracks. Ten minutes after the *call to quarters*, during the day on Sundays, and every evening, it is the duty of each such sentry to visit all the rooms belonging to his particular entrance hall. He then orders all cadets whom he may find visiting in rooms not their own to their proper quarters, and reports all who fail to comply promptly with his orders to the sergeant of the guard, as well as all absentees; and the sergeant of the guard passes on all such reports to the officer of the day. A sentry similarly reports every irregularity that may occur on his beat, and particularly the name of any cadet who may have absented himself from the barracks for more than ten minutes. A high sense of the honorable confidence reposed in a sentry seems to be generally entertained; and there is every reason to believe that the cadet sentries at West Point perform their duties in a trustworthy and satisfactory manner.

The general duties of the battalion are assimilated as much as possible to those of a battalion in quarters. The daily detail of duties is drawn up by the cadet adjutant. The cadets for guard are detailed by the first sergeants of their respective companies at each evening parade, and the daily routine is in this respect as nearly as possible the same as that of military life.

There is no yearly vacation; and the furlough which each cadet may obtain at the end of his second year is subject to the following conditions, viz.:—

1st. If he has obtained 350 demerit in the two preceding years, he is detained twelve days; if 325, 300, 275, 250, or 200 demerit within the same period, he is detained ten days, eight days, five days, three days, or two days respectively.

2d. He is required to sign a certificate, declaring that he has in *no manner improperly interfered with, or molested or injured new cadets.* The furlough of any cadet declining to sign this certificate is limited to one month, from 28th July to 28th August. Although there have been instances of cadets declining to sign this certificate, it is probable that, as a general rule, the cadet conscience places a liberal interpretation on the words of the formula.

Leave of absence from the Academy for one to two days is occasionally granted, but only for exceptional reasons.

Buildings.

The *cadet barrack* is a handsome stone building of four stories. It contains 176 rooms, of which 136 are cadets' quarters, 14 feet by 22 feet, arranged in eight divisions, each division having its own entrance, and having no interior communication with the other divisions. Not more than two cadets are lodged in the same room. The two beds in each room are curtained off from the room, and separated from each other by a partition. There are numerous bathing rooms in the basement, to which the cadets have access.

Each division of quarters is under the superintendence of an assistant instructor of tactics, who visits the rooms of his division three times in the course of each day, and occasionally during the night. He makes a daily report in writing to the commandant of the condition of the rooms under his charge, noting all delinquencies that may have come to his knowledge since his last report.

A division of quarters is divided into two *subdivisions of quarters* of two floors each, each subdivision being under the charge of one of the cadet officers, who has his quarters therein, and who is responsible for the discipline of his subdivison, and for the proper fulfillment of all orders that may be issued relative to the police of quarters. He visits all the rooms of his subdivision 30 minutes after reveillé, and immediately after *taps* (lights out), notes all irregularities, and makes a daily report in writing to the superintendent of his division, recording all delinquencies, and certifying that since the report of the previous day he has faithfully performed all duties required of him as *inspector of subdivision.*

The *Academy* is a building detached, containing the following rooms and departments, viz.:—

Chemical department, comprising laboratory, lecture-room, room for electrical experiments, and a work-room; *fencing department; gymnasium; mineralogical collection; engineering department*, comprising drawing and model rooms; *artillery model room; mathematical model room; drawing academy; trophy room; picture and statue galleries; mineralogical section rooms;* and 10 *recitation rooms* (or halls of study).

Another detached building contains the *observatory;* and *library* of 20,000 volumes, to which the cadets have access at stated times.

There are no rooms specially set apart for day rooms, reading or recreation rooms.

The *mess hall* is a detached building. The central hall where the cadets take all their meals is 96 feet by 46 feet and 20 feet high. Quarters for the purveyor with kitchen and bakery, and with quarters for the necessary servants in the basement, are attached.

The cadets are formed in the barrack square previous to each meal, and are marched to and from the mess hall. The officer in charge visits the mess hall at all meal times. The senior cadet officer present is responsible for good order.

The *Riding School* is detached and is admirably adapted to its purpose.

Expenses.

The Academy is entirely supported by the State. The average annual cost for 62 years has been $137,315; and this sum includes the cost of all buildings and structures, of repairs and maintenance. The yearly appropriations during the last eight years have varied from $170,000 to $200,000, but does not include certain sums which are paid out of the regular appropriation to the War Department.

A new cadet is admitted to the Academy on the 1st of July. From that date he is credited with Government pay at the rate of $30 a month, which allowance is calculated as sufficient to pay for the whole cost of his equipment and maintenance. As the monthly pay is, however, small compared with the first cost of uniforms and outfit, a new cadet usually deposits with the treasurer of the Academy on entrance from $60 to $80, to be credited to his account. Thenceforth all wants and necessaries are supplied to the cadet by the Government, the prices being a trifle above cost and charged against his account. At the end of his residence, a balance is struck, and the sum standing to his credit, if any, is paid over to him. It is possible by this arrangement for a very careful and steady lad to secure his education, his maintenance during four years, a position in the army, and $100 in addition, at the time of his graduation.

STAFF FOR GOVERNMENT AND INSTRUCTION, JAN. 1, 1872

SUPERINTENDENT.—Col. THOMAS H. RUGER, 18th Infantry.

Military Staff.

Adjutant.—Captain Robert H. Hall, 10th Infantry.
Quartermaster.—Captain Tully McCrea, 1st Artillery.
Treasurer.—1st Lieut. James M. Marshall, 4th Artillery.
Surgeon, U. S. A.—Thomas A. McParlin, M. D.
Assistant Surgeon, U. S. A.—Van Buren Hubbard, M. D.

Academic Staff.

Commandant of Cadets and Instructor of Artillery, Cavalry and Infantry Tactics.—Lieut. Col. EMORY UPTON, 1st Artillery.
Assistant Instructor of Artillery Tactics.—Captain Alexander Piper, 3d Artillery.
Assistant Instructor of Infantry Tactics.—Captain Joseph S. Conrad, 2d Infantry.
Assistant Instructor of Artillery and Infantry Tactics.—Capt. John Egan, 4th Artillery.
Assistant Instructor of Cavalry Tactics.—Captain Alfred E. Bates, 2d Cavalry.
Assistant Instructor of Artillery, Infantry and Cavalry Tactics.—1st Lieut. William S. Starring, 2d Artillery.
Assistant Instructor of Infantry Tactics.—1st Lieut. John F. Stretch, 10th Infantry.
Professor of Mathematics.—ALBERT E. CHURCH, LL.D.
Assistant Professor of Mathematics.—1st Lieut. John P. Story, 4th Artillery.
Acting Assistant Professors of Mathematics.—1st Lieut. William F. Reynolds, jr., 1st Artillery; 2d Lieut. John E. Greer, Ordnance; 2d Lieut. Albert H. Payson, Engineers; 2d Lieut. Frank Heath, 3d Artillery; 2d Lieut. Philip M. Price, jr., 2d Artillery.
Professor of Drawing.—ROBERT W. WEIR, N. A.
Assistant Professor of Drawing.—1st Lieut. Edward H. Totten, 1st Artillery.
Acting Assistant Professor of Drawing.—2d Lieut. Charles W. Whipple, 3d Artillery.
Professor of Chemistry, Mineralogy, and Geology.—HENRY L. KENDRICK, LL.D.
Assistant Professor of Chemistry, Mineralogy, and Geology.—2d Lieut. Jnhn Pitman, jr., Ordnance.
Acting Assistant Prof. of Chemistry, Mineralogy, and Geology.—2d Lieut. Samuel E. Tillman, 4th Artillery.
Professor of the Spanish Language.—PATRICE DE JANON.
Assistant Professor of the Spanish Language.—1st Lieut. James O'Hara, 3d Artillery.
Professor of Natural and Experimental Philosophy.—PETER S. MICHIE.
Assistant Prof. of Natural and Experimental Philosophy.—1st Lieut. James Mercur, Engineers.
Acting Assistant Professors of Natural and Experimental Philosophy.—2d Lieut. Edward S. Holden, 4th Artillery; Additional 2d Lieut. Edgar W. Boss, Engineers.
Professor of the French Language.—GEORGE L. ANDREWS.
Assistant Professor of the French Language.—1st Lieut. Geo. G. Greenough, 4th Artillery.
Acting Assistant Professor of the French Language.—2d Lieut. Thomas H. Barber, 1st Artillery.
Professor of Ethics and Law.—JOHN FORSYTH, D.D.
Assistant Professor of Ethics and Law.—Captain John S. Poland, 6th Infantry.
Professor of Military and Civil Engineering.—JUNIUS B. WHEELER.
Assistant Professor of Military and Civil Engineering.—Captain Jarrett J. Lydecker, Engineers.
Acting Assistant Professors of Military and Civil Engineering.—Captain Oswald H. Ernst, Engineers; 1st Lieut John C. Mallery, Engineers.
Instructor of Ordnance and Gunnery.—Captain THOMAS C. BRADFORD, Ordnance.
Assistant Instructor of Ordnance and Gunnery.—1st Lieut. James W. Reilly. Ordnance.
Instructor of Practical Military Engineering, Military Signaling and Telegraphy, Commanding Company E, Engineers.—Captain OSWALD H. ERNST, Engineers.
Assistant Instructor of Military Signaling and Telegraphy, and Acting Signal Officer.—1st Lieut. Edward H. Totten, 1st Artillery.
Assistant Instructor of Practical Military Engineering, on duty with Company E, Engineers.—2d Lieut. Frederick A. Mahan, Engineers.
Sword Master.—Antoué Lorentz.

COURSE OF INSTRUCTION.

The studies pursued, and the instruction given at the Military Academy, are comprised under the following heads, in the Official Regulations:—

I. INFANTRY, ARTILLERY, AND CAVALRY TACTICS, AND MILITARY POLICE AND DISCIPLINE.—This course will conform to the system of Infantry Tactics and Military Police and Discipline, established for the government of the Army, and will comprise the schools of the soldier, company, and battalion, the evolutions of the line, the manual exercise and manœuvres of Light Infantry and riflemen, with the police and discipline of camp and garrison. (2.) Artillery Tactics will comprise exercise of field, siege, and garrison artillery; manœuvres of batteries; mechanical manœuvres and target practice. (3.) Cavalry tactics will comprise the schools of the trooper mounted, of the platoon, and of the squadron; and equitation.

II. THE USE OF THE SWORD, &c.—Will comprise the use of the small-sword, broadsword, and bayonet, and such military gymnastics as circumstances may permit.

III. MATHEMATICS.—This course will comprise:

(1.) *Algebra.*—Fundamental operations; involution and evolution; reduction and conversion of fractional and radical qualities; reduction and solution of equations, including those of the third degree ratios and proportions; summation of infinite series and figurate numbers; nature, construction, and use of logarithms.

(2.) *Geometry.*—Geometry of right lines, planes, and volumes and spherical geometry; and the formation and construction of determinate geometrical equations.

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

(4.) *Mensuration and Surveying.*—Mensuration of planes; surfaces and volumes; principles and practice of common land surveying; different methods of plotting and calculating such surveys; trigonometrical surveying; measurement of heights and distances: leveling; and use of instruments in plotting, surveying, &c.

(5.) *Descriptive Geometry.*—The graphic illustration and solution of geometrical problems in space; and the particular application of this method to spherical projections, construction of maps, to shades and shadows, and perspective, and isometric projections.

(6.) *Analytical Geometry.*—Construction of algebraic expressions; solution of determinate problems; determination and discussion of the equations of the right line, plane and conic sections; discussion of the general equations of the second degree involving two or three variables; determination of loci, &c.

Differential and Integral Calculus, with its application to maxima and minima, the drawing of tangents, rectification of curves, radii of curvatures, quadratures, cubatures, &c.

IV. FRENCH LANGUAGE.—This course will comprise:

French Grammar; reading and writing French; and translating (from text and orally) English into French and French into English.

V. SPANISH LANGUAGE.—This course will comprise:

Spanish Grammar; reading and writing Spanish; and translating (from text and orally) English into Spanish and Spanish into English.

VI. DRAWING.—This course will comprise:

Topography, with lead-pencil, pen and ink, and colors.
Figures, with pen and ink.
Landscape, with the lead-pencil.
Landscape, with colors.

VII. CHEMISTRY, MINERALOGY, AND GEOLOGY.—This course will comprise:

Chemical Physics.—Magnetism; static and voltaic electricity; electro-mag-

netism; magneto-electricity; thermo-electricity; animal electricity; construction and use of apparatus illustrating the principles of the foregoing subjects and their mutual relations. Heat—its nature, sources, and effects; relation between thermal energy and other forces; measurement and equilibrium of temperatures; thermal and aqueous phenomena of the atmosphere; light as a chemical agent.

Chemistry.—Its general laws and language; inorganic and organic chemistry theory of radicals, types, and substitutions; animal chemistry; animal nutrition, heat, and force; relation between the mineral, vegetable, and animal kingdoms; applications of chemistry to agriculture, fermentation, &c.

Mineralogy.—Crystallography; structure, practical determination and uses of minerals; descriptive mineralogy.

Geology.—The earth's features; classification, structure, modes of occurrence and distribution of rocks; rock veins; division of geological history into ages; the various agents of geological changes; geology of the United States.

VII. NATURAL AND EXPERIMENTAL PHILOSOPHY.—This course will comprise:

Mechanics.—1st. General classification of the physical sciences; general constitution and physical properties of bodies; measurements of the masses; densities and weights of bodies; definitions and descriptions of natural forces. 2d. *Mechanics of Solids.*—Work; laws of equilibrium and of motion; free and constrained motion of solids; motion of projectiles; planetary motions and the general principles of physical astronomy. 3d. *Mechanics of Fluids.*—Mechanical properties of fluids; equilibrium and motion of fluids; general principles of buoyancy; equilibrium and stability of floating bodies; specific gravity; and barometrical measurements. 4th. *Mechanics of Molecules.*—General principles of sound, heat, light, and electricity, to be taught principally by lecture. 5th. *Application.*—Objects and principles of machines; friction; stiffness of cordage and adhesion; discussion of the elementary machines—cord, lever, inclined plane, wheel and axle, pullies, screw, hydraulic press, and hydraulic ram.

Acoustics.—Theory of the internal structure of bodies; nature of sound; waves in general; velocity of sound in solids, liquids, and gasses, and measurement of distances by sound; qualities of sound; reflection, refraction, divergence and decay of sound; echoes, hearing and speaking trumpets, and description of the ear.

Optics.—Nature of light; laws of its deviation; laws of vision; optical instruments; chromatics; achromatism; polarization, interference, and chromatics of polarized light.

Astronomy.—Description of the solar and stellar systems; celestial and terrestrial spheres; figure and magnitude of the earth; its motions, with the appearances and vicissitudes arising therefrom; theory of astronomical reductions; eclipses, occultations, and transits; tides and twilight; use of astronomical instruments and tables; methods of making, clearing, and calculating observations for time, latitude, longitude, the earth's magnetism and true meridian.

IX. ORDNANCE AND GUNNERY.—This course will comprise:

Ordnance.—1st. The theory and preparation of gunpowder, cannon, artillery carriages, projectiles, implements, machines, small-arms, ammunition, and military fireworks. 2d. Practical instruction in making musket, rifle, pistol, cannon and howitzer cartridges; preparation of strap, grape, and canister shot, fuzes, slow and quick match, port-fire, signal rockets, carcases, fire-balls, light balls, and incendiary composition; loading shells, shrapnel shot and grenades; putting up stores for transportation; loading caissons; in determining the pressure on the bore of a gun; in determining the initial velocity of projectiles; in the manner of proving powder, and when circumstances will admit of it, the operation of casting cannon solid and hollow, casting of projectiles and the usual methods of testing gun-metals, will be witnessed.

Gunnery.—Embracing the study of the movements of projectiles; the theory of pointing fire-arms; the different kinds of fires and their effect; the art of breaching, and the composition of batteries.

X. ETHICS AND LAW.—This course will comprise:

Ethics.—1st. Common basis with law. 2d. In moral science, the pursuit of

the highest good for each and all; the realization of excellence by virtue, the fulfillment of obligations to God and our country, to ourselves and others; and 3d, In its practical division, the duties, vices and passions.

Law.—1st. General principles. 2d. International law. 3d. Political organization and constitution of the United States. 4th. Rules and articles of war: and the organizations, powers, forms, and proceedings of courts-martial.

XI. PRACTICAL MILITARY ENGINEERING.—This course will comprise:

The preparation of trench and battery materials—gabions, facines, sandbags, &c.; the manner of tracing and profiling batteries and intrenchments, by cords, pickets and laths; the defiladement of intrenchments and other works; the distribution and posting of working parties, with their implements and materials in the construction of batteries, intrenchments, &c.; the construction of the various revetments for batteries and intrenchments, the laying of platforms for field, siege, and garrison artillery; the construction of palisades, fraises, abatis, rifle-pits, and trous-de-loup; the manner of placing intrenchments and other works, together with houses, walls, fences, &c., in a state of defense; the trace, defiladement, and construction of the several kinds of trenches and saps; descent and passage of a ditch, and other operations of a siege; the manner of laying out, constructing, tamping and springing mines, both for attack and defense, with the application of electricity thereto; trestle, ponton, and other bridge exercises; military reconnoissance of a route for the march of a column of troops, and of a locality for defensive works.

XII. MILITARY AND CIVIL ENGINEERING, AND THE SCIENCE OF WAR.

Military Engineering.—1st. Principles and methods of planning and constructing temporary works, comprising intrenchments, inclosed works, batteries, lines, bridge-heads, with the modes of their attack and defense. 2d. Permanent Fortifications.—Principles of planning and constructing permanent works for land and sea-coast defense, with an analysis and description of the modern systems of fortifications; the attack and defense of permanent works, including mines.

Civil Engineering.—Comprising building materials, masonry, carpentry, bridges, roads, railroads, canals, and river and harbor constructions. The theory and description of mechanism and machines. The principles of architecture.

Descriptive drawing as applied to civil engineering, architecture and fortification.

Science of War.—The military organization of states and kingdoms; composition and organization of an army; strategy illustrated and explained by military history; the operations of a campaign, comprising the movements of troops and their general dispositions for attack and defense.

DISTRIBUTION OF STUDIES BY YEARS AND CLASSES.

Subjects.—First Year—Fourth Class.

MATHEMATICS.—Davies' Bourdon's Algebra. Davies' Legendre's Geometry and Trigonometry. Church's Descriptive Geometry.

FRENCH LANGUAGE.—Bolmar's Levizac's Grammar and Verb Book. Agnel's Tabular System. Berard's Leçons Françaises. * Spier's and Surrenne's Dictionary.

ARTILLERY AND INFANTRY TACTICS.—Practical Instruction in the Schools of the Soldier, Company, and Battalion. Practical Instruction in Artillery.

SMALL-ARMS.—Instruction in Fencing and Bayonet Exercise.

Second Year—Third Class.

MATHEMATICS.—Church's Descriptive Geometry, with its application to Spherical Projections. Church's Shades, Shadows, and Perspective. Davies' Surveying. Church's Analytical Geometry. Church's Calculus.

FRENCH LANGUAGE.—Bolmar's Levizac's Grammar and Verb Book. Berard's Leçons Françaises. Chapsal's Leçons et Modèles de Litterature Française. Agnel's Tabular System. Rowan's Morceaux Choisis des Auteurs Modernes. * Spier's and Surrenne's Dictionary.

SPANISH LANGUAGE.—Josse's Grammar. Morale's Progressive Reader. Ollendorff's Oral Method applied to the Spanish, by Valazquez and Simonne. * Seoane's Neuman and Barretti's Dictionary.

DRAWING.—Topography, &c. Art of Penmanship.

INFANTRY, ARTILLERY, AND CAVALRY TACTICS.—Practical Instruction in the Schools of the Soldier, Company, and Battalion. Practical Instruction in Artillery and Cavalry.

Third Year—Second Class.

NATURAL AND EXPERIMENTAL PHILOSOPHY.—Bartlett's Mechanics. Bartlett's Acoustics and Optics. Bartlett's Astronomy.

CHEMISTRY.—Fowne's Chemistry. Chemical Physics, from Miller.

DRAWING.—Landscape. Pencil and Colors.

ARTILLERY, CAVALRY, AND INFANTRY TACTICS.—United States Tactics for Garrison, Siege, and Field Artillery. Upton's Infantry Tactics. Practical Instruction in the Schools of the Soldier, Company, and Battalion. Practical Instruction in Artillery and Cavalry.

PRACTICAL MILITARY ENGINEERING.—Myer's Manual of Signals. Practical and Theoretical Instruction in Military Signaling and Telegraphy.

Fourth Year—First Class.

MILITARY AND CIVIL ENGINEERING, AND SCIENCE OF WAR.—Mahan's Field Fortifications. Mahan's Outlines of Permanent Fortification. Mahan's Civil Engineering. Mahan's Fortifications and Stereotomy. Mahan's Advanced Guard and Outpost, &c. Mahan's Industrial Drawing. * Moseley's Mechanics of Engineering.

MINERALOGY AND GEOLOGY.—Dana's Mineralogy. Hitchcock's Geology.

ETHICS AND LAW.—French's Practical Ethics. Halleck's International Law. Kent's Commentaries (portion on Constitutional Law). French's Law and Military Law. Benét's Military Law and the Practice of Courts Martial. * Webster's Dictionary.

ARTILLERY, CAVALRY, AND INFANTRY TACTICS.—United States Tactics for Cavalry. Practical Instruction in the Schools of the Soldier, Company, and Battalion. Practical Instruction in Artillery and Cavalry.

ORDNANCE AND GUNNERY.—Benton's Ordnance and Gunnery. Practical Pyrotechny.

PRACTICAL MILITARY ENGINEERING.—Practical Instruction in fabricating Facines, Sap Fagots, Gabions, Hurdles, Sap Rollers, &c.; manner of laying out and constructing Gun and Mortar Batteries, Field Fortifications, and Works of Siege; formation of Stockades, Abattis, and other military obstacles; and throwing and dismantling Pontoon Bridges.

Myer's Manual of Signals. Practical Instruction in Military Signaling and Telegraphy.

PROGRAMME OF CAMP DUTIES FROM JULY 5, TO AUGUST 30.

Reveillé, 5 a. m. Policing camp just after reveillé. Infantry company drills, for all classes, 5.30 a. m. Surgeon's call, 6.30 a. m. Breakfast call, 7 a. m. Parade call, 8 a. m Guard mounting, immediately after parade. Siege and sea-coast artillery drill for 1st class; Light Battery drill, 2d class; Foot Light Battery drill, 4th class; 9 till 10 a. m. Laboratory duty for two weeks, signaling, practical and topograpical engineering, for rest of term for 1st class, 10 till 12 a. m. Laboratory duty for 3d class for two weeks, 10 till 12 a. m. Infantry squad drill for 4th class, 10 till 11 a. m. Dinner, 1 p. m. Policing camp, 4 p. m. Infantry company's drill for all classes, 5.30 p. m. Parade, sunset. Supper, after parade. Tattoo, 9.30 p. m. Taps, 9.45 p. m.

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* Books marked * are for reference.

I. REGULATIONS

RELATIVE TO

THE ADMISSION OF CADETS INTO THE MILITARY ACADEMY.

APPLICATIONS for admission into the United States Military Academy at West Point, should be made by letter to the Secretary of War. By provision of law, each Congressional and Territorial district, and the District of Columbia, is entitled to have one cadet at the Military Academy, and no more. The district appointments are made on the nomination of the member of Congress representing the district at the date of the appointment. The law requires that the individual selected shall be an actual resident of the Congressional district of the State or Territory, or District of Columbia, from which the appointment purports to be made. Also, appointments "at large," not to exceed ten, are annually made. Application can be made, at any time, by the candidate himself, his parent, guardian, or any of his friends, and the name placed on the register. No preference will be given to applications on account of priority; nor will any application be entered in the register when the candidate is under or above the prescribed age; the *precise age* must be given; *no relaxation of the regulation in this respect will be made;* nor will any application be considered in cases where the age and other qualifications of the candidates are not stated. The fixed abode of the candidate, and *number* of the Congressional district which he considers his permanent residence, must be set forth in the application. The pay of a cadet is $30 per month, to commence from his admission into the Military Academy, and is considered ample, with proper economy, for his support.

The appointments will be made annually in the month of February or March, on the applications made within the preceding year. The claims of all the candidates on the register will be considered and acted upon. No certain information can be given as to the probable success of the candidate, before the arrival of the period for making the selections. Persons, therefore, making applications, must not expect to receive information on this point.

As a general rule, no person will be appointed who has had a brother educated at the institution.

QUALIFICATIONS.

Candidates must be over sixteen and under twenty-one years of age, at the time of entrance into the Military Academy; must be at least five feet in height, and free from any deformity, disease, or infirmity, which would render them unfit for the military service, and from any disorder of an infectious or immoral character. They must be able to read and write well, and perform with facility and accuracy the various operations of the four ground rules of arithmetic, of reduction, of simple and compound proportion, and of vulgar and decimal fractions.

It must be understood that a full compliance with the above conditions will be insisted on—that is to say—the candidate must write in a fair and legible hand, and without any material mistakes in spelling, such sentences as shall be dictated by the examiners; and he must answer promptly, and without errors,

all their questions in the above-mentioned rules of arithmetic: failing in any of these particulars, he will be rejected.

It must also be understood, that every candidate will, soon after his arrival at West Point, be subjected to a rigid examination by an experienced medical board; and should there be found to exist in him any of the following causes of disqualification, to such a degree as will immediately, or in all probability may at no very distant period, impair his efficiency, he will be rejected:

1. Feeble constitution and muscular tenuity; unsound health from whatever cause; indications of former disease; glandular swellings, or other symptoms of scrofula.

2. Chronic cutaneous affections, especially of the scalp, or any disorder of an infectious character.

3. Severe injuries of the bones of the head; convulsions.

4. Impaired vision from whatever cause; inflammatory affections of the eyelids; immobility or irregularity of the iris; fistula lachrymalis, &c., &c.

5. Deafness; copious discharge from the ears.

6. Loss of many teeth, or teeth generally unsound.

7. Impediment of speech.

8. Want of due capacity of the chest, and any other indication of a liability to a pulmonic disease.

9. Impaired or inadequate efficiency of one or both of the superior extremities on account of fractures, especially of the clavicle, contraction of a joint, extenuation, deformity, &c., &c.

10. An unnatural excurvature or incurvature of the spine.

11. Hernia.

12. A varicose state of the veins, of the scrotum and spermatic cord, (when large,) sarcocele, hydrocele, hemorrhoids, fistulas.

13. Impaired or inadequate efficiency of one or both of the inferior extremities on account of varicose veins, fractures, malformation, (flat feet, &c.,) lameness, contraction, unequal length, bunions, over-lying or supernumerary toes, &c., &c.

14. Ulcers, or unsound cicatrices of ulcers likely to break out afresh.

The above Regulations were issued by the War Department in 1862. Although it appears from this official document, that "applications for admission into the United States Military Academy at West Point, should be made by letter to the Secretary of War," and that "the claims of all candidates on the register will be considered and acted upon," it is also stated, that "*the district appointments are made on the nomination of the member of Congress representing the district at the date of the appointment.*" This delicate duty, and great privilege of selecting, out of all the young men between the ages of sixteen and twenty-one years, in a Congressional district of at least 70,000 inhabitants, who aspire to serve their country in a military capacity, the one *best* qualified, or even *well* qualified, is not imposed or conferred directly by law, but by the practice of the appointing power, on the member for that district.

Summary of Qualifications (in Circular of 1871).

A sound body and constitution, a fixed degree of preparation, good natural capacity, an aptitude for study, industrious habits, perseverance, an obedient and orderly disposition, and a correct moral deportment are such essential qualifications that candidates knowingly deficient in any of these respects should not, as many do, subject themselves and their friends to the chances of future mortification and disappointment, by accepting appointments to the Academy and entering upon a career which they can not successfully pursue.

Method of Testing the Qualifications of Candidates.

Candidates should be able to *read* with facility from any book, giving the proper intonation and pauses, and to *write* portions that are read aloud for that purpose, spelling the words and punctuating the sentences properly. Some historical work should preferably be chosen, and successive passages read till the reading exercises are ended. Then, from another part of the book, a suitable paragraph or paragraphs, of reasonable length, should be read aloud to the candidates, with proper intonations and pauses, as a guide to punctuation, and written down by them as read.

In Arithmetic they should be able to perform with facility examples under the four ground rules, and hence should be familiar with the tables of addition, subtraction, multiplication, and division, and be able to perform examples in reduction and in vulgar and decimal fractions, such as:

Add $\frac{2}{3}$ to $\frac{3}{4}$; subtract $\frac{2}{5}$ from $\frac{5}{6}$; multiply $\frac{3}{4}$ by $\frac{7}{8}$; divide $\frac{2}{5}$ by $\frac{3}{8}$

Add together two hundred and thirty-four thousandths, (.234,) twenty-six thousandths, (.026,) and three thousandths, (.003.)

Subtract one hundred and sixty-one ten thousandths (.0161) from twenty-five hundredths (.25.)

Multiply or divide twenty-six hundredths (.26) by sixteen thousandths (.016.)

They should also be able to change vulgar fractions into decimal fractions, and decimals into vulgar fractions, with examples like the following:

Change $1\frac{5}{8}$ into a decimal fraction of the same value.

Change one hundred and two thousandths (.102) into a vulgar fraction.

In simple and compound proportion, examples of various kinds should be given, and the candidates should understand the principles of the rules followed.

In English Grammar candidates should exhibit a familiarity with the nine parts of speech and the rules in relation thereto; should be able to parse any ordinary sentence given to them, and, generally, should understand those portions of the subject usually taught in the higher academies and schools throughout the country, under Orthography, Etymology, Syntax, and Prosody.

In Descriptive Geography they should name, locate, and describe the natural grand and political divisions of the earth, and be able to delineate any one of the States or Territories of the American Union, with its principal cities, rivers, lakes, seaports, and mountains.

In History they should be able to name the periods of the discovery and settlement of the North American continent; of the rise and progress of the United States, and of the successive wars and political administrations.

The examinations in Orthography, Grammar, Geography, and History may be either oral or written.

Candidates undoubtedly deficient in any one requisite, or more than one, should resign any expectation of admission till the deficiency is overcome.

Candidates should first be examined by a medical practitioner, with reference to the physical requirements and disqualifications set forth in the circular; such as are manifestly disqualified being so informed.

The condition of body and mind considered together should be regarded, as well as general proficiency in the studies as a whole. Especially should natural ability and manifest aptitude for acquiring and applying knowledge take precedence of mere scholastic finish and readiness of answer to former problems. Other things being equal, preference should be given, in order, to those whose claims are strengthened by military, naval, or other distinguished service rendered to the country by themselves or their immediate relatives; and it is better for candidates to be nearer the minimum than the maximum age.

BOARD OF VISITORS

In the Regulations for the government of the Military Academy, approved July 1, 1816, provision for the appointment of a Board of Visitors, to consist of five competent gentlemen, who should attend at each general examination, and report thereon to the War Department through the Inspector, who appears to have been from the start the senior officer of the corps of Engineers.

In 1846 (Aug. 8), Congress authorized the appointment annually, by the President, of a Board of Visitors, whose duty it was made to attend each yearly examination, and report to the Secretary of War upon the discipline, instruction, police and fiscal affairs of the Academy. The members were to be taken from one half of the number of States, alternating yearly with the other half, each member being a *bona fide* resident of the State from whence appointed, and each Congressional district being in turn designated to furnish an appointee. Of the members each year, not less than six must be taken from among officers actually serving in the militia.

Extract from Act of Congress approved August 8, 1846, *amended by Acts of March* 16, 1868, *and February* 21, 1870.

That the President is authorized to appoint a Board of Visitors to attend the annual examination of the Military Academy, whose duty it shall be to report to the Secretary of War, for the information of Congress, at the commencement of the next succeeding session, the actual state of the discipline, instruction, police, administration, fiscal affairs, and other concerns of the institution: *Provided*, That the whole number of visitors each year shall not exceed seven: *Provided, further*, That no compensation shall be made to said members beyond the payment of their expenses for board and lodging while at the Military Academy, and an allowance, not to exceed eight cents per mile, for traveling by the shortest mail route from their respective homes to the Academy, and back to their homes. And in addition to the other members of the Board of Visitors to be appointed by the President, according to law, to attend the annual examination of cadets at the United States Military Academy, there shall be on every such board two Senators, to be designated by the Vice-President, or President *pro tempore* of the Senate; and three members of the House of Representatives, to be designated by the Speaker of the House of Representatives, such designations respectively to be made at the session of Congress next preceding the time of such examination; and the Senators and members so appointed shall make full report of their action as such visitors, with their views and recommendations in regard to the said Military Academy, within twenty days after the meeting of Congress, at the session next succeeding the time of their appointment.

EXTRACT FROM REPORT OF VISITORS FOR 1871.

Twenty-five years ago West Point was substantially separate from the outside world; for several months of the year a mail was not received oftener than once in three or four days. The presence of visitors was almost wholly unknown, and the officers and cadets formed a community by and of themselves. The relations existing between the officers and cadets was like that at present existing between the officers and soldiers at a military post. Cadets were permitted to visit at the quarters of professors and officers on Saturday afternoons, and at no other time. But so reserved were the manners of officers, even on such occasions, that the privilege, though recognized, was very rarely exercised. There was substantially no social intercourse between the officers and the cadets.

In those days, too, the rigor of discipline put all cadets, the sons of the rich and the sons of the poor, upon a common footing. The regulations not only prohibited any cadet from receiving money from his parents and friends, but no place existed, or was permitted to exist, on the limits, where cadets could expend money. Occasionally a cadet was allowed to purchase what he pleased under the head of "sundries;" not exceeding one dollar in amount, and that only on the order of an officer in charge.

But all this has changed. West Point is now or fast becoming a place of fashionable resort. Hotels have been erected in near proximity to the post, and hundreds of visitors now repair thither where one did in former years. This influx of fashionable life has caused a relaxation of the rules in regard to cadets visiting. The great distance between officers and cadets has been gradually diminished. Cadets of the first class may now visit officers every day in the week, and officers and cadets associate together with a freedom of intercourse not formerly known. Insensibly the standard of discipline has been lowered, until the Academy has less than formerly the character of the Regular Army, and more the features of a militia establishment, where officers and men are separated while on duty, but mingle in social intercourse when the hour of drill or parade has passed.

Although the regulation in regard to cadets receiving money remains unchanged, yet, at present, a new functionary, known as the "cadet confectioner," is allowed to keep open on cadet limits a place of resort which cadets are known to frequent daily to enjoy the table, and where they may treat their fellows without stint or limit. Thus one of the elements of equality which formerly existed among the cadets is destroyed, and the son of a wealthy man may fare sumptuously, while the poor boy must confine himself to such food as the mess-hall affords.

Many other causes might be mentioned as contributing to the present condition of things, and many other illustrations of the change from the custom of former years might be given. But those members of the board who have been appointed by the Vice-President and Speaker of the House of Representatives, and whose duty it is by law specially made to report to Congress upon this subject, will doubtless do so at length, and therefore this board pass the subject without as full a consideration as would otherwise be demanded. But this board, feeling the importance of a high state of discipline to the efficiency of the Academy, to accomplish the purpose for which it is maintained, earnestly recommend a return to the stricter kind of discipline which was administered years ago. An army must be governed by different methods and upon different principles from a civil society, and to an army and to every military establishment discipline is a necessity.

With a view to this end, in the opinion of this board, the superintendent and commandant of cadets should always be officers of high rank, who, by their age and military distinction, can command not only the respect but the implicit obedience of the cadets.

REPORT OF THE BOARD OF VISITORS FOR 1863.

The Board of Visitors invited by the Secretary of War to visit the Military Academy at West Point, to make "a full and free investigation of the Military and Scientific instruction of the Cadets, and of the internal police, discipline, and fiscal concerns of the institution, and communicate the results of their observations, with any suggestions for the improvement of the Academy," consisted of the following members:

Oliver S. Munsell, *Illinois*, PRESIDENT. Birdsey G. Northrop, *Mass.*, SECRETARY. Thomas M. Allen, *Missouri*. Henry Barnard, *Connecticut*. Samuel W. Bostwick, *Ohio*. Thomas Brainard, *Penn*. Cyrus Bryant, *Illinois*. A. W. Campbell, *West Virginia*. Ralph W. Emerson, *Mass*. Oran Faville, *Iowa*. John H. Goodenow, *Maine*. P. D. Gurley, *District of Columbia*. Oliver P. Hubbard, *New Hampshire*. Edward Maynard, *District of Columbia*. Henry S. Randall, *New York*. William H. Russell, *Conn*. William A. Rust, *Maine*. Albert Smith, *New Hampshire*.

The Visitors introduce an account of their inspection with the following remarks:

Some of our number came with objections and prejudices against the Academy. But all doubts as to the value and importance of the institution were banished by the evidence presented in the course of our personal inquiries into its present condition and actual results. The Mexican war clearly evinced the value of military science. Still more has the present war demonstrated the necessity of maintaining, and even enlarging our Military Academy.

This Academy belongs to the whole nation. So far as its purpose and numbers permit, it is the Peoples' College. It is maintained for the special benefit of no particular section, sect, party, or class. We could discover no evidence of aristocracy, exclusiveness, or caste. The Cadets represent all sects and parties, and almost all nationalities, now naturalized among us. The poor are not denied its privileges, for the expenses of all are paid alike. If particular dogmas have at any time prevailed here, the fact is an accidental, rather than an essential one, and should be referred to the ruling influences at the seat of government, and not to any inherent element in the local organization at West Point.

Their Report has been communicated to the Secretary, by whom the same will be transmitted to Congress—to receive such attention as the Secretary and Congress may see fit to bestow on its various suggestions. By permission of the Secretary, we transfer to our pages, that portion of the Report in which the subject of the Admission of Cadets—their number, age, attainments, and mode of appointment, is discussed with considerable fullness.

ADMISSION OF CADETS.

In concluding the report of their inspection of this, the only national military school, to which the country naturally looks for the organization and command of her armies, and the construction of her works of defense, the Visitors would respectfully urge on the consideration of the Department, an immediate and thorough revision of the law and regulations relating to the admission of Cadets—the number, the qualifications required, and the mode of ascertaining these qualifications, and of making the appointments. No matter how appropriate may be the location, how complete the buildings and equipment, and how skillful and faithful the teachers, unless there is a constant and sufficient supply of pupils of the right age, character, bodily and mental vigor and aptitude, as well as aspirations for a military career, the public will be disappointed in the practical workings of the institution.

1. The number of pupils in the Military Academy is determined by the law, which limits the Cadet Corps of the United States Army to one cadet for each Congressional District in the several States, one for each Territory, one for the District of Columbia, and to forty more, whom the President may appoint, ten each year, from the country at large, without reference to their residence. Under this law, if each Congressional District and Territory were represented, the whole number of cadets would be two hundred and eighty, but owing to vacancies by withdrawal or non-appointment in Congressional Districts in the States involved in the rebellion, the number at this time is reduced to less than two hundred—and the graduating class of 1863, to twenty-five—a number altogether inadequate for the regular army in time of peace, and much below the present and future exigences of the service, while the expense of the Academy remains the same. We are assured by the Superintendent that without any additional expense for building and material equipment, and with a small advance in the pay of pupils and assistant teachers, the Cadet Corps could be increased to four hundred. The Visitors are unanimously of the opinion that the corps should be at once increased to this number, and should be maintained at this maximum at all times, by authorizing the President to appoint to any vacancy which may remain unfilled for three months by reason of nullification, secession, rebellion, or any other cause. If the appointments to fill and maintain the Corps at this maximum, can be selected out of the many American youths, ambitious to serve their country in the army, on the plan of an open competi

tive examination in the several States, the Visitors believe that ninety out of every one hundred thus appointed will go through the whole course with honor, and the average ability, scholarship, and good conduct of the whole corps, will equal that now reached by the first ten of each class.

2. By the original law providing for the appointment of cadets to the corps of Artillerists and Engineers, and by the act of 1812, by which the Military Academy was made to consist of the Corps of Engineers, the candidates for cadets were to be "not under the age of fourteen, nor above the age of twenty-one years." By regulations of the Department the minimum age is fixed at sixteen years, and the Visitors believe that the interests of the Academy and the military service, will be promoted by making the legal age for admission between eighteen and twenty-one years. The four years preceding and including eighteen are peculiarly the formative period of the body, mind, and character, and should be devoted to the acquisition of right habits of study and general culture, as the proper foundation for all special and professional training, which should not be commenced until the constitution is consolidated, the taste for a pursuit is distinctly pronounced, and the moral character is naturally developed under the influences and supervision of home. The experience of Europe, and particularly of France and England, has led to the abandonment of juvenile military schools, as nurseries for officers; and the very common practice of nominating candidates who exceed the legal age, expresses the convictions of our own people that military studies now require more maturity of mind than was deemed necessary in the early history of the Academy. The present want of uniformity as to age and mental discipline explains in part, the wide disparity of attainments between members of the same class. With few brilliant exceptions, confined to cadets of rare aptitude and vigor of mind, the most solid practical education is obtained by those who come to West Point when at least eighteen years of age, with at least a good preparation in English studies, and a taste for mathematical and military pursuits.

3. The school attainments required by law of candidates for admission to the Military Academy, are as rudimentary and limited as our language can express—far below, we are assured, the requisitions of any similar school in the world. Prior to 1812, when the Academy was little more than a school of mathematics, taught by two professors, in the line of geometrical and algebraical demonstrations, and the practical exercises were confined to surveying, and the simplest forms of military construction, the candidates were not

subjected to any examination. The act of 1812, provides that "each candidate previously to his appointment, shall be well versed in reading, writing, and arithmetic," and by regulations of the department, the knowledge of arithmetic is restricted to only a portion of that science. There were special reasons at the start for thus limiting the amount of knowledge, when the minimum age of admission was fixed at fourteen years, and the Academy was properly a juvenile military school, like all cadet schools in Europe at that time. At that date, science entered far less than now into the art of war, as applied to the means and modes of attack as well as of defense. Besides, the opportunities of even elementary instruction were then far less widely or equally distributed through all the States than now, when the general government has set apart over sixty million acres of the best land in aid of primary schools in all the new States, and nearly every State legislature has subjected the entire property of their several communities to taxation for the support of public instruction. Now that the requirement as to age has been advanced from the fourteenth to the sixteenth year, and by the voluntary action of parties having the nomination, or seeking the appointment, to the eighteenth year, we see no reason why the school attainments corresponding to, and compatible with that age, should not be also required. The least that should be demanded of any candidate is that amount of general culture and attainments, which constitutes a good English education, and which it is now the aim of the public schools, and their boast, to give without partiality, to all, poor and rich alike, if the advantages they proffer are properly improved. And we see no injustice in fixing the standard of general attainments and culture as high as that now reached by cadets in good standing at the close of their first year in this Academy, including even an elementary knowledge of one modern language. If the French, or Spanish, or German language is to be mastered by American officers for the sake of the military science and literature which it embodies, or its uses in conversation, or official duty, called for by the exigences of our foreign relations, both in peace and war, its acquisition should be begun as early in life as possible, while the organs of speech are flexible, and the grammatical and etymological difficulties of a new language are more readily surmounted. Judging from the results of the examinations we have witnessed here, and what we know of the attainments made by students in colleges elsewhere, very few persons, who begin the study of modern languages, late in their school life, in the pressure of other studies, ever attain the mastery of even one, so as to be able to use it as an instrument of written or spoken com-

munication, or make its treasures of science and literature a familiar possession.

Whatever may be thought of the disciplinary and practical value of earlier and longer attention to one or more modern languages, to those, whose minds will otherwise be almost exclusively subjected to the peculiar training of the mathematics, there can be no doubt that young men who have reached the age of eighteen, and desire to profit by the special studies of a purely military school, should exhibit in their language, habits, and attainments that intellectual, moral, and esthetical culture, which the public or private schools of any State can, and should give to any youth of average ability of that age.

4. Low as the requirements for admission now are, from a defective and vicious mode, as we believe, of selecting candidates, and making appointments to the Cadet Corps, the number of candidates nominated and provisionally appointed, who present themselves at West Point and shrink from any examination, or who fail to pass even the entrance examination which is confined to reading a few passages of familiar English prose or verse, and writing a few sentences from dictation, and performing on the blackboard a few operations of the most elementary character in arithmetic,—or being admitted, are not able to gain or keep a respectable standing for one year, although the studies of the first year belong to a general, and not a military education,—or by a "special providence," manage just to escape dismission from incompetency, and graduate,—is disgracefully large. The country abounds in youth, competent to master and profit by the course of instruction here provided, and ambitious of enjoying these privileges of education, and opportunities of distinction; and a selection by lot from the juvenile population of any state, could not result in so few prizes, and such a dreary waste of blanks as have been realized from the appointments made, in the necessary absence of all personal knowledge of the candidates by the appointing power, on the recommendation, or nomination of one or more persons in each Congressional District, in no way responsible for the incompetency of the individuals named.

From official tables prepared from the records of the Academy,* it appears that the proportion of all who graduate, to all appointed in successive periods of ten years, is as follows:

For Ten Years,	from	1802	to 1811, ...	0.606
" "	"	1812	to 1821, ...	0.289
" "	"	1822	to 1831, ...	0.377
" "	"	1832	to 1841, ...	0.472
" "	"	1842	to 1851, ...	0.510
" "	"	1852	to 1861, ...	0.523

* See Boynton's "History of Military Academy at West Point," p. 293.

From official returns furnished by the Superintendent, a portion of which are hereto appended, (B. C.) it appears that out of 4626 who have been admitted to the Corps of Cadets, (including two hundred now members,) only 2020 were able to graduate, and of those who failed, (2398, excluding those who remain,) more than three-fifths broke down in the first year in studies which in almost every military and scientific school in Europe are required for admission. Out of the whole number regularly nominated, recommended, and provisionally appointed from 1841 to 1863, more than twenty per cent. failed to pass the examination, as to health and constitution, or the slight examination in reading, writing, and ciphering. And this proportion would be increased by the number who withdrew in advance from the consciousness of their unfitness for a position to which ambitious and influential friends had promoted them. Out of the whole number admitted from 1851 to 1862, more than one-third failed during their first year. The proportion of graduates to the whole number admitted is 46 per cent. and of those who failed to graduate, 54 per cent.

The Visitors are unanimously of opinion that in a matter of such vital importance as the right organization and command of the armies of the United States, on which the honor and safety of the whole country depend, the original appointment to the Cadet Corps which is the *first step* in promotion to such command, as well as to all the special duties which attach to the engineer service, should not be made in any case except on the principle of finding the best youth for the place— having the health, character, vigor of body, maturity and aptitude of mind, and preparatory knowledge, to profit by the opportunities of the special military training provided by the government for this corps, and a decided taste and expressed desire for a military career. And to this end, the law and regulations should provide for the rigorous exclusion in advance of all who can not present testimonials from the teachers under whose instruction they have been for the two years next previous, that in their opinion they possess the qualifications above specified, and who do not make a written declaration of their desire to enter the Corps for the purpose of qualifying themselves to labor in the military service of the government, to which they will bear true allegiance against all enemies foreign and domestic, and over all state and local authority, government and constitution whatever. To select the best out of any number who may present their testimonials and written declarations, public examination should be held of all applicants at such times and places as the

law should prescribe, by such persons and under such regulations as the Department shall be authorized to appoint; and the results of such examination of each person examined, and in each subject specified by law, should be returned to the Department, in which return the applicants should be arranged in the order of merit. From this merit roll, revised from year to year, all appointments to the Cadet Corps should be made, and in the order of merit as assigned by the examiners.

This principle of appointment and promotion by merit which we advocate, is in full and successful operation in the classification and advancement of cadets in the Academy itself, and the country will be satisfied if the same principle can be as fairly and rigorously enforced on all who aspire to enter, as well as on all promotions in the service after leaving the institution. The principle itself, of selection by merit, either in the mode of public examination, or of careful and searching inquiry by competent and impartial educators, designated for this purpose by the parties to whom custom and not law had assigned the grave responsibility of nominating candidates, has been voluntarily applied in several Congressional Districts. Not a cadet known to have been thus selected and appointed, has ever broken down from want of vigor of body or mind, or failed to reach and maintain an honorable position on the merit roll of the Academy; and to this careful selection by those who felt the responsibility of the privilege accorded to them, is the country indebted for its most eminent and useful officers.

To the objection that selection by public competitive examination, will involve expense, we reply, that any expense which will do away with the prejudices against the Academy, which the present system of patronage has done so much directly and indirectly to evoke and foster, and which will, at the same time, exclude incompetent, and secure the services of vigorous, talented, well trained officers, for every arm of the service, will be well incurred. But, in our opinion, there will be no more expense in selecting and educating a given number of cadets on this plan, than on the present. The two thousand cadets who were appointed by patronage and failed to graduate, cost the government, directly and indirectly each year, a much larger sum than it would have taken to have excluded them in advance from the institution by competitive examination, and filling their places by better men; and their exclusion by substituting better material, would have been an incalculable gain to the Academy, facilitating its discipline, increasing the value of its instruction, and giving to the army a larger number of competent officers.

The objection, that the mode of making all appointments by open competitive examination, will deprive the President, and members of Congress of the opportunity of appointing the sons of meritorious officers, or poor, and it may be, orphan boys of genius—is more plausible than real. That such appointments have been made, to the manifest advantage of the country, is certain. But we know not a single instance of such marked success, on the part of a cadet thus appointed, as to attract investigation, where the same youth would not have secured the appointment in open competition. But if he had failed, and the place had been filled by one better qualified, the country would have been no loser, and he would have suffered no injustice or neglect. We fear, from an abuse of this amiable motive of rewarding meritorious parents, and assisting the poor, that in some instances, weak, ignorant, and incompetent persons are appointed, as though this Academy were a public charity school, or home for orphans; and not a special school for military instruction and training, for which the great object, in any mode of appointment, is to select those who will profit most by its advantages, and do the country the greatest service after being thus educated at its expense.

To the objections that, in these examinations, "the most forward boys will have the best chance, and such boys seldom make the best men," and that no amount of book knowledge can give assurance of the great military genius, "which must be born and not made," we reply, that these objections apply just as forcibly to any plan of nomination, and to every system of instruction. But we believe that those examinations can be and will be so conducted as to distinguish what is precocious from what is the healthy development of the faculties, what is solid from what is showy in attainments, what is vigor, grasp and aptitude of mind from what is mere memory and quickness, in competing candidates. All of these candidates must bring the testimonials of their former teachers, as to their character, ability and attainments, must have reached the age of eighteen years, and will be called upon to exhibit orally as well as in writing their knowledge and opinions on subjects which require judgment, reflection, presence of mind and decision. If a young man of eighteen and upward shows that he has done well what he had undertaken to do thus far in life, that he has preserved a sound constitution in vigorous health, has mastered the studies appropriate to his age, is honest, diligent, thoughtful, teachable, courageous, courteous, and ambitious of excellence generally, then the country has every assurance which can be given that on this basis of character, talents, attainments, and application, a solid fabric of military

education can be reared, and that in the hour of trial he will show not only courage to dare, but competence to devise, influence and command. In the responsibilities of such an hour will be found the fruitage of all his previous promise and preparation.

To the objection—"that a competitive examination must always result in the success of the best instructed, wholly irrespective of the capacity of the competing candidates; and the plan will thus secure for the country the services of dull mediocrity well instructed, and exclude genius without opportunities of development,"—we reply, that this does occur now under the present system, but need not, and never has been the result of competitive examination properly conducted. The examination which we propose to have inaugurated, is not to search simply or mainly for the results of memory or diligence, but for "vigor and aptitude of mind" in reference to the special purposes of this Academy. The examination will be poorly conducted, and will operate here widely differently than elsewhere, if it does not only exclude in advance palpable incompetency, and ascertain beyond doubt the possession by all the successful candidates, of that knowledge which is the basis of a special military training, but also seek, and give credit in the result, for the quick eye, the firm set mouth, the vigor and elasticity of body, the rapid decision, the contempt of danger, the competency to influence and command—and all the other marks of the incipient soldier and officer, as well as the mathematical tastes and qualities of mind which indicate the successful engineer. Composed as every Examination Commission might be, of at least one experienced officer of the United States Army, of one member (past or present,) of the Academic Board, of one officer of the State Militia, as well as one or more experts in educational matters, the military qualities of body, character and mind, will be sought for as well as the mere results of memory, diligence and good opportunities of instruction, in the competing candidates.

To the objection, that candidates will make special preparation, and in the phraseology of the class-room, "cram for the occasion," we reply,—to such preparation and cramming as cover the whole ground of a good English education, we can see no possible objection; the more of it, the better. If the preparation is only crude and on the surface, we are sure that the ploughshare of interrogation requiring precise answers, oral and written, will very soon expose its superficial and undigested character.

To the sifting out and selection by open competition, might be added a period of probation for the successful candidates—making

their first year's connection with the academy a further test of capacity, preparation, and aptitude for a military career. No pains and no expense should be spared to exclude from the academy and the service, incompetent, indifferent, and unteachable cadets and officers; such men are "cumberers of the ground," and no influence and inertia should be potent enough to resist the inevitable working of the principle of open competition, applied at frequent intervals, and at every stage of promotion, in getting rid of such cadets and officers.

The fact that such a public examination is to be held from year to to year, and that the educational privileges of this Academy, and immediate and prospective promotion in the army are the prizes which await success, will, in five years call forth more latent genius in the obscure corners and poor families of a State, than has ever been sought out by the lantern of patronage, (which is now seldom carried beyond the family, or neighborhood, or party of the person having the nomination,) since the foundation of the Academy. With the network of public and elementary schools, woven by state legislation over all the land—with public schools of a higher grade, and special schools of science and the arts already established, at short intervals, or which will be called into existence by the demand for a higher and different preparation from that now given, it may be safely said, that no genius, likely to attract the attention of a member of Congress, will exist, which will not be developed under the same influences by which the "dull mediocrity" of the rest of the community will be educated. Once set in the path of instruction and development, real genius will assert its own claims to attention, and will, on a first or second trial, before any board of examiners, make its vigor, courage, and persistence felt. The result will be the same in this institution, as in every really good Public High School and Free Academy—all classes as to wealth, occupation, religious and political affinities will be represented,—provided the regulations are judicious, and the examination practical and impartial.

This is the experience of the competitive principle in France ever since it was inaugurated by Carnot in the Polytechnic School at Paris, and Napoleon extended its application to every public special school, and to promotion in every department of administration, civil as well as military. And where is there more general administrative ability, central and local? Where are abler or better trained officers, military and civil, to be found? Where does "well instructed mediocrity," no matter how well backed up by wealth, find less favor, or genius for organization and command, no matter how poor or unfriended, find such speedy and sure recognition?

The experience of England in the trial of the two principles of patronage and competitive examination for admission, not only to the military and naval schools, but to the East India and the Civil service generally, is instructive, and especially on the points which we are now considering. Prior to the Crimean war, (which exposed the utter incompetency of a large number of officers, who had obtained their military education and promotion by patronage and purchase,)—admission to the Royal Military Academy at Woolwich, was by nomination, and the age fixed by law, was fourteen years.

The Secretary of War was satisfied by personal inquiry in 1855, that nothing could do so much to narrow and cramp the full development of a boy's mind, as his long confinement from so early an age among lads having the same limited attainments, special studies, and destination;—that a majority of those admitted on nomination and through influential friends, had only the minimum qualifications specified by law;—that to most cadets the severer studies were irksome and imperfectly mastered, on account of immaturity of mind and imperfect preparation;—that the certainty of promotion by influence and purchase, after obtaining the diploma of the Academy, and not unfrequently without it, took away all stimulus for continued study;—that resignations were common, when the profession of arms ceased to be a pastime, or could be exchanged for something that paid better—and the service was incumbered by officers without large and trained capacity for command, although not deficient in courage and dash. Under these circumstances the Secretary of War, advanced the minimum age of candidates from fourteen to eighteen years, removed all the general studies of the Academy into the preparatory course, and opened the doors of admission to those only, who could prove their title to enter by personal merit, in a free competitive examination. The same principle was applied to appointments and promotion in the new regiments called for by the exigences of the great war in which England found herself engaged.

Subjects, time, and places of examination, were officially made known throughout the kingdom, and commissions to conduct the examinations were appointed, composed of men of good common sense, military officers, and eminent practical teachers and educators. The results as stated in a debate in Parliament, five years later, on extending this principle to all public schools, and to all appointments and promotions in every department of the public service, were as follows:—In the competitive examinations for admission to the Royal Military Academy, candidates from all classes

of society appeared—sons of merchants, attorneys, clergymen, mechanics, and noblemen, and among the successful competitors, every class was represented. Among the number was the son of a mechanic in the arsenal at Woolwich, and the son of an earl, who was at the time a Cabinet Minister—the graduates of National Schools, and the students of Eton, and other great Public Schools. The most successful candidates were between the ages of eighteen and nineteen, as is found to be the case in competitions for admission to the Polytechnic School of France. Out of 579 successful candidates for the latter, between 1854 and 1857, 450 were over eighteen years. But the most important result of the competitive examinations for Woolwich, was the superior mental ability, the vigorous health, and eagerness for study exhibited by the new classes, and the small number who have failed on account of ill-health or incompetency. On this point, Mr. Edward Chadwick, in a Report before the National Social Science Association, at Cambridge, in 1862, says:—

"Out of an average three hundred patronage appointed cadets at the Royal Military Academy at Woolwich, for officers of engineers and the artillery, during the five years preceding the adoption of the principle of open competition for admission to the Academy, there were fifty, who were after long and indulgent trial, and with a due regard to influential parents and patrons, dismissed for hopeless incapacity for the service of those scientific corps. During the five subsequent years, which have been years of the open competition principle, there has not been one dismissed for incapacity. Moreover, the general standard of capacity has been advanced. An eminent professor of this university who has taught as well under the patronage as under the competitive system at that Academy, declares that the quality of mind of the average of the cadets, has been improved by the competition, so much so, that he considers that the present average quality of mind of the cadets there,—though the sorts of attainment are different, has been brought up to the average of the first classmen of this (Cambridge) university, which of itself is a great gain. Another result, the opposite to that which was confidently predicted, by the opponents to the principle, has been that the average physical power or bodily strength, instead of being diminished, is advanced beyond the average of their predecessors."

The opening of the Royal Military School at Woolwich to competition, on the basis of a more advanced age, and more thorough general education, has not only drawn in pupils of higher average ability and attainments, but has enabled the authorities to extend

the course of instruction. In this, the only safe way, they solved the problem which has tortured the ingenuity of the friends of our Academy—of crowding new studies acknowledged to be desirable if not indispensable, into a course already too crowded for cadets so unequally, and, many of them, so imperfectly prepared for the course as it is.

Another result of immense importance to the educational interests of Great Britain has followed the introduction of these open competitive examinations for appointments to the Military and Naval Schools, to the East India service, as well as to fill vacancies in the principal clerkships in the War, Admiralty, Ordnance and Home Departments of the government:—a stimulus of the most healthy and powerful kind, worth more than millions of pecuniary endowment, has been given to all the great schools of the country, including the universities of England, Scotland and Ireland. As soon as it was known that candidates, graduates of Trinity College, Dublin, had succeeded over competitors from Oxford and Edinburgh in obtaining valuable appointments in the East India service—the professors in the latter universities began to look to their laurels. As soon as it was known to the master of any important school, that some of his leading pupils might compete in these examinations, and that his own reputation as a teacher depended in a measure on the success or failure of these pupils, he had a new motive to impart the most vigorous and thorough training to his whole school.

The success of candidates who had never seen the inside of a government Military School, in open competition for appointments to the Artillery and Engineer Corps, in the new regiments raised in 1855, over those who hold the diplomas of the Royal Military Academy, was one of the reasons which led to a thorough revision of the whole system of military education.

These results, imperfectly presented here, will, the Visitors believe, be realized from the changes, which they now suggest, in the requirements as to age, attainments, capacity and aptitude, and especially in the mode of ascertaining these qualifications, of candidates for appointments to the Cadet Corps of the United States Army.

To the present low requirements, and mode of selecting cadets, do they attribute the hostility which they know exists, to some extent, against this Academy, in different parts of the country. The charges of personal, and political favoritism in making nominations, and the absence of reasonable search, among all the youth of a district, for the best qualified in natural endowments and acquired

knowledge irrespective of the poverty, or wealth, or occupation, or family, or party relations of the parents or guardians, we are forced to believe, in too many instances, to be well founded. To these hasty and injudicious nominations, do we attribute the bitter disappointments of so many individuals and families caused by the numerous failures to pass the almost formal entrance examinations in reading, spelling, penmanship, and elementary operations of arithmetic, or if admitted, to maintain a respectable standing in conduct and studies during their first year's connection with the institution. To this inequality of preparation and maturity of mind on entrance, do we attribute the astonishing disparity of capacity and attainments in the members of the same class, and the very large proportion of all who are admitted, who fail to graduate in very high standing as men of science or military promise.

To this want of preparatory knowledge, maturity of mind, and taste for mathematical and military studies, do we attribute most of the difficulties of internal administration, and class-room instruction. So long as the cadet is a boy, or if full grown in body, a youth with only boyish tastes, and without scholarly and soldierly aspirations,—so long as not a few are in the Academy, not because they sought its privileges from an inward and irrepressible impulse to a military career, but for the eclat of a military position to be resigned when such position involves sacrifices; *so long* will the admission of each new class, and especially, the period of encampment be signalized not only by boyish pranks, but by personal outrages on unoffending members of the same corps, which we had supposed to belong to the dark ages of collegiate institutions, when boyish inmates were congregated in large numbers away from the restraints of family discipline;—so long will the time, skill, and patience of able professors, which should be devoted to the elucidation of difficult scientific principles and their applications to military art, be engrossed in supplying the defects of an elementary education, which should have been obtained by the cadet as well, or better, at home; so long will the severe mathematical studies, and their special applications, difficult enough to task a well disciplined mind even with the preparation provided in a thorough knowledge of arithmetic, algebra, and geometry,—be irksome in the extreme, and be never mastered to any useful purpose to the army of the United States, by more than one half of the graduates of the Academy;—so long will the country be disappointed in the subsequent career of many graduates, for whose military instruction and training all these appropriate and costly preparations have been made.

In view of these and other considerations the Board of Visitors unanimously recommend that the law and regulations relating to the military academy be so modified as to provide as follows:

I. The Cadet Corps of the army of the United States shall consist of four hundred members, to which each state and territory shall be entitled to a number equal to its representation in the Congress of the United States, and the remainder shall be designated by the President from the country at large, including the District of Columbia; and he shall also fill, in the same way, any vacancy which for any cause may remain unfilled, for three months after the annual examination in each year.

II. No person shall be appointed to the cadet corps until he has been found qualified in the particulars designated by law, after a public examination conducted in such places, at such times, and in such manner as Congress shall prescribe; from which examination no person resident of that portion of the country for which the same is held, shall be excluded, who shall present credentials from the teacher or teachers whom he had last attended, that he is over seventeen, and under twenty-one years of age, of unblemished moral character, and personal habits, of good physical strength and constitution, and has given evidence of aptitude and vigor of mind for the studies and duties of a military career. The examiners shall make return under oath to the Secretary of War, of the persons so presenting themselves, examined, and found qualified, arranged in the order of merit, specifying the residence and school or schools which they have attended in the two years previous, and the degree of merit exhibited in each subject of the examination. And all appointments to fill vacancies for any state or territory, or for the country at large, shall be made from these returns, and in the order of merit as assigned by the examiners, until the same shall be revised by new regulations of the Department.

III. No person shall be returned to the Secretary of War as a suitable candidate for admission to the Cadet Corps, unless he

1. Shall be *over* seventeen, and under twenty-one years of age.

2. Shall possess an unblemished moral character and correct personal habits.

3. Shall be in good health, and in no way incapacitated by want of vigor and elasticity of physical constitution for military service.

4. Shall possess vigor and aptitude of mind for the studies of the Military Academy, and shall give evidence, oral and written, of a good English education, which, in view of the wide spread facilities of instruction in public and private schools, might very properly embrace

(*a.*) The correct use of the English language, in speaking, reading, and writing the same.

(*b.*) Penmanship, book-keeping, and elementary drawing.

(*c.*) The ability to perform with facility and accuracy the various operations of arithmetic.

(*d.*) The elementary principles of algebra and geometry.

(*e.*) A thorough knowledge of American geography and history, and the leading features of the Constitution of the United States, and of the State of his residence.

(*f.*) Or so much of the subjects above specified as shall be deemed indispensable to the immediate and profitable attention of the Cadets on their admission to the special studies and occupations of a military school.

5. Shall make a written declaration of his desire to obtain admission to the Cadet Corps for the purpose of qualifying himself for the military service of the United States, which service he assumes from the date of his appointment as cadet, to continue in the same for a period of at least sixteen years—bearing true faith and allegiance to the Constitution and government of the United States, against all enemies, foreign and domestic, and paramount to all obligations to any State government, authority, or constitution.

APPENDIX.

The Appendix to the Report of the Visitors of the Military Academy for 1863, contains the following tables and documents referred to in the Report.

TABLE A.—Showing the condition in life of the parents of the Cadets of the United States Military Academy from 1842 to 1863 inclusive.

TABLE B.—Showing the number of Cadets actually admitted into the United States Military Academy from each State and Territory from its origin March 16th, 1802, to October 19th, 1863.

TABLE C.—Showing the number of Cadets who have graduated at the Military Academy, from its origin to 1863, with the State and Territories where appointed.

TABLE D.—Showing the whole number of Cadets admitted and the whole number graduated from each State and Territory from 1802 to October 1863, together with the percentage of those who graduated, and of who failed, out of the whole number admitted from each State, and the number of Cadets to which each State and Territory is now entitled, according to the apportionment of members of Congress, under the Census of 1860.

STATEMENT EXHIBITING THE CONDITION IN LIFE OF THE PARENTS OF THE CADETS OF THE U. S. MILITARY ACADEMY AT WEST POINT, NEW YORK, FOR THE LAST TWENTY-TWO YEARS, FROM 1842 TO 1863, INCLUSIVE.

	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863
Fathers are or were farmers or planters	59	61	61	68	72	67	69	75	70	63	67	58	66	62	60	52	48	57	65	29	33	38
Fathers are or were mechanics	14	12	15	22	22	25	22	21	16	14	14	13	12	17	26	22	15	30	12	13	8	12
Fathers are or were judges or lawyers	27	25	30	35	33	30	29	23	34	33	34	35	36	26	25	29	32	32	36	23	35	39
Fathers are or were merchants	18	15	23	37	29	29	31	38	36	38	35	35	39	40	30	26	41	28	28	23	24	29
Fathers are or were boarding-house or hotel keepers	5	2	4	3	7	6	4	2	2	2	3	3	5	2	2	1	....	....	3	4	4	5
Fathers are or were physicians	12	15	15	13	21	19	21	21	18	14	14	13	9	8	9	17	16	10	18	10	13	18
Fathers are or were in the army, navy, or marine corps	14	16	16	13	11	13	17	17	18	22	24	27	28	22	20	20	26	29	33	23	25	33
Fathers are or were clergymen	4	6	6	6	5	3	3	4	4	4	3	5	4	6	5	4	5	6	7	7	8	11
Fathers are or were in the civil employment of the General or State government	5	15	10	9	5	2	3	7	7	8	10	11	14	13	13	7	31	29	18	8	11	14
Miscellaneous: as, bank officers, editors, professors, masters of vessels, &c.	15	11	15	23	35	36	41	24	32	39	30	26	14	25	13	13	12	6	37	44	39	42
Occupation not stated, or no occupation	48	31	23	17	1	2	2	8	7	11	13	7	10	19	15	20	25	39	22	18	18	19
Total	221	212	224	236	241	232	242	240	244	239	247	232	237	239	223	221	251	266	279	202	218	260
Of these numbers, there are without fathers living	26	57	44	48	42	41	34	48	40	45	36	35	29	33	33	24	46	33	42	25	25	36
Without fathers or mothers living	22	16	18	15	21	20	18	16	20	17	19	17	15	9	6	7	7	8	10	11	9	7
Total orphans	48	73	62	63	63	61	52	64	60	62	55	52	44	42	39	31	53	41	52	36	34	42
Of these numbers the parents are stated to be in moderate circumstances	....	156	150	164	192	182	196	203	215	207	218	205	206	215	196	195	216	218	239	184	199	232
Of these numbers the parents are stated to be in reduced circumstances	182	26	26	30	35	38	40	29	25	16	9	8	8	7	8	8	8	7	6	2	5	5
Of these numbers the parents are stated to be in indigent circumstances	....	6	8	8	8	8	4	4	2	2	....	1	1	1	1	1	1	....	....	....	1	5
Of these numbers the parents are stated to be in independent circumstances	....	6	10	12	6	4	5	4	2	14	20	22	22	16	18	17	26	41	24	16	12	17
Of these numbers the parents are stated to be in unknown circumstances	39	18	19	16	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Total	221	212	224	236	241	232	242	240	244	239	247	232	237	239	223	221	251	266	279	202	218	260

NOTE.—Of the 97 Cadets admitted, to October 19th, 1863, as given in the table on page 321, 46 were appointed from the U. S. Volunteers engaged in the War, who hold the following rank: 1 *Captain*, 5 *First Lieutenants*, 3 *Second Lieutenants*, 10 *Non-commissioned Officers*, 20 *Privates*, 1 *Musician*, and 6 *Clerks*, from military departments.

STATEMENT SHOWING THE NUMBER OF CADETS ACTUALLY ADMITTED INTO THE UNITED STATES MILITARY ACADEMY FROM ITS ORIGIN, MARCH 16TH, 1802, TO OCTOBER 19TH, 1863.

Year of Admission.	Maine.	New Hampshire.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	New Jersey.	Pennsylvania.	Delaware.	Maryland.	Virginia.	West Virginia.	North Carolina.	South Carolina.	Georgia.	Alabama.	Mississippi.	Louisiana.	Ohio.	Kentucky.	Tennessee.	Indiana.	Illinois.	Missouri.	Arkansas.	Michigan.	Florida.	Texas.	Iowa.	Wisconsin.	California.	Minnesota.	Oregon.	New Mexico.	Utah.	Washington.	Nebraska.	Kansas.	Dakota.	Colorado.	Nevada.	Dist. of Columbia.	At Large.	Unknown.	Total.
1802	...	...	3	5	...	1	1	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10
1803	...	...	3	...	...	...	1	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	9
1804	...	...	1	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	9
1805	...	...	3	...	...	...	2	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	9
1806	...	...	5	1	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	9
1807	...	2	5	2	...	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	17
1808	1	1	8	2	...	4	10	...	2	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	42
1809	1	...	...	2	...	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	10
1810	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
1811	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
1812	1	1	1	1	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	10
1813	...	1	3	11	...	1	30	...	5	...	...	6	...	4	2	2	...	...	...	2	1	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	...	1	88
1814	...	...	4	14	1	...	48	4	9	2	21	22	...	3	...	1	...	...	...	4	5	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	...	...	146
1815	...	...	1	1	...	1	14	1	4	4	6	5	...	3	4	1	...	...	...	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	...	...	61
1816	...	2	...	1	...	2	1	1	1	1	1	9	...	2	4	2	...	...	...	2	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	...	34
1817	...	3	3	6	...	2	5	1	3	1	3	4	...	...	8	1	1	...	1	2	3	5	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	55
1818	...	4	4	11	1	6	22	3	13	...	6	17	...	5	5	1	...	...	1	3	5	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	...	116
1819	4	1	5	4	1	5	11	6	9	3	3	10	...	4	5	1	...	1	...	1	5	...	1	...	1	...	2	...	...	...	1	...	...	...	...	...	...	...	...	...	...	3	...	...	86
1820	3	3	1	6	1	1	9	...	11	...	4	4	...	3	3	1	...	2	1	1	4	2	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	67
1821	...	1	...	5	...	1	16	4	7	2	5	8	...	5	5	5	...	...	...	...	1	6	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	77
1822	3	4	5	6	1	4	10	1	14	1	4	12	...	7	9	4	2	...	1	3	3	4	1	...	2	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	106
1823	2	...	3	7	1	3	13	2	9	1	4	13	...	9	3	...	...	...	3	8	8	4	...	1	4	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	106
1824	5	2	1	5	2	4	8	3	7	1	3	2	...	1	2	3	3	2	2	5	6	5	4	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	79
1825	2	2	1	6	1	3	15	2	12	1	7	7	...	6	6	5	2	1	1	5	7	3	1	1	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	103
1826	2	3	1	2	4	1	12	3	8	2	6	11	...	5	1	4	1	...	4	3	3	7	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	91
1827	1	3	3	3	1	...	18	1	11	1	3	15	...	9	4	1	1	...	2	7	5	2	...	1	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	97
1828	5	4	2	5	1	5	11	2	10	1	3	14	...	6	4	2	3	2	...	4	8	5	3	1	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	107
1829	1	3	4	10	1	4	16	2	13	1	2	14	...	5	6	4	3	...	3	4	3	2	1	...	3	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	109
1830	1	2	1	4	2	1	14	2	8	...	5	18	...	5	3	5	1	...	1	3	6	5	3	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	...	99
1831	4	1	1	5	2	2	18	2	6	2	7	8	...	6	4	4	1	1	1	4	6	3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	92
1832	3	3	1	4	2	2	11	4	12	2	3	10	...	7	5	2	3	1	1	2	5	4	2	3	...	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	...	101
1833	1	2	1	8	...	6	9	2	8	1	6	17	...	5	1	3	...	3	4	4	4	6	3	2	2	...	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	...	106
1834	...	1	2	1	...	1	7	1	5	2	4	4	...	2	4	4	4	2	1	3	3	5	1	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	63

Year of Admission.	Maine.	New Hampshire.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	New Jersey.	Pennsylvania.	Delaware.	Maryland.	Virginia.	West Virginia.
1835..	5	1	2	4	...	1	13	1	10	...	2	1	...
1836..	4	4	1	2	3	2	19	4	8	...	2	10	...
1837..	2	1	...	5	...	3	17	3	13	1	6	14	...
1838..	1	1	2	2	1	2	9	...	8	1	3	10	...
1839..	2	1	2	2	1	2	12	4	7	1	1	2	...
1840..	4	...	...	6	2	...	16	1	7	1	2	5	...
1841..	3	2	2	7	...	4	12	...	11	...	8	10	...
1842..	2	1	1	7	1	1	12	3	11	...	4	9	...
1843..	...	1	1	1	...	...	5	...	5	1	1	...	...
1844..	1	2	...	2	1	1	7	2	7	...	2	8	...
1845..	3	1	1	3	...	3	12	1	6	...	1	6	...
1846..	3	1	2	5	1	2	14	1	10	1	4	7	...
1847..	3	1	2	2	...	1	10	1	8	...	1	5	...
1848..	1	1	...	1	1	1	9	4	7	...	3	3	...
1849..	3	1	1	8	...	2	11	3	7	1	...	8	...
1850..	3	2	3	4	1	...	8	1	11	...	2	7	...
1851..	1	...	1	5	...	1	13	...	8	1	1	3	...
1852..	2	...	...	...	1	1	13	3	5	...	3	3	...
1853..	2	2	...	3	...	3	8	3	4	...	3	5	...
1854..	3	...	2	5	1	1	10	2	10	...	4	5	...
1855..	...	...	1	3	2	1	11	1	11	1	1	2	...
1856..	2	1	1	2	...	...	11	2	8	...	1	3	...
1857..	3	2	...	2	1	2	6	1	8	...	1	7	...
1858..	2	...	...	5	...	1	5	2	8	...	2	4	...
1859..	...	...	1	1	...	1	4	2	8	...	1	2	...
1860..	2	...	1	3	1	...	10	1	9	1	1	2	...
1861..	4	3	1	4	1	2	14	2	13	1	3	2	...
1862..	1	...	1	3	1	1	11	1	6	...	4	1	...
1863..	...	...	2	2	...	1	8	2	5	...	3	7	..1
Total.	102	78	104	232	42	102	650	101	424	41	179	379	1

Year of Admission.	North Carolina.	South Carolina.	Georgia.	Alabama.	Mississippi.	Louisiana.	Ohio.	Kentucky.	Tennessee.	Indiana.	Illinois.	Missouri.	Arkansas.	Michigan.	Florida.	Texas.
1835..	4	3	...	1	...	2	5	8	7	3	1	...	...	...	...	...
1836..	5	3	5	2	1	1	7	3	5	1	1	...	...	...	1	...
1837..	6	6	6	2	...	...	6	4	3	3	2	...	1	1	...	...
1838..	4	3	6	3	...	2	7	6	6	2	1	1	...	1	...	...
1839..	1	2	2	3	...	...	3	6	1	2	...	1	1	1	1	...
1840..	7	4	4	...	1	1	6	5	5	1	...	...	...	...	...	...
1841..	3	4	5	1	...	2	8	4	7	3	1	...	1	...	1	...
1842..	4	6	5	3	1	...	4	4	4	2	3	...	1	...	...	...
1843..	1	3	...	3	1	2	6	...	3	4	3	2	...	3	...	...
1844..	4	2	1	4	1	2	5	3	3	3	3	2	1	2	...	...
1845..	1	2	2	3	2	2	7	5	3	2	1	2	...	1	1	...
1846..	5	1	5	4	2	4	4	4	5	2	2	1	...	...	...	2
1847..	3	3	...	1	...	1	7	3	8	3	2	1	...	1	...	...
1848..	3	3	3	2	2	...	10	3	3	2	4	2	1	1	...	...
1849..	1	1	3	3	3	...	8	1	3	3	3	2	1	1	1	2
1850..	4	4	4	2	2	3	2	5	3	3	2	...	...	...	...	...
1851..	3	...	1	1	1	2	5	3	3	2	8	...	1	...		...
1852..	3	1	...	2	1	2	7	5	7	5	1	2	...	3	...	...
1853..	3	2	5	4	...	1	6	4	2	3	1	3	...	1	1	1
1854..	2	3	3	4	3	2	6	1	6	2	4	3	2	1	...	1
1855..	3	2	1	...	1	1	7	1	...	3	7	1	...	1	1	1
1856..	...	1	1	1	1	2	4	3	4	3	...	2	1	2	1	1
1857..	2	2	3	2	3	2	5	7	4	1	1	2	...	1	...	1
1858..	4	2	5	2	1	1	9	1	4	6	1	...	...	...	1	...
1859..	2	1	2	2	2	2	4	3	4	3	2	...	...	...	...	...
1860..	2	2	...	3	2	1	4	2	2	2	7	2	1	...	...	...
1861..	...	...	...	1	...	...	8	1	...	6	3	3	...	3	...	...
1862..	...	...	...	...	...	...	7	7	...	4	4	5		...	...	...
1863..	7	4	8	4	5	2	4	2	7	2	1	1	2	...	1	2
Total.	190	159	189	88	51	67	243	196	178	109	81	67	17	38	20	11

Year of Admission.	Iowa.	Wisconsin.	California.	Minnesota.	Oregon.	New Mexico.	Utah.	Washington.	Nebraska.	Kansas.	Dakota.	Colorado.	Nevada.	Dist. of Columbia.	At Large.	Unknown.	Total.
1835..	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	1	74
1836..	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	97
1837..	...	1	...	...	...	...	...	...	...	...	...	...	...	4	7	...	117
1838..	...	...	...	...	...	...	...	...	...	...	...	...	...	3	26	...	111
1839..	1	...	...	...	...	...	...	...	...	...	...	...	...	1	13	...	76
1840..	...		...	...	...	...	...	...		...	...	...	...	1	5	...	84
1841..	...	...	...	...	...	...	...		...	...	...	...	...	3	17	...	114
1842..	...	...	...	...	...	...	...	...	...	...	...	...	...	2	18	...	109
1843..	1	1	...	...	...	...	...	...	...	...	...	...	...	...	12	...	60
1844..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	...	75
1845..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	...	81
1846..	...	...	...	...	...		...	...	...	...	...	...	...	1	10	...	103
1847..	2	...	...	...	...	...	...	...	...	...	...	...	...	1	9	...	74
1848..	...	1	...	...	...	...	...	...	...	...	...	...	...	...	10	...	81
1849..	1	2	...	...	...	...	...	...	...	...	...	...	...	...	10	...	89
1850..	...	2	1	1	...	...	...	...	...	...	...	...	...	...	10	...	90
1851..	...	...	...	...	...	...	...	...	...	...	...	...	...	1	11	...	71
1852..	1	...	1	...	...	...	1	...	...	...	...	...	...	1	16	...	90
1853..	2	...	...	...	...	1	...	...	...	...	...	...	...	...	10	...	83
1854..	...	3	1	1	1	...	1	...	...	...	...	...	...	...	10	...	103
1855..	...	1	2	...		1	...	1	...	1	...			...	10	...	80
1856..	1	2	...	...	1	...	...		...	...	...	...	...	1	10	...	78
1857..	1	...	1	...	...	1	...	...	...	...		...	...	...	10	...	82
1858..	1	...	1	1	...	...	...	...	1	...	...			...	10	...	75
1859..	...	...	...	1	...	...	...	1	...	1	...	...	...	...	10	...	60
1860..	...	...	...	...	...	...	1	...	...	...	...	...	...	...	10	...	72
1861..	1	3	...	1	...	...	...	...	...	...	1	...	...	1	26	...	108
1862..	2	...	2	1	...	1	...	...	1	1	...	1	...	1	13	...	81
1863..	...	...	1	...	1	1	...	...	...	...	...	...	1	...	10	...	97
Total.	14	17	10	6	3	5	8	2	2	3	1	1	1	113	330	26	4,626

NOTE.—Owing to the destruction of the records by fire in 1838, the States in which some of the Cadets resided previous to that event is given; though it is believed they were appointed "At Large." The President of the United States having determined late in August, 1863, to fill all the existing vacancies from the seceded States there were in the FOURTH CLASS, numbering 97, on the 19th of October, 48 thus appointed. 10 Cadets similarly appointed had not, on that date, been examined for admission into the Military Academy.

C

THE FOLLOWING STATEMENT EXHIBITS THE ACTUAL NUMBER OF CADETS WHO HAVE GRADUATED AT THE MILITARY ACADEMY, FROM ITS ORIGIN TO THE PRESENT DATE, WITH THE STATES AND TERRITORIES WHENCE APPOINTED.

Year of Graduation	Maine.	New Hampshire.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	New Jersey.	Pennsylvania.	Delaware.	Maryland.	Virginia.	North Carolina.	South Carolina.	Georgia.	Alabama.	Mississippi.	Louisiana.	Ohio.	Indiana.	Illinois.	Kentucky.	Tennessee.	Arkansas.	Missouri.	Michigan.	Wisconsin.	Dist. of Columbia.	Florida.	At Large.	Iowa.	Texas.	Utah Territory.	Minnesota.	Washington Ter.	Oregon.	New Mexico Ter.	California.	Nebraska Ter.	Aggregate.
1802				1							1																													2
1803				1			1					1																												3
1804			1	1																																				2
1805						1	1						1																											3
1806			5	1			2	1	1					1											4															15
1807			4				1																																	5
1808		2	6	3		1	1			1															1															15
1809			2	1			3				1																													7
1811	1	1	3	1		2	5	1	2		1	1																1												19
1812	1		3	2		3	4	1	1			1		1														1												18
1813							1																																	1
1814		1	2	5		1	9		3			1	1							1		1						5												30
1815			1	5			14		1		4	2		2	3				4									4												40
1817	1		1		1		4		1			8								1		1						1												19
1818			1	2		1	3	1	2	2	5	3	1									1						1												23
1819		1	3	4		1	6	2		1	3	2	1	1				1			1	1						1												29
1820				1			11	1			5	3	3	1					1				2					2												30
1821		1		4		1	6		2		2	1		3	1				1	1			1																	24
1822		2	3	2	1	5	6	2	6			5	1	1		1			2			1	1					1												40
1823		1	3	4	1	3	5	2	3	2			3	1			1					2	1			1		2												35
1824	1	3		5			6		4		3	2		2			1	1				2	1																	31
1825		1	1	2		1	9	3	5		3	3	2	2	2							2	1																	37
1826	1	2	2	1	1		2	1	7	1	2	8	3	2	1			1		1		1	1		1			1	1											41
1827			3	4			6		4		2	4	3	2		1			3			4				1		1												38
1828	3	1	2	4		5	2	1	1		1	1		1		1	1	1	2	2	1		2		1															33
1829	2	1	1	5		3	7	3	4		2	2	2	3	3				4	1		2						1												46
1830	2		1	1	2		6	1	4	1	4	2	2	1	1			1	1	1	1	4	2		1			3												42

CADETS WHO HAVE GRADUATED AT THE MILITARY ACADEMY.

Year of Graduation.	Maine.	N. Hampshire.	Vermont.	Massachusetts.	Rhode Island.	Connecticut.	New York.	New Jersey.	Pennsylvania.	Delaware.	Maryland.	Virginia.	North Carolina.	South Carolina.	Georgia.	Alabama.	Mississippi.	Louisiana.	Ohio.	Indiana.	Illinois.	Kentucky.	Tennessee.	Arkansas.	Missouri.	Michigan.	Wisconsin.	Dist. Columbia.	Florida.	At Large.	Iowa.	Texas.	Utah Territory.	Minnesota.	Washingt'n Ter	Oregon.	N. Mexico Ter.	California.	Nebraska Ter.	Aggregate.
1831	1	1	...	...	1	...	8	2	4	1	3	2	2	1	1	...	...	.	3	...	...	2	1	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	33
1832	3	3	1	2	1	1	6	1	5	...	2	4	1	1	...	1	1	...	3	...	1	3	3	...	...	1	...	1	...	...	...	...	...	...	...	...	...	..	..	45
1833	...	2	1	7	...	2	5	1	5	1	1	5	1	2	1	2	...	...	...	1	...	1	2	...	1	...	...	2	...	...	...	...	...	...	.	...	...	...	...	43
1834	...	1	2	1	...	1	7	...	6	...	1	5	...	1	1	...	...	...	1	1	...	4	1	...	1	...	...	1	1	...	..	...	...	...	...	...	...	...	..	36
1835	4	1	1	4	...	...	11	2	4	1	2	4	3	2	3	1	..	...	4	...	..	4	1	...	...	...	...	3	...	1	...	...	...	...	...	...	...	...	...	56
1836	2	3	1	1	3	1	10	3	6	1	2	5	2	2	..	...	...	...	...	1	...	2	1	...	..	...	...	1	...	2	...	...	...	...	...	..	...	...	...	49
1837	1	1	1	6	...	2	4	3	5	2	4	6	2	...	2	1	...	...	...	2	1	1	1	...	1	1	...	3	...	...	...	...	...	...	...	...	...	...	...	50
1838	...	...	2	...	...	1	7	...	4	...	1	3	1	2	2	2	2	2	3	..	1	3	2	...	1	1	...	1	...	4	..	..	...	...	..	...	...	...	...	45
1839	2	1	1	2	...	1	6	...	5	..	1	1	1	1	...	...	...	...	3	1	...	3	1	...	...	...	...	1	...	...	...	...	...	..	...	...	...	...	...	31
1840	3	1	...	2	...	..	8	1	3	...	...	4	3	...	...	...	...	1	6	...	..	..	3	..	...	...	...	2	1	4	...	...	...	...	.	...	...	...	..	42
1841	1	1	1	5	...	2	6	...	7	1	4	7	1	3	...	...	.	...	2	3	2	1	1	1	...	1	...	...	...	2	...	...	...	...	...	...	...	...	...	52
1842	1	1	1	2	2	...	7	1	5	..	2	7	1	3	1	2	1	1	4	1	1	3	1	...	...	.	...	2	...	6	...	...	...	...	...	...	...	...	...	56
1843	2	1	2	.	...	1	7	2	4	...	...	3	.	...	...	...	...	...	3	2	...	2	1	...	1	1	...	...	...	6	1	...	...	...	...	...	...	...	...	39
1844	...	1	...	1	1	1	2	...	3	1	2	1	1	...	...	...	...	...	2	...	...	4	1	1	...	...	...	2	...	1	...	...	...	...	...	...	...	...	...	25
1845	3	...	1	2	...	1	8	...	1	...	...	2	1	...	2	...	...	1	4	2	...	3	1	...	...	...	...	...	1	8	...	...	...	...	...	...	...	...	...	41
1846	2	1	2	4	1	1	10	1	8	...	3	5	2	1	4	...	...	...	...	...	1	1	3	...	...	...	...	1	...	8	...	...	...	...	...	...	...	...	...	59
1847	...	...	...	...	...	...	5	...	3	...	...	2	1	2	...	...	..	...	8	4	2	...	...	...	1	1	...	...	...	8	1	...	...	...	...	...	...	...	...	38
1848	1	1	...	..	...	...	5	3	5	...	...	1	1	3	...	2	...	...	1	1	2	...	2	1	...	1	1	...	...	7	...	...	...	...	...	...	...	...	...	38
1849	...	1	1	2	...	2	5	...	3	...	..	5	...	...	2	...	2	...	4	2	...	2	2	...	1	...	...	...	1	8	...	...	...	...	...	...	...	...	...	43
1850	3	1	1	3	1	...	7	...	6	...	3	2	2	1	2	...	...	2	...	...	1	2	2	..	...	...	...	...	...	5	...	...	...	...	...	...	...	...	..	44
1851	1	...	1	3	...	1	6	...	5	...	...	2	3	...	...	1	...	1	2	2	1	2	3	..	...	...	...	1	...	6	1	...	...	...	...	...	...	...	...	42
1852	...	...	...	...	1	1	7	2	4	...	2	...	2	...	...	2	1	...	6	2	1	2	1	...	1	2	...	...	...	6	...	...	...	...	...	...	...	...	...	43
1853	1	1	...	2	...	1	5	1	3	...	1	5	..	2	3	1	...	...	8	3	2	1	2	...	2	...	...	...	1	5	1	1	...	...	...	...	...	...	...	52
1854	2	1	2	1	1	...	4	1	5	...	...	4	2	3	2	2	2	1	1	1	.	...	1	...	...	...	3	...	...	6	...	1	...	...	...	...	...	...	...	46
1855	..	1	1	4	...	...	7	...	8	1	...	...	2	...	1	...	...	1	2	1	2	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	34
1856	1	...	.	...	...	...	8	1	3	...	...	2	1	...	...	1	1	...	7	3	...	4	2	...	1	2	.	1	...	10	...	...	...	...	...	...	...	...	...	48
1857	2	2	...	2	..	2	3	1	1	...	...	3	..	2	4	2	...	...	2	1	1	3	1	...	2	...	...	..	...	3	1	1	...	...	...	...	...	...	...	39
1858	1	...	...	4	...	1	1	1	1	...	2	...	2	1	2	1	1	...	2	1	...	1	1	...	...	.	...	...	...	3	.	...	1	...	...	...	...	...	...	27
1859	..	...	1	.	...	...	4	...	4	...	1	1	...	...	...	1	...	...	2	..	1	...	1	...	...	1	1	...	...	3	...	...	...	1	..	...	...	...	...	22
1860	1	...	1	3	1	...	7	1	3	1	1	...	2	2	...	1	...	...	3	1	6	...	...	1	...	...	...	...	...	5	...	...	...	...	1	...	...	...	...	41
1861	3	3	1	3	1	2	15	2	10	.	1	1	...	.	...	...	...	...	5	1	1	4	1	1	2	3	2	1	...	14	1	...	...	...	...	1	1	...	...	80
1862	1	...	..	3	...	1	3	...	2	...	.	...	...	..	...	...	...	...	6	1	...	1	1	...	1	...	...	...	...	5	...	...	...	1	...	...	...	1	1	28
1863	...	...	1	2	...	1	4	1	5	...	1	...	...	...	...	...	...	...	3	2	...	2	...	...	...	...	...	2	...	...	...	...	...	...	1	...	...	...	...	25
Total	54	47	75	131	20	55	329	51	197	18	79	142	63	59	44	26	14	15	118	48	30	83	56	5	24	17	7	50	6	139	6	3	1	2	2	1	1	1	1	2020

TABLE D.

EXHIBITING THE WHOLE NUMBER OF CADETS ADMITTED TO THE MILITARY ACADEMY FROM EACH STATE AND TERRITORY, AND THE WHOLE NUMBER GRADUATED.

STATE AND TERRITORY.	Admitted.		Graduated.			Fail'd to Graduate.		Remain.		No. entitl'd '60.
	From	Total.	From	Total.	Per cent.	Number.	Per cent.	No.	Per ct.	
Alabama,	1817	88	1822	26	.295	61	.693	1	.012	7
Arkansas,	1827	17	1841	5	.294	.....	.705	...	....	2
California,	1850	10	1862	1	.100	6	.600	3	.300	3
Connecticut,	1802	102	1805	55	.539	43	.422	4	.039	4
Delaware,	1806	41	1808	18	.439	22	.539	1	.022	1
Florida,	1822	20	1826	6	.300	14	.700	...	....	1
Georgia,	1813	139	1815	44	.329	95	.670	...	....	3
Illinois,	1815	81	1819	30	.370	42	.519	9	.111	13
Indiana,	1812	109	1814	48	.440	52	.477	9	.083	11
Iowa,	1839	14	1843	6	.428	6	.428	2	.144	6
Kansas,	1855	3	....	.....	.....	2	.667	1	.333	1
Kentucky,	1813	196	1819	83	.423	105	.531	8	.046	9
Louisiana,	1817	67	1819	15	.223	51	.761	1	.016	4
Maine,	1808	102	1811	54	.529	43	.422	5	.049	5
Maryland,	1802	179	1802	79	.441	95	.537	5	.022	5
Massachusetts,	1802	232	1802	131	.324	91	.392	10	.043	10
Michigan,	1814	38	1823	17	.447	18	.474	3	.079	6
Minnesota,	1850	6	1859	2	.333	2	.333	2	.333	2
Mississippi,	1819	51	1823	14	.274	37	.725	...	....	5
Missouri,	1802	67	1806	24	.358	37	.552	6	.090	9
New Hampshire,	1817	78	1808	47	.602	28	.359	3	.039	3
New Jersey,	1803	101	1806	51	.504	45	.446	5	.050	5
New York,	1802	650	1803	329	.506	289	.444	32	.050	31
North Carolina,	1803	190	1805	63	.331	127	.668	...	....	8
Ohio,	1813	243	1815	118	.485	105	.432	20	.083	19
Oregon,	1854	3	1861	1	.333	1	.333	1	.333	1
Pennsylvania,	1804	424	1806	197	.464	203	.479	24	.057	24
Rhode Island,	1814	42	1817	20	.476	20	.476	2	.048	2
South Carolina,	1809	159	1806	59	.371	100	.628	...	....	6
Tennessee,	1815	178	1820	56	.314	122	.686	...	....	10
Texas,	1840	11	1853	3	.272	8	.727	...	....	2
Vermont,	1803	104	1804	75	.721	26	.250	3	.029	3
Virginia,	1802	379	1803	142	.374	237	.615	4	.011	13
West Virginia,	1863	1	....	.....	.....	.....	.....	1	1.000	1
Wisconsin,	1837	17	1848	7	.411	7	.412	3	.177	6
Dist. of Columbia,	1806	113	1811	50	.443	62	.549	1	.008	1
New Mexico,	1852	5	1861	1	.200	3	.600	1	.200	1
Utah,	1853	3	1858	1	.333	1	.333	1	.333	1
Washington,	1855	2	1861	2	.100	.....	.....	1	.500	1
Nebraska,	1858	2	1862	1	.500	.....	.....	1	1.000	1
Dakota,	1861	1	....	.....	.....	.....	.....	1	1.000	1
Colorado,	1863	1	....	.....	.....	.....	.....	1	1.000	1
Nevada,	1863	1	....	.....	.....	.....	.....	1	1.000	1
At large,	1837	330	....	139	.421	156	.473	35	.106	40
Unknown,	1803	26	....	.....	.....	.....	.....	...	....	...
Total,		4,626		2,020				210		294

The Totals in the column of Cadets admitted, graduated, and failed to graduate, for each State and Territory, and for the country at large, are obtained from Tables prepared by Capt. Boynton, in his "History of the United States Military Academy." The per centage of graduates, failures, &c., is calculated from the totals thus obtained. The minute accuracy of the results is slightly effected by the difficulty of assigning the twenty-six Cadets admitted, whose place of residence was unknown, to their respective States. The column of Cadets to which each State and Territory is entitled in the apportionment of members of Congress under the Census of 1860, is official so far as States not involved in rebellion are concerned; the latter is given according to the Census of 1850

OPINIONS OF COL. THAYER AND OTHERS.

On the recommendations of the Board of Visitors as to the conditions of admission to the United States Military Academy at West Point.

EXTRACT from a letter of COL. SYLVANUS THAYER, Superintendent of the United States Military Academy, from 1816 to 1831.

"The Extracts from the Report of the Visitors at West Point, for 1863, I have read with the highest satisfaction, not to say admiration. The subject of the admission of Cadets, their number, age, attainments, and mode of appointment, is discussed in the most complete and able manner, *ne laissant rien a desirer*, as far as I can see. I am naturally the more pleased from finding my own views so perfectly reflected in many important particulars. The only difference I notice is the small addition to my standard of attainment for admission. I not only agree to that, but would raise the standard as high as Congress would be willing to adopt. The higher the standard, the more perfect will be the test of capacity. The subject, as you may well suppose, is not a new one with me. More than forty years ago I made my first effort to have the mode of appointment by nomination, done away with, and admission by open competition adopted. My last effort before the late one, was made in 1858, while I was in command of the Corps of Engineers, during the absence of Gen. Totten. At the same time, I recommended a higher standard of attainment, a Board of Improvement, and some of the other changes comprised in my "Propositions," but with little expectation, however, that my solitary voice would be heeded. After long despairing, I am now encouraged and cheered. Admission by competitive examination, open to all, may not be attained as soon as we wish, but come it must at no d stant day. Let every future Board of Visitors recall the attention of the Government to your excellent Report; no new arguments are needed, and let all the publications devoted to the cause of education, agitate the question unceasingly.

We have been favored with the perusal of the "Propositions, referred to in Col. Thayer's letter, and submitted by him to the Secretary of War, in 1863, with "Suggestions for the Improvement of the United States Military Academy." So far as the Visitors go, their views, and those of Col. Thayer, are almost identical, but Col. Thayer's communication to the Secretary includes many other suggestions relating to the instruction, discipline, and administration of the institution, which we hope will be adopted by the Secretary, and embodied in the Regulations.

In addition to the modifications suggested by Col. Thayer, we should like to see the theoretical course at West Point reduced to two years; and Special Courses, or Schools of Application and Practice

established for the Engineer, Artillery, Cavalry, and Infantry service, open only to those who should show natural aptitude, and the proper amount of acquired knowledge, whether graduates of the scientific course of West Point, or any State scientific or classical school, in a competitive examination. In each of these courses or schools, there should be a graduation, and promotion, in the particular service, according to merit. Our whole system of military instruction should terminate in a STAFF SCHOOL, open only to those who, in addition to the knowledge required for graduation in at least two of the above special courses, should have had at least three years actual experience in service. While members of the Staff School, these candidates for the Staff Corps, should, if called for by the State authorities, assist without compensation, in conducting Military Encampments of the Officers of the State Militia, like those held every year in Switzerland, and corresponding to what is known in this country to Teacher's Institutes. The graduates of the Staff School, should constitute the Staff Corps, from which all vacancies in the higher offices of the Regular Army should be filled, and all appointments to new regiments be made.

EXTRACT from a letter of GEN. H. K. OLIVER.

I have read with the utmost care, the Extract from the Report of the Board of Examiners of the Military Academy at West Point, for the year 1863, and most heartily concur in the views therein set forth, and especially in that portion of it, which recommends a competitive examination of candidates for admission. In all its relations it is right. In fact it stands out prominently as the only proper mode of admittance.

My intimate acquaintance with the Academy, having attended the examination in 1846, by invitation, and again in 1847, as Secretary of the Board of Visitors for that year, enables me to speak with reasonable authority. These visits afforded me opportunities, which I improved to the utmost, and most minutely, to become intimately well informed of the effect of the prevailing method of selection, and of its practical results upon character and scholarship after admission, as well as to know, with what degree of fidelity, the institution was answering the intent of its founding, and the just expectation of the country; and I was then satisfied, and subsequent observation has confirmed me in my opinion, that whatever of deficiency prevailed, was traceable to the method of admission. Faithful teachers and faithful teaching will achieve great results, but they can not make good, incompetent natural endowments, nor infuse vigor and life into sluggish natures. I sincerely hope that the Government will feel the force of your views, and comply with your most commendable recommendations.

RESOLUTION adopted by the American Institute of Instruction at the Annual Meeting in August, 1863.

WHEREAS, the security and honor of the whole country require in the military and naval service the right sort of men with the right sort of knowledge and training; *and whereas*, the military and naval schools established to impart this knowledge and training will fail in their objects, unless young men are selected as students, of the right age, with suitable preparatory knowledge, with vigor of body, and aptitude of mind, for the special studies of such schools; *and whereas*, the mode of determining the qualifications and selecting the students, may be made to test the thoroughness of the elementary education given in the several States, therefor

Resolved, That the Directors of the American Institute of Instruction are authorized and instructed to memorialize the Congress of the United States, to revise the terms and mode of admission to the National Military and Naval Schools, so as to invite young men of the right spirit, and with vigor and aptitude of mind for mathematical and military studies, who aspire to serve their country in the military and naval service, to compete in open trial before intelligent and impartial examiners in each State, without fear or favor, without reference to the wealth, or poverty, or occupation, or political opinions of their parents or guardians, for such admission, and that in all cases the order of admission shall be according to the personal merits and fitness of the candidate."

EXTRACT from letter of Prof. Monroe, St. John's College, Fordham, N. Y.

I rejoice that some one has taken hold of this subject at last. It needs only to be understood to be adopted; for I can not see from what quarter any opposition to it can arise. You rightly observe that "all the educational institutions of the several States" are interested in this mode of appointment. Great Britain, France, and many of the Continental States admit to their military schools the most competent young men who present themselves, and the method is found to be as economical as it is equitable. Long years of *winnowing* is saved to the Government; for the subjects who present themselves are, of course, the most capable. For several years I was a witness of the beneficial effects produced on youth in France by the stimulation of their energies in order to undergo an examination for admission into the military or naval schools. Our present mode of appointment appears to be an anomaly; for while monarchies find it expedient to adopt a less exclusive mode of sustaining their military organizations, we still cling to one founded on patronage and prerogative. Many of our young men in different colleges and educational institutions have a taste and vocation to the military profession, and have an equal right to compete for a place in the only fields where such a taste can be gratified—viz, in the army and navy. These careers should then be open to them. There is danger and want of policy in suppressing the legitimate aspirations of young men in a nation which is, say what we can, passionately fond of military glory.

EXTRACT from the Report of the Board of Visitors of the U. S. Military Academy at West Point for 1864.

The main features of the Report of the Visitors for 1863 we most cordially approve, especially its recommendations of competitive examination, and raising the age and qualifications of candidates for admission. The only student who obtained his appointment through competitive examination (introduced into his district by the member of Congress upon whose recommendation he was appointed from the common schools * of New York) graduated at the head of his class this year.

* The successful candidate, out of twenty competitors, was a member of the Free Academy of the city of New York, and stood in scholarship about the middle of his class.

The beneficial effect on schools, as regards both pupils and teachers, of throwing open appointments in civil, as well as in military and naval service, to competition, and giving them to the most meritorious candidates, on examination, is thus commented on in the Report of the Queen's Commissioners on the Endowed Schools of Ireland:

This measure has received the unanimous approval of our body, who regard it as an effectual method of promoting intermediate education. The experience already obtained respecting the operation of public and competitive examinations, so far as they have hitherto been tried, leaves no doubt on our minds that the extension of this system would, under judicious management, produce very beneficial effects, both in raising the standard of instruction, and in stimulating the efforts of masters and of pupils. The educational tests adapted for examinations for the public service would be, in our opinion, of all others the most general in their character, and therefore, those best calculated to direct the efforts of teachers to that course of mental discipline and moral training, the attainment of which constitutes, in our opinion, the chief object of a liberal education. The experience of the civil service commission has shown the shortcomings of all classes in the most general and most elementary branches of a literary and scientific education.

These views are strongly corroborated by the testimony, appended to the Report, of prominent teachers and educators consulted on the subject:

Prof. Bullen, in the Queen's College, Cork, remarks:—"No movement ever made will so materially advance education in this country as the throwing open public situations to meritorious candidates. It has given already a great impulse to schools and will give greater. The consequence of throwing the civil service open to the public is already beginning to tell—although only in operation a few months, it has told in a most satisfactory manner in this city; and, from what I can see, it will have the happiest results on education generally."

Prof. King, Head Master of a Grammar School at Ennis, writes:—"These examinations have already caused improvements in my own school by inducing me to give instruction in branches which I had never taught before."

The Dean of Elphin, the Archdeacon of Waterford and the Bishop of Doun, advocate the measure on the ground of its tendency to produce competition between schools, and to stimulate private enterprise. The Bishop of Cashel "thought that this competition would be more valuable than the endowment of schools giving education gratuitously."

In confirmation of the above views, and as an illustration of the benefits likely to accrue both to the cause of education and to the public service from the extension of the system of competitive examinations, we may add that, at the late competitive examination for certificates of merit held by the Royal Dublin Society, Mr. Samuel Chapman, who was educated solely by the Incorporated Society, as a foundation boy, obtained the first place and a prize of £5. In consequence of this success the Bank of Ireland immediately appointed him to a clerkship. Mr. Chapman was originally elected to the Pococke Institution, from a parish school, by a competitive examination; and on his leaving the Santry school Prof. Galbraith appointed him his assistant in Trinity College, in consequence of the skill in drawing which he exhibited, and his knowledge of mathematics, as proved by his final examination.

III. COMPETITIVE EXAMINATION AT WEST POINT.

DEBATE IN THE UNITED STATES SENATE, MAY 18TH, 1864.

THE Bill making appropriation for the Military Academy being under consideration, Senator Anthony, of R. Island, remarked on the following amendment:

And be it further enacted, That hereafter, in all appointments of cadets to the Military Academy at West Point, the selections for such appointments in the several districts shall be made from the candidates according to their respective merits and qualifications, to be determined under such rules and regulations as the Secretary of War shall from time to time prescribe.

This, Mr. President, is substantially the proposition which I offered at the last session; and although I was not so fortunate as to obtain for it the assent of the Senate, mainly from an apprehension of practical difficulties in carrying out what is admitted to be a desirable reform if it could be effected, yet the general expression of Senators was so much in favor of the principle, and I have been so much strengthened in my views on the subject by subsequent reflection and examination, that I am emboldened to renew it.

I differ entirely from those who are fond of disparaging the Military Academy. It has been of incalculable service to the country; it is the origin and the constant supply of that military science without which mere courage would be constantly foiled, and battles would be but Indian fights on a large scale. Not to speak of the Mexican war, throughout the whole of which West Point shone with conspicuous luster, it is safe to leave the vindication of the Academy to the gallant and able men who have illustrated the annals of the war that is now raging. Nor have its indirect advantages been less marked than its direct. It has kept alive a military spirit, and kept up a good standard of military instruction in the volunteer militia. It furnished, from its graduates who have retired from the Army, scores of men who rushed to the head of our new levies, who organized and instructed them, inspired them with confidence, and led them over many a bloody field to many a glorious victory. Large numbers of our best volunteer officers owe their instruction indirectly to West Point.

To say that no course of military instruction can make a pupil a military genius, can create in him that rare quality that takes in at a glance, almost by intuition, the relative strength of great masses opposed to each other, and that power of combination which can bring an inferior force always in greater number upon the severed portions of a superior force, is very true. To discard military education on that account would be like shutting up the schools and colleges because they can not turn out Miltons and Burkes and Websters. Education does not create, it develops and enlarges and inspires and elevates. It will make the perfect flower, the majestic tree, from the little seed; but it must have the seed. And what I desire is that the Academy at West Point should have the best seed; that its great resources, its careful culture, its scientific appliances, should not be wasted on second-rate material. The Academy has never had a fair chance; the country has not had a fair chance; the boys have

the country. I desire that the Academy shall begin, as it goes on, upon the not had a fair chance. This is what I want them all to have, and especially competitive principle. As all its standing, all its honors, are won by competition, so should the original right to compete for them be won. I would give all the youth of the country a fair chance; and, more desirable than that, I would give the country a fair chance for all its youth. I would have the Academy filled up by those young men who, upon examination by competent judges, should be found most likely to render the best service to the country; to make the best officers; whose qualifications, physical, intellectual, and moral, whose tastes and habits, should seem to best fit them for military life.

But, it is objected, no such examination would be infallible. Of course it would not be. No human judgment is infallible. Our deliberations are not infallible; but therefore shall we not deliberate? The decisions of the Supreme Court are not infallible; therefore shall we abolish the court?

A SENATOR. The Senator from New Hampshire would say yes.

MR. ANTHONY. I know the Senator from New Hampshire [Mr. HALE] would say "Yes." He would abolish both the Academy and the Court, and I can well suppose that the policy which would abolish the one might abolish the other. But although such an examination would not be infallible, it would, if properly organized and properly conducted, accomplish much toward the reform which all admit to be desirable, if it be practicable. It can not be doubted that the young men who would come out best from such a trial would, as a body, be superior to those who are selected upon mere personal preferences, and these preferences generally not for themselves, but for their parents; not for their own qualifications, but as a recognition of the political services of their fathers.

But, again, it was objected when I made this proposition a year ago that it was not equal; because, in giving to any given place of examination, some young men would have further to travel than others! If this objection had not been gravely made by men for whom I have the highest respect I should be tempted to call it puerile. A boy asks the privilege of going a hundred miles to the place of examination, and is told that he can not have it because another boy will have to go two hundred miles, and another but fifty, and it is not equal! The fact that either of them would go five hundred miles on foot for the opportunity of competition is not taken into the account. On the same principle our elections are not equal, for one man must travel further than another to reach the polls. For a boy who can not obtain the means to travel from his home to the place of examination—and there will be very few such of those who would be likely to pass high in the examination—the plan proposed would be no worse, certainly, than the present system; for those who have the means the difference in travel is too small an item to enter into the account.

No plan can be made perfectly equal. Shall we therefore refuse to make a large advance toward equality? Certainly the system which invites a competition from all who are in a condition to avail themselves of it is more equal than that which excludes all competition. But although equality in the advantages of the Academy is very desirable, and although the amendment proposed would be a long step in that direction, it is not for that reason that I urge it. It is not to give all the young men an equal chance for the Academy, it is to give the Academy a chance for the best young men; and although even under this system the best young men will often fail of success, it can not be doubted that many more of them will enter the service than under the present system.

Nor will the advantages of this competition be confined to those who reach the prize for which so many will struggle. An incalculable although an incidental benefit will accrue to the thousands whose youthful hearts will be stirred by an honorable ambition, and who will cultivate their minds by liberal studies and develop their physical power by manly exercises in the struggle upon which the humblest may enter, and in which the proudest can obtain only what he fairly earns. Under the present system the Academy wastes full half its strength upon boys who never ought to be admitted, and whose natural incapacity derives but little benefit from the partial training that they receive there. Under the system proposed, the Academy would exert its influence upon thousands of the brightest and most aspiring boys all over the country, stimulating them to the pursuit of such studies and to the formation of such habits as, if they fail to carry them to West Point, will help to conduct them to usefulness and honor in whatever path of life they may choose.

But, again, we are met with the objection that this proposition is impracticable, that it looks very well on paper, but that it can not be carried into effect. Let us see. It is quite safe to conclude that what has been done can be done, and that what wise and judicious people do, and persist in doing after experiment, is proper to be done. What is the most warlike nation of Europe? What nation of Europe has carried military science to the highest degree? What nation of Europe has the greatest genius for organization? You will say the French. Let us see what is their sytem. I read from the report of the Commission appointed by Congress in 1860 to visit the Military Academy at West Point, and report upon the system of instruction; a commission of which you, Mr. President, [Mr. FOOT,] were a member:

Among the European systems of military education that of France is preëminent. The stimulating principle of competition extends throughout the whole system; it exists in the appointment of the student, in his progress through the preliminary schools, in his transfer to the higher schools, in his promotion to the Army, and in his advancement in his subsequent career. The distinguishing features of the French system are thus described by the British commissioners.

"1. The proportion, founded apparently upon principle, which officers educated in military schools are made to bear to those promoted for service from the ranks. 2. The mature age at which military education begins. 3. The system of thorough competition on which it is founded. 4. The extensive State assistance afforded to successful candidates for entrance into military schools whenever their circumstances require it. * * * * * *

Admission to the military schools of France can only be gained through a public competitive examination by those who have received the degree of bachelor of science from the lycées or public schools, and from the orphan school of La Flèche.

A powerful influence has thus been exercised upon the character of education in France. The importance of certain studies has been gradually reduced, while those of a scientific character, entering more directly into the pursuits of life, have been constantly elevated.

The two great elementary military schools are the School of St. Cyr and the Polytechnic School. These, as well as the other military schools, are under the charge of the Minister of War, with whom the authorities of the schools are in direct communication. Commissions in the infantry, cavalry, and marines can only be obtained by service in the ranks of the army, or by passing successfully through the School of St. Cyr, admission to which is gained by the competitive examination already referred to."

Again, the Commission say, speaking of the School of St. Cyr:

The admission is by competitive examination, open to all youths, French by birth or by naturalization, who, on the 1st of January preceding their candidature,

were not less than sixteen and not more than twenty years old. To this examination are also admitted soldiers in the ranks between twenty and twenty-five years, who, at the date of its commencement, have been actually in service in their regiments for two years.

A board of examiners passes through France once every year, and examines all who present themselves having the prescribed qualifications.

A list of such candidates as are found eligible for admission to St. Cyr is submitted to the Minister of War. The number of vacancies has already been determined, and the candidates admitted are taken in the order of merit.

Twenty-seven, or sometimes a greater number, are annually, at the close of their second year of study, placed in competition with twenty-five candidates from the second lieutenants belonging to the army, if so many are forthcoming, for admission to the Staff-School at Paris. This advantage is one object which serves as a stimulus to exertion, the permission being given according to rank in the classification by order of merit.

In regard to the Polytechnic School, the Commission say:

Admission to the School is, and has been since its first commencement in 1794, obtained by competition in a general examination, held yearly, and open to all. Every French youth between the ages of sixteen and twenty (or if in the army up to the age of twenty-five) may offer himself as a candidate.

This is the system which was organized by Carnot and adopted and extended by Napoleon. Under this system the French army has attained its perfection of organization, its high discipline, its science, its dash, and its efficiency.

But not the French alone have adopted the competitive system. In England, all whose traditions are aristocratical, where promotion in the army has so long been made by patronage and by purchase, the sturdy common sense of the nation has pushed away the obstructions that have blocked up the avenues to the army, and have opened them to merit, come from what quarter it may. In the commencement of the Crimean war, the English people were shocked at the evident inferiority of their army to the French. Their officers did not know how to take care of their men, or how to fight them. And although in the end British pluck and British persistence vindicated themselves, as they always have and always will, it was not till thousands of lives had been sacrificed that might have been saved under a better system. No French officer would have permitted that memorable charge at Balaklava, which was as remarkable for the stupidity that ordered it as for the valor that executed it, and which has been sung in verses nearly as bad as the generalship which they celebrate. After the war, the English Government, with the practical good sense which usually distinguishes it, came, without difficulty, to the conclusion that merit was better than family in officering the army, and that it was more desirable to put its epaulets upon the shoulder of those who could take care of the men and lead them properly than upon those who could trace their descent to the Conqueror, or whose uncles could return members of Parliament. Accordingly, the Royal Military Academy, which had been filled, as ours is, by patronage, was thrown open to public competition. On this subject I quote from the very interesting and valuable report of the Visitors of the Military Academy in 1863:

The same principle was applied to appointments and promotion in the new regiments called for by the exigencies of the great war in which England found herself engaged.

Subjects, time, and place of examination were officially made known throughout the kingdom, and commissions to conduct the examinations were appointed, composed of men of good common sense, military officers, and eminent practical teachers and educators. The results, as stated in a debate in Parliament five years later, on extending this principle to all public schools, and all appoint-

ments and promotions in every department of the public service, were as follows: in the competitive examinations for admission to the Royal Military Academy candidates from all classes of society appeared—sons of merchants, attorneys, clergymen, mechanics, and noblemen, and among the successful competitors every class was represented. Among the number was the son of a mechanic in the arsenal at Woolwich, and the son of an earl who was at that time a cabinet minister—the graduates of national schools, and the students of Eton, and other great public schools.

On this point Mr. Edward Chadwick, in a report before the National Social Science Association, at Cambridge in 1862, says:

"Out of an average three hundred patronage-appointed cadets at the Royal Military Academy at Woolwich, for officers of engineers and the artillery, during the five years preceding the adoption of the principle of open competition for admission to the Academy, there were fifty who were, after long and indulgent trial and with a due regard to influential parents and patrons, dismissed for hopeless incapacity for the service of those scientific corps. During the five subsequent years, which have been years of the open-competition principle, there has not been one dismissed for incapacity. Moreover, the general standard of capacity has been advanced. An eminent professor of this university, who has taught as well under the patronage as under the competitive system at that Academy, declares that the quality of mind of the average of the cadets has been improved by the competition, so much so that he considers that the present average quality of the mind of cadets there, though the sorts of attainment are different, has been brought up to the average of the first-class men of this (Cambridge) university, which of itself is a great gain. Another result, the opposite to that which was confidently predicted by the opponents to the principle, has been that the average physical power or bodily strength, instead of being diminished, is advanced beyond the average of their predecessors."

I read this also from the same report:

Another result of immense importance to the educational interests of Great Britain has followed the introduction of these open competitive examinations for appointments to the military and naval schools, to the East India service, as well as to fill vacancies in the principal clerkships in the war, admiralty, ordnance, and home departments of the Government. A stimulus of the most healthy and powerful kind, worth more than millions of pecuniary endowment, has been given to all the great schools of the country, including the universities of England, Scotland, and Ireland. As soon as it was known that candidates, graduates of Trinity College, Dublin, had succeeded over competitors from Oxford and Edinburg in obtaining valuable appointments in the East India service, the professors in the latter universities began to look to their laurels. As soon as it was known to the master of any important school that some of his leading pupils might compete in these examinations, and that his own reputation as a teacher depended in a measure on the success or failure of these pupils, he had a new motive to impart the most vigorous and thorough training.

Such has been the result in France and in England. We are not without examples at home. The competitive system has been tried in repeated instances here in the appointments both to the Military and the Naval Academy. Several Representatives in Congress, with a conscientious sense of the responsibility resting upon them, have given their patronage to the result of general competition, among them the gentleman who so ably represented, in the last Congress, the district in which I live. The results have been most satisfactory. Here, again, I will quote from the report of the Board of Visitors for 1863:

The principle itself, of selection by merit, either in the mode of public examination or of careful and searching inquiry by competent and impartial educators designated for this purpose by the parties to whom custom, and not law, had assigned the grave responsibility of nominating candidates, has been voluntarily applied in several Congressional districts. Not a cadet known to have been thus selected and appointed has ever broken down from want of vigor of body or mind, or failed to reach and maintain an honorable position on the merit-roll

of the Academy; and to this careful selection by those who felt the responsibility of the privilege accorded to them is the country indebted for its most eminent and useful officers.

The same report makes some observations on another point:

To the objection that selection by public competitive examination will involve expense, we reply that any expense which will do away with the prejudices against the Academy, which the present system of patronage has done so much directly and indirectly to evoke and foster, and which will, at the same time, exclude incompetent and secure the services of vigorous, talented, well-trained officers for every arm of the service, will be well incurred. But in our opinion there will be no more expense in selecting and educating a given number of cadets on this plan than on the present. The two thousand cadets who were appointed by patronage and failed to graduate, cost the Government, directly and indirectly, each year a much larger sum than it would have taken to have excluded them in advance from the institution by competitive examination and filling their places by better men; and their exclusion by substituting better material would have been an incalculable gain to the Academy, facilitating its discipline, increasing the value of its instruction, and giving to the Army a larger number of competent officers.

Even under the despotic government of Austria the competitive system has been adopted for the higher places, and it has been adopted by Prussia and Italy. In Austria every subject can claim admission into the military schools on payment of the cost of his instruction; and all the appointments to the staff are on the competitive system. On this subject I read from the work upon Military Education and Schools, by Hon. Henry Barnard, who stands in the very front rank of the great educators, and who gives to the competitive system the weight of a name which alone should incline us strongly in its favor:

The yearly examinations, the manner in which the marks of the monthly examinations tell on the final one, and the careful classification of the pupils in the order of merit, reminded us of the system of the Polytechnic more than any other school we have seen. * * * *

The arrangements for the general staff-school require more remark.

In our report upon Austrian schools we have specially noticed this school as remarkable for its thorough and open competitive character from first to last, and its very sensible plan of study. Admission to it is by competition, open to officers of all arms. The pupils are not unduly overburdened with work; perhaps there is even room for one or two more subjects of importance; but what is done seems to be done thoroughly. The officers are carefully ranked on leaving the school, according as the abilities they have displayed may be considered a criterion of their fitness for employment on the general staff; and in this order they enter the staff corps. The consequence is that every officer knows distinctly, from the time that he first competes for admission until his final examination on leaving, that the order in which he will enter the staff depends entirely on his own exertions and success at the school. It seemed to us that this open competition produced a spirit of confidence and energy in the students as great, if not greater, than any we met with elsewhere.

I quote from the same work in regard to the military education in Sardinia:

Admission into the artillery and engineer school may be considered the reward of the most distinguished pupils of the *Accademia Militare*, who, after spending their last year in that institution in the study of the higher mathematics, chemistry, and architectural drawing, are transferred for the completion of their education to the school of the artillery and engineers.

The staff-school, the formation of which dates from 1850, is chiefly frequented by officers of the infantry and cavalry, who must be below the age of twenty-eight years upon their entrance. It is carried on upon the competitive final examination, the ablest entering the staff corps in that order.

In the same work Mr. Barnard characterizes the Staff-School at Vienna:

The most striking features in the system of this school, both at the entrance

and throughout the course, are, that it is distinctly competitive, that it admits very young officers, and that while the work is considerable, the subjects for study are not numerous. In these three points it differs considerably from the Prussian staff-school, in which the students are generally older, and the principle of comp etition is not so fully carried out. In the Austrian school the studentsare pl aced, on entering, in the order which their entrance examination has just fixed. They are examined once a month during their stay. On leaving the school their respective places are again determined, and they have a claim for appointments in the staff corps in the exact order in which they were placed on leaving the school. In Belgium the competitive system is fully adopted.

The following testimony is from a report on the progress of the principle of competitive examination for admission into the public service, read before Section F. Economic Science and Statistics of the British Association for the Advancement of Science, at Leeds, September 27, 1858, by Edward Chadwick:

Mr. Canon Mosely attests that the "qualifications of the whole" body of competitive candidates appeared to rise above the general "level of the education of the country." It is stated in evidence before the commissioners for inquiring into the means of improving the sanitary condition of the army, that this was most decidedly so of the whole body of competing candidates for medical appointments in the East India service. Mr. Canon Mosely concludes his report on the last year's experience in the following terms: "With reference to the general scope and tendency of competitive examinations, I may perhaps be permitted the observation, that the consciousness which success in such examinations brings with it in early life of a power to act resolutely on a determinate plan, and to achieve a difficult success, contributes more than the consciousness of talent to the formation of a manly and honorable character, and to success on whatever career a man may enter."

The report of the last Board of Visitors at West Point, from which I have read, I believe has not yet been printed by Congress; I have read from a pamphlet copy of it printed in the Journal of Education. The Board was composed, as it usually is, of men of high character and ability. After a full and laborious examination of the whole subject, they unanimously and earnestly recommend the adoption of the competitive system.

If the appointments to fill and maintain the corps at this maximum [four hundred] can be selected out of the many American youths ambitious to serve their country in the Army, on the plan of an open competitive examination in the several States, the Visitors believe that ninety out of every one hundred thus appointed will go through the whole course with honor, and the average ability, scholarship, and good conduct of the whole corps will equal that now reached by the first ten of each class.

With such experience of other nations, with such examples at home, I submit that we may safely in this republican country give our young men the privileges that are conceded in imperial France and in aristocratic England; that we may safely place competition against patronage, and give to modest merit a chance with pretentious imbecility. I would go somewhat further in the competitive system. I would not have the Army or the Navy officered exclusively by the graduates of the national Academies. If any young man, at his own expense, and by his own study and aptitude for the profession, has fitted himself for a command in either, let the competition be open to him equally with those who have been instructed at the public expense, and let the epaulets rest on the shoulders that are most worthy to wear them. But I do not propose to follow the subject to this extent at present. I shall be abundantly content if the Senate will adopt the competitive system, which has worked so well in other countries and so well here as far as it has been tried, in the Military Academy.

TABLE VIII.—SUMMARY OF EXAMINATIONS FOR ADMISSION TO THE UNITED STATES MILITARY ACADEMY FOR FIFTEEN YEARS, FROM 1856 TO 1870, INCLUSIVE.

Appointed from—	Candidates.	Accepted, total.	Rejected.																						
				On what account.																					
					Literary incompetency.																				
					In the year—																Deficient in—					
			Total.	Physical disability.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	During fifteen years.	Writing, including orthography.	Reading.	Arithmetic.	Geography.	Grammar.	History.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Alabama	32	20	12	1	..	1	..	1	..	..	..	..	1	..	..	..	3	1	4	11	5	3	4	7	7	7
Arkansas	10	7	3	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	2	1	1	1	1	2	..
California	15	12	3	....	..	..	..	..	..	..	..	..	..	..	..	..	2	1	..	3	....	..	2	3	2	3
Connecticut	22	14	8	2	..	..	2	..	..	..	..	..	..	..	1	..	..	..	3	6	2	..	4	1	2	2
Delaware	11	6	5	....	..	..	..	..	..	..	..	..	..	..	1	2	..	1	1	5	2	2	4	3	3	4
Florida	4	4	....	....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	....	....	..	....	..	..	..
Georgia	32	23	9	....	..	2	1	..	..	..	..	..	..	..	..	..	4	2	..	9	7	2	7	4	3	5
Illinois	55	47	8	1	1	..	..	..	..	..	..	..	1	..	1	..	3	..	1	7	5	1	1	2	4	1
Indiana	67	46	21	2	1	2	..	3	1	..	..	1	2	3	2	2	1	1	..	19	17	8	9	3	3	3
Iowa	24	19	5	1	..	..	..	..	..	..	..	..	2	1	1	..	..	..	..	4	4	3	3	..	..	..
Kansas	6	3	3	....	..	1	..	..	..	..	..	..	..	..	..	..	..	..	2	3	2	..	1	2	1	1
Kentucky	60	43	17	....	1	..	1	..	..	1	..	1	2	1	..	..	3	2	5	17	8	5	9	7	6	6
Louisiana	18	14	4	1	..	..	1	..	..	..	..	1	..	..	..	..	..	..	1	3	2	..	3	1	1	1

Maine	26	22	4	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	2	4	3	..	2	3	1	2
Maryland	32	25	7	2	..	..	1	..	..	2	..	1	..	..	..	1	..	..	..	5	3	2	3	1	1	1
Massachusetts	43	42	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	1	..
Michigan	29	20	9	1	..	..	..	1	1	..	..	..	1	..	1	..	3	1	..	8	6	..	3	..	2	3
Minnesota	11	9	2	..	..	..	..	..	1	..	..	..	..	1	..	..	..	..	..	2	2	..	1	..	..	..
Mississippi	24	16	8	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	6	7	4	4	4	6	5	5
Missouri	48	32	16	1	1	..	1	3	2	..	..	..	..	..	2	..	2	..	4	15	12	6	7	1	6	3
Nebraska	5	4	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	1	1
Nevada	7	1	6	..	..	..	..	..	..	2	..	..	..	..	..	1	..	1	2	6	1	..	3	1	3	1
New Hampshire	14	12	2	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	1	..	..	1	..	1
New Jersey	27	25	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	..	..	1	..	..	1
New York	157	128	29	4	2	2	..	2	..	1	2	..	1	2	..	1	4	1	7	25	15	1	6	6	10	6
North Carolina	32	26	6	..	1	1	2	..	..	..	..	..	..	..	..	..	1	1	..	6	2	1	4	1	..	1
Ohio	111	80	31	4	3	2	1	1	2	2	3	..	1	1	2	2	1	1	5	27	18	13	9	3	6	4
Oregon	4	3	1	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..
Pennsylvania	127	101	26	6	1	2	2	2	..	1	2	1	..	2	..	1	..	..	6	20	13	6	10	4	5	4
Rhode Island	7	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
South Carolina	22	17	5	1	..	1	..	..	..	..	..	..	..	..	..	..	1	1	1	4	2	..	3	1	2	2
Tennessee	48	33	15	3	..	..	1	..	1	..	1	..	1	1	1	1	3	1	1	12	10	4	3	3	2	2
Texas	8	5	3	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	2	3	1	..	3	2	1	1
Vermont	13	12	1	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1	1	..	..	..	..	..
Virginia	46	34	12	1	3	1	..	1	..	1	1	..	..	..	..	..	..	..	4	11	8	4	6	3	3	2
West Virginia	10	6	4	1	..	..	..	..	..	..	..	..	..	1	..	..	1	1	..	3	2	1	1	1	1	..
Wisconsin	27	20	7	2	..	..	..	1	1	1	..	..	..	..	..	..	..	2	..	5	3	1	3	..	1	..
Dist. Columbia	6	5	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	1	..	..	..	..	..
Colorado Ter	4	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	1	1	1	1	1	..
New Mexico	5	4	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..
Utah Ter	3	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Washington Ter	4	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dakota Ter	3	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Arizona Ter	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Idaho Ter	4	..	4	..	..	..	..	..	..	..	..	..	..	..	1	1	..	1	1	4	2	..	3	2	3	2
Montana	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Wyoming Ter	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
At large	192	170	22	3	..	1	1	1	..	..	..	2	..	..	1	2	1	3	7	19	7	7	8	6	9	6
Grand totals	1,459	1,133	326	41	16	16	14	16	9	11	11	8	13	13	15	14	36	23	70	285	173	76	133	80	98	81

TABLE VIII—Continued.—SUMMARY OF EXAMINATIONS FOR ADMISSION TO THE UNITED STATES MILITARY AND NAVAL ACADEMIES DURING THE YEAR 1871.

STATES AND TERRITORIES.	U. S. MILITARY ACADEMY.											U. S. NAVAL ACADEMY.										
			REJECTED.											REJECTED.								
				On what account.											On what account.							
					For deficiency in—											For deficiency in—						
	Candidates.	Accepted total.	Total.	Physical disability.	Reading.	Writing and orthography.	Arithmetic.	Geography.	Grammar.	History.		Candidates.	Accepted total.	Total.	Physical disability.	Reading.	Writing and orthography.	Arithmetic.	Geography.	Grammar.	History.	
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.		No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	
Alabama	4	1	3	....	....	....	1	3	2	3		1	1	....	....	....	....	....	....	....	....	
Arkansas	1	....	1	....	....	....	1	..	1	1		1	1	....	....	....	....	....	....	....	....	
California	....	....	....	....	....	....	....	....	....	....		....	....	....	....	....	....	....	....	....	....	
Connecticut	2	1	1	....	....	....	1	..	1	..		1	....	1	....	....	....	....	1	....	....	
Delaware	1	1	....	....	....	....	....	....	....	....		1	1	....	....	....	....	....	....	....	....	
Florida	....	....	....	....	....	....	....	....	....	....		....	....	....	....	....	....	....	....	....	....	
Georgia	4	....	4	1	....	....	2	2	2	3		3	3	....	....	....	....	....	....	....	....	
Illinois	3	2	1	....	....	....	1	..	..	..		3	3	2	....	....	2	2	2	1	..	
Indiana	4	3	1	....	....	....	1	1	1	1		6	4	2	....	....	2	2	2	2	..	
Iowa	4	2	2	1	....	....	....	..	1	..		....	....	....	....	....	....	....	....	....	....	
Kansas	1	1	....	....	....	....	....	..	..	..		....	....	....	....	....	....	....	....	....	....	
Kentucky	7	4	3	....	2	3	2	2	3	2		2	1	1	....	....	....	1	....	....	....	
Louisiana	2	2	....	....	....	....	....	....	....	....		1	1	....	....	....	....	....	....	....	....	

Maine	1	1								1	1								
Maryland										4	2	2			1	1	1		
Massachusetts	4	3	1	1						2	2								
Michigan										1		1				1	1	1	
Minnesota										1	1								
Mississippi	3	3								3	2	1			1	1	1	1	
Missouri	4	1	3			2		1	2	3	3								
Nebraska																			
Nevada	1	1																	
New Hampshire										1	1								
New Jersey	2	1	1					1	1	2	2								
New York	15	10	5	2		1		2	3	2	11	9	2			2	2	1	2
North Carolina										2	1	1			1	1			
Ohio	9	8	1			1		1	1	1	5	3	2			1	2		
Oregon	1	1																	
Pennsylvania	13	8	5	2	1	1	1	1	3	2	5	1	4	1		3	3	3	2
Rhode Island	2	1	1	1					1		1		1	1					
South Carolina											2	1	1			1			
Tennessee	4	3	1				1	1		1	5	3	2	1					
Texas	2	2																	
Vermont	1	1									2	1	1			1	1		
Virginia	5	1	4	1		1	2	1	2	2	1	1							
West Virginia	1	1																	
Wisconsin	2	1	1			1	1		1	1	2	2							
Arizona Ter											1	1							
Colorado Ter	1	1																	
Dakota Ter																			
District of Columbia																			
Idaho Ter																			
Montana Ter											1	1							
New Mexico Ter	1	1									1	1							
Utah Ter	1	1																	
Washington Ter											1	1							
Wyoming Ter																			
Foreign											*1	1							
At large	13	10	3	2			1				17	15	2			1	2	1	1
Total	119	77	42	11	3	10	15	14	24	22	97	71	26	3		15	21	11	10

*A Japanese student.

ARTILLERY SCHOOL AT FORTRESS MONROE.

HISTORICAL NOTICE.

The Artillery School of the United States Army at Fortress Monroe, was organized and opened April 1, 1868, under a code of regulations and programme of instruction drawn up by Col. William F. Barry (who was placed in command from the start), and approved by the General of the Army. After two years of experience the code and programme were revised, and the present system established. The class of 1868 and of 1869, consisted, each, of twenty lieutenants of artillery, and of the whole number, thirty-eight were sent back to their regiments after having passed a satisfactory examination. To this number at the close of the school year (April) 1871, sixteen more out of the class of twenty were found qualified to return to their respective regiments; twenty more are now in the progress of instruction, constituting together one-half of all the officers of that grade belonging to the artillery.

COURSE OF INSTRUCTION.*

The course of theoretical instruction embraces the subjects of mathematics, ordnance, and gunnery, military engineering and surveying, military history, and military, constitutional, and international law. The method of pursuing these studies is very similar to that pursued at the Military Academy at West Point, viz., by recitations, questions, and demonstrations at the blackboard. In military history each officer is required, in addition to his regular recitations, to prepare and read before the class and staff of the school two essays or memoirs upon some battle, campaign, or the military events of some epoch of peculiar interest.

The topics for these essays are selected by the instructor in military history, with the approval of the commandant and superintendent of instruction, and are generally confined to events not prior to the last two decades of the eighteenth century.

The necessary maps, instruments, and apparatus for the elucida-

* Report of Col. Barry, dated September 12, 1871.

tion or practical application of the various subjects of the entire range of the theoretical course have to a considerable extent been supplied to the school by requisitions upon the Engineer and Ordnance Departments of the Army. They are kept in active use, and are of the greatest value.

Instructions in the theoretical course is confined to the months of autumn, winter, and the early spring, except instruction in mathematics, which unavoidably has to be given during the months of May, June, July, and August.

The course of practical instruction is pursued, as the weather permits, throughout the entire year, but is more closely attended to during the months of summer and autumn. This course consists of the service of every species of gun, howitzer, or mortar in use in the United States military service; of the use of the various kinds of projectiles and fuses; the laying of platforms; the use of plane-tables, and telemeters, for ascertaining ranges; of mechanical manœuvres; transportation and other handling of all kinds of ordnance, and particularly of the 15-inch guns and their carriages, and of 13-inch mortars and their beds, and of other heavy material which has been adopted into the artillery of the United States.

The practical course also includes very full target practice with every description of ordnance; the duties of the laboratory, as far as they immediately concern officers of artillery; and the study of and recitation in the tactics for light and heavy artillery, and as much of the tactics for infantry as is essential for artillery officers.

Guns, carriages, ammunition, platforms, artillery machines, including hydraulic-jacks of greater or less power, and other appliances, are supplied by requisition on the Ordnance Department in such number and variety as may be desired. The school is compelled to be indebted to the Ordnance Department for the occasional use, when necessary, of some of its instruments and apparatus for determining initial velocities, pressures, densities, etc.

Instruction in the practical course is designed to be as thorough as possible, and no officer leaves the school who has not become practically familiar with the tools of his trade, and able to use them intelligently.

A school for non-commissioned officers, and for such other enlisted men as may desire to avail themselves of its advantages, is also established. Every non-commissioned officer belonging to the five instruction batteries is required to attend the school for one year's full course of instruction; all other enlisted men are permitted to attend. But their attendance upon school is entirely voluntary.

Enlisted men of good character, and belonging to batteries not stationed at the post where the Artillery School is established, are also permitted to enjoy the benefits of one year's course of instruction at the school. Such men, on their own application, are nominated by their battery commanders to their regimental commanders, on whose approval they are detached from their batteries, by orders from the head-quarters of the Army, and directed to report themselves in person to the commanding officer of the school. Of this last-named class of men twenty-two have undergone or are now undergoing instruction at the school.

The course of instruction for the non-commissioned officers is both practical and theoretical. The practical course is pursued *pari passu* with that of the commissioned officers, but is not carried to the same extent, being restricted to the scope of the necessary duties and requirements of non-commissioned officers of artillery, and to the average capacity of enlisted men of that grade in our Army.

The theoretical course of instruction for the non-commissioned officers embraces mathematics, history of the United States, geography, reading, and writing. The subject of mathematics includes the entire field of arithmetic, and, for the more advanced scholars, it is carried as far as equations of the second degree in algebra. The instruction in most of the branches is conducted as in the school for commissioned officers, by recitations at the blackboard, and by questions.

Since the commencement of the duties of the Artillery School one hundred and three enlisted men (chiefly non-commissioned officers) have gone through the entire course of practical and theoretical instruction for one year, and have been awarded by the staff of the school engraved certificates, signed by each of its members, setting forth that fact.

The following-named officers constitute the staff and instructors at the school at the present date, and, with the above-stated exceptions, have been thus on duty since its first establishment:

Commandant.—Colonel W. F. Barry, Second Artillery.

Superintendent of Theoretical Instruction.—Lieutenant-Colonel I. Roberts, Fourth Artillery.

Superintendent of Practical Instruction.—Major G. A. De Russy, Third Artillery.

Member of Staff.—Major T. G. Baylor, Ordnance Department.

Adjutant of School and Secretary of Staff.—First Lieutenant I. C. Breckinridge, Second Artillery.

Instructor in Mathematics, Ordnance, and Gunnery.—Captain R. Lodor, Fourth Artillery.

Instructor in Military, International, and Constitutional Law, and in Tactics.—Captain S. S. Elder, First Artillery.

Instructor in Mathematics and Military Engineering.—Captain S. N. Benjamin, Second Artillery.

Instructor in Mathematics and Military History.—Captain E. R. Warner, Third Artillery.

Instructor in Tactics.—Captain J. W. Piper, Fifth Artillery.

A library of books of reference, professional instruction and general reading, to the number of 2,050 volumes, belongs to the school, made up of duplicates from the libraries of the War Department and the Military Academy, and a bequest of Col. Archer.

A museum of field, siege, and sea-coast artillery; specimens of primers, fuses, and projectiles; different varieties of small arms of this and other countries; instruments for inspecting cannon and projectiles, has been commenced by the Superintendent, as a useful aid to the course of practical and theoretical instruction in the school. It now numbers over 4,000 articles.

The Artillery School has been organized and conducted thus far to the satisfaction of the Department, and favor, with this arm of the service, without any special pecuniary expense to the Government by the present Commandant, Col. William F. Barry—who closes his annual Report with the remarkable paragraph:—"No special appropriation (beyond the ordinary requirements of this Military Póst) for the maintenance of this school are now needed, and none are required."

VIRGINIA MILITARY INSTITUTE AT LEXINGTON.

HISTORICAL NOTICE.

THE VIRGINIA MILITARY INSTITUTE at Lexington, was established in 1839, and was organized and conducted from the start on the plan of the Military Academy at West Point, by Col. Francis H. Smith, a graduate of that institution of the class of 1833, and professor there from 1834 to 1836.

The State makes an annual appropriation of $15,000 for its support, on the basis of which a certain number (usually 36) cadets are admitted without charge; in consideration of which they are required to teach in some school of the State for two years after graduation. In the selection of State cadets regard is had to their capacity to profit, and inability to pay the expenses of tuition and board, and an equal representation of each senatorial district. Any commissioned officer of the militia of the State can become a student for a period not exceeding ten months, and receive instruction in any or all departments of military science taught therein, without charge for tuition.

The course of instruction was from the start distinctly scientific, and since its return [from Richmond where it was removed after the destruction of its building and library, when Lexington was taken possession of by Gen. Hunter] in 1866, and its reorganization on its present basis of a general School of Applied Science, it has become even technic in reference to all the chief industries and natural resources of Virginia.

The origin and military character of the Institute are thus set forth by the Superintendent in an address to the Corps of Cadets, Sept. 10, 1866:

"Peculiar circumstances gave to this Institution its distinctive military character. Here the State had a deposit of arms, in an arsenal, which had been established for many years before the organization of the Institution, and the annuity which had been formerly given to the public guard by the State, was transferred to the Virginia Military Institute, as the basis of its support. Upon this foundation the Virginia Military Institute was established, and as the duty imposed upon the cadet was military, so military discipline and military instruction became an essential and distinctive feature in the education it supplied. Besides daily exercises in the school of the soldier, company, and battalion in *infantry*, and of the piece and battery in *artillery* tactics, minute instruction is

given in the class-room, upon all the theoretic branches of the military art, embracing, in addition to those enumerated, *ordnance* and *gunnery*, *military strategy* and *military history*, and the principles and practice of field and permanent fortifications.

It is not necessary that I should say any thing, at this time, to vindicate the completeness of the arrangements made in this institution for theoretical and practical military education. The sanguinary conflict which has just closed has fully tested its efficiency. *One-tenth* of the Confederate Armies was commanded by the élèves of this school, embracing three *major generals*, thirty *brigadier generals*, sixty *colonels*, fifty *lieutenant colonels*, thirty *majors*, one hundred and twenty-five *captains*, between two and three hundred *lieutenants;* and the terrible results of the battles, in numbering one hundred and twenty-five of these among the *killed*, and three hundred and fifty among the *wounded*, show that the élèves of this institution met the call of their country with an earnestness of devotion which places them in most honorable distinction for their heroic defense of what they believed to be right.*

We give the organization and course of instruction from the latest Circular, issued by the Superintendent.

Academic Staff.

Superintendent, and Professor of Mathematics and Moral Philosophy—General Francis H. Smith, A. M.

Professor of Latin, and English Literature—Col. John T. L. Preston, A. M.

Professor of Practical Engineering, Architecture, and Drawing—Col. Thomas H. Williamson.

Professor of Agriculture—Col. Wm. Gilham, A.M., (Philip St. George Cocke).†

Professor of Animal and Vegetable Physiology applied to Agriculture—Col. Robert L. Madison, M. D. (Mercer).‡

Commandant of Cadets, Instructor of Infantry, Cavalry, and Artillery Tactics, and Professor of Military History and Strategy—Col. Scott Ship.

Professor of Mathematics—Col. James W. Massie.

Professor of Natural and Experimental Philosophy—Col. William B. Blair, (Jackson).

Professor of Civil and Military Engineering and Applied Mechanics—General G. W. C. Lee.

Professor of Practical Astronomy, Geology, Descriptive and Physical Geography and Meteorology—Col. John M. Brooke.

Professor of Geology, Mineralogy, and Metallurgy—Col. Marshall McDonald.

Professor of General and Applied Chemistry—Col. M. B. Hardin.

Professor of Modern Languages—Col. Thomas M. Semmes.

Professor of Physics and Superintendent of Physical Survey of Virginia—Commodore M. F. Maury, LL D.

Professor of Fine Arts—Col. William D. Washington.

Assistant Professors.

Assistant in Physics—Col. W. E. Cutshaw.

Assistant Professor of French Language—Capt. O. C. Henderson.

Assistant Prof. of Chemistry, Mineralogy, and Geology—Capt. J. H. Morrison.

Assistant Professor of English, and Drawing—Lieut. James H. Waddell.

Assistant Professor of Latin—Capt. Wm. M. Patton.

Assistant Professor of Mathematics—Lieut. R. H. Cousins.

Assistant Prof. of Geography, Drawing and Tactics—Capt. Wm. B. Pritchard.

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* Although no one institution contributed so large a number of officers to the Confederate Armies, the Military Institute at Frankfort, Ky., the Cadet Corps connected with the arsenals in Norfolk, Richmond, and other Southern cities, and the State Military Institutes in Alabama and Louisiana, furnished a large number of subordinate officers, which facilitated the early organization of the armed forces of the South.

† Gen. Cocke, in 1866, gave $20,000 to endow this professorship.

‡ Dr. Mercer of Louisiana, made a donation of $11,800 to this chair.

Assistant Professor of Mineralogy, Latin, and Tactics—Capt. W. H. Butler.
Assistant Professor of Natural Philosophy and Latin—Lieut. R. E. Nelson.
Assistant Professor of Mathematics—Lieut. W. C. Powell.
Assistant Professor of Latin—Lieut. James E. Heath.
Assistant Professor of Drawing—Lieut. M. Palmer.
Assistant Professor of Tactics—Capt. W. Denham.
Assistant Professor of Mathematics, &c.,—Capt. G. K. Macon.

Military Staff.

Surgeon—Col. R. L. Madison,
Ass't Surgeon—H. T. Barton, M.D.
Act'g Treasurer—Capt. W. A. Deas.
Com. and Steward—Capt. J. T. Gibbs.
Adjutant—Capt. F. H. Smith, Jr.

III. SCHOOLS AND COURSES OF INSTRUCTION.

Academic Schools.

First Year—Fourth Class.—Arithmetic (Smith and Duke's); Algebra (Smith's); Geometry (Smith's Legendre); Plane and Spherical Trigonometry (Smith's); French (Levizac and La Porte's Grammar, Gil Blas, Pinney No. 5, Fasquelle); Geography (Maury); Pencil and Pen Drawing: Composition and Declamation; Latin (Cæsar, Virgil, Cicero, Horace).

Second Year—Third Class.—Descriptive Geometry (Smith's); Analytical Geometry (Smith's Biot): Shades, Shadows and Perspective (Lectures); Differential and Integral Calculus (Courtenay and La Croix); Surveying (Field Exercise); French (Noel and Chapsal, Laporte and Collot, French Classics); Latin (Cæsar, Virgil, Livy, and Cicero); Mechanical Drawing, Composition, and Declamation; Physics (Ganot).

Third Year—Second Class.—Natural Philosophy (Bartlett and Bouchalat's Mechanics, Bartlett's Optics and Acoustics, Bartlett and Gummere's Astronomy): Latin (Terence and Horace); Chemistry (Fownes, and Practical Instruction in Laboratory); Physical Geography (Somerville); Infantry Tactics.

Fourth Year—First Class.—Civil Engineering (Mahan, Rankine, and Lectures); Military Engineering (Laisne, aide memoire); Architecture (Lectures and Drawing); Human Physiology (Kirke); Military History and Strategy (Jomini); Rhetoric (Blair); Intellectual Philosophy (Wayland); Logic (Whately); Moral Philosophy (Paley and Butler); Constitution of United States (Kent); Mineralogy (Dana); Geology (Gray and Adams); Infantry tactics (Hardee); Artillery and Ordnance (Benton and United States Tactics).

Special School of Applied Science.

The Special School of Applied Science, in the Virginia Military Institute, is arranged in seven *Courses*, which may be prosecuted separately or in combination: 1. Architecture; 2. Civil Engineering; 3. Machines; 4. Mining; 5. Analytical and Applied Chemistry; 6. Metallurgy; 7. Agriculture.

I. ARCHITECTURE.—1. *Drawing*—Including pen and colored topography, mechanical lettering and coloring. 2. *Materials*—Stone, brick, wood, mortar, mastics, glue, paints, &c. 3. *Masonry*—Retaining walls, walls of inclosure, edifices, ornaments, arches, stone-cutting. 4. *Carpentry*—Timbers, framing, beams, joints, floors, partitions, roofs, domes, centres, windows, stairways. 5. *Foundations*—In water, on land. 6. *Classical Architecture*—Orders, Egypt, Rome, Greece. 7. *Design.* 8. *Romanesque.* 9. *Gothic.*

II. CIVIL ENGINEERING.—1. *Drawing*—Pen and colored topography, mechanical, etc. 2. *Materials*—Same as in Course of Architecture. 4. *Carpentry*—Same as in Course of Architecture. 5. *Foundation*—Same as in Course of Architecture. 6. *Surveying*—Running lines and curves for common and railroads, canals, leveling profiles, estimates, &c. 7. *Bridges*—Stone, Wooden, Iron. 8. *Common Roads.* 9. *Railroads.* 10. *Tunnels.* 11. *Locomotives.* 12. *Canals.* 13. Rivers, Docks, Harbors. 14. *Mining.*

III.—MACHINES—GENERAL PRINCIPLES OF MACHINES.—*Muscular Power*—Power of men, Power of horses, etc. *Water Power and Wind Power*—Sources of water for Power. Water-Power Engines in general. Water-Bucket En-

gines. Water-Pressure Engines. Vertical Water-wheels. Turbines. Fluid-on-Fluid, Impulse-Engines, Windmills. *Steam and other Heat Engines*—Relations of the Phenomena of Heat. Combustion and Fuel. Principles of Thermo-dynamics. Furnaces and Boilers. Steam-Engines. Electro-Magnetic Engines.

IV.—MINING.—*Course of Lectures on Mining*—Embracing prospecting, breaking ground, boring, blasting, tubing, sinking shafts, driving tunnels, ventilating and lighting; the different methods of working mines; mining machinery and motors, engines, horses, pumps, wagons, drums, etc.; dressing and concentration of Minerals, crushers, stamps, washers, amalgamators, etc.; quarrying and open workings; details of mining in this country and statistics.

Drawing.—Geological maps and sections; coloring the same; and plans and sections of mines, quarries and other open workings; mining machinery and implements; plans of ventilation.

V.—METALLURGY.—*Geology* of Coal, Iron, Copper, Lead, Zinc, Salt, etc.

Metallurgy—Review of more important metals and their ores; Metallurgical implements, structures, and processes, crucibles, furnaces, blowing machines; details of the smelting and manufacture of Iron, Copper, Lead, Silver, Gold, etc.

Drawing—Coloring of maps and sections; drawing of furnaces, refiners, cokeing ovens; Metallurgical apparatus.

VI.—ANALYTICAL AND APPLIED CHEMISTRY.—In the Laboratory facilities are afforded for prosecuting the various branches of practical Chemistry. Each student will work independently of the others, receiving personal guidance and instruction from the Professors. In the last year the course may be varied according to the special object the student has in view.

The following is an outline of *Systematic Course for Students in Mining and Metallurgy:* 1. Qualitative Analysis. 2. Quantitative Analysis; (*a.*) Analysis of substances of known composition; (*b.*) Analysis of ores, slags, etc. 3. Assayers —Ores of Lead, Silver, Gold, Iron, Copper, etc.

VII.—AGRICULTURE.—1. *Chemistry*—General and applied to Agriculture. 2. *Mineralogy.* 3. *Histology.* 4. *Vegetable Physiology.* 5. *Agricultural Botany.* 6. *Zoology.* 7. *Civil Engineering*—Applied to farm bridges, roads, drainage. 8. *Rural Architecture.* 9. *Drawing.* 10. *Anatomy and Physiology of Sub-Kingdom*—Vertebrata. 11. *Human Physiology.* 12. *Hygiene and Dietetics.* 13. *General Botany.* 14. *Animal Toxicology.* 15. *Veterinary Practice.* 16. *General Principles. Chemistry, Geology, Mechanics, and Domestic Economy.*

IV. SYSTEM OF INSTRUCTION AND GOVERNMENT.

The System of Instruction and Government is founded upon that of the United States Military Academy at West Point.

As soon as a young man enters the Institution, it assumes over him an entire control, and not only directs his moral and intellectual education, but provides every thing required for his personal wants or comfort. A Cadet, may, if his parents desire it, remain in charge of the Institution for the entire term of four years, as the system of government keeps it always in operation. The months of July and August, in each year, are devoted exclusively to Military Exercises. Furloughs are granted to those who may desire it, in turn, during this period. The Cadets are lodged and boarded in the Institution, their Clothing, Books, and other supplies, being provided by the Quartermaster of the Institute, *at cost.* The sick are under the special care of the Surgeon, with Hospital and other facilities for nursing.

The energy, system, subordination, and self-reliance which the military government of the Institute cultivates, give a practical character to the education which it supplies. The high reputation which its Alumni have established for the School is the evidence of its value.

V. DEGREES.

A Diploma, signed by the Governor of Virginia and by the Visitors and Faculty, is awarded to all Cadets who may pass approved examinations on all the studies of the Academic School, with the title of "*Graduate of the Virginia Military Institute.*" A like Diploma is awarded to all who may complete the course prescribed for either of the *Special Schools of Applied Science,* with the title of "*Graduate*" in such school.

MILITARY TACTICS IN STATE SCHOOLS OF SCIENCE.

INTRODUCTION.

In the Act of Congress (July, 1862) making grants of public lands to the several States for the endowment of State Schools of Agriculture and the Mechanic Arts, it is provided that military tactics shall be included in their schemes of instruction; and by an Act of March, 1869, the President is authorized to detail an army officer to each institution, to instruct in such tactics. On these two provisions, with further coöperative legislation, State and National, a system of military instruction can be gradually developed, which, for economy, efficiency, and uniformity, will meet all the conditions of a national armament, and compare favorably, as against foreign invasion or domestic insurrection, with that of Switzerland or Prussia. Thus far the subject has received only slight attention, and the connection of these departments with the State militia, or volunteer companies, or the appointment of cadets to our national military schools or to vacancies in the army, has not been discussed. We state briefly what is attempted in a few of these schools:

CORNELL UNIVERSITY AT ITHACA, N. Y.

In Cornell University (to which the United States Land Grant of 989,000 acres of land was assigned by the Legislature of New York, and which Mr. Ezra Cornell has endowed with the sum of $525,000, securely invested and drawing interest at seven per cent.), the military tactics is incorporated into the general organization of the students, and made the basis of the College of Military Science. (1.) Attendance on military exercises is made obligatory on every able-bodied student; and for this purpose the whole number is organized into a military corps—arms and equipments being furnished by the State—under the Military Professor, who has the title of Commandant, and is aided in his duties by a staff, selected in view of military aptitude, general deportment, and proficiency in studies. (2.) All students are required to observe and conform to such regulations as may, from time to time, be promulgated by the Commandant; provide themselves with the university cap for ordinary wear, and with the blouse or fatigue cap for parade; and are

held to strict accountability for the proper use of the arms and other property issued to them. (3.) The practical instruction for all students embraces infantry and artillery tactics, and special exercises with the sabre, sword, and bayonet; and (4.) for those who elect, a military course consisting of (a.) *Military Engineering*, (b.) *the Art of War*, and (c.) *Military Law*. At the close of each year, after the graduating exercises, the Faculty will recommend to the Governor of the State a list (not exceeding one in every ten of such graduates), distinguished for general proficiency in any one of the complete University courses, special attainments in military science, expertness in military exercises, and of good moral character and of sound health, with a request to transmit the same to the President of the United States for his consideration in making appointments for positions in which such qualifications are demanded.

STATE AGRICULTURAL COLLEGE AT AMHERST, MASS.

The Military features of the Course of Study were originally administered by Capt. Henry E. Alvord, of the United States Army, who had been specially charged with this instruction in the Military Institute and University at Norwich, Vt. The specifications are:

FRESHMAN YEAR.—*First Term*—Military Drill; Infantry Tactics; School of the Soldier; *Second Term*—Do.; and School of the Company and Manual of Arms. *Third Term*—Do.; and School of the Company and Battalion.

SOPHOMORE YEAR.—*First Term*—Military Drill; Infantry Tactics; Manual of the Bayonet and Instruction in duty as Skirmishers. *Second Term*—Do.; and Bayonet Exercise. *Third Term*—Do.; and Skirmish and Battalion Drill; Guard Duty; and Forms of Parade and Review.

JUNIOR YEAR.—*Third Term*—Military Drill; Artillery Tactics; School of the Piece. *Second Term*—Do.; and Artillery and Cavalry Tactics; Manual of the Sabre; School of the Trooper dismounted; Instruction in Heavy Artillery Tactics and Gunnery. *Third Term*—Do.; School of the Section; Infantry Tactics; Battalion Drill.

SENIOR YEAR.—*First Term*—Military Drill and Cavalry, Artillery and Infantry Tactics; Duty as Drill Masters and Officers in Infantry and Artillery Drill; Theoretical Instruction in Cavalry Tactics, and the organization and uses of Cavalry. *Second Term*—Military Drill and Cavalry Tactics; Sabre Exercise. *Third Term*—Military Drill; Target Practice; Sword Play: and General Drill.

The Committee of Examination for 1870 report as follows:

Your Committee can not refrain from alluding to the interest which all the young men take in the drills, the evident beneficial effect upon their bearing and health, and the value of the accomplished soldiers and officers thus made for the future service of the Commonwealth, in the event of another call to send forth her sons for herself or the nation. Were no other result accomplished by this institution, the money of the Commonwealth could be no more judiciously expended, and yet this is but an incident to the regular course.

The Principal, Col. Clark, writes: "We have a fine hall for in-door exercise, and are furnished by the State with cannon, breech-loading rifles, sabres, &c., and consider our course a decided success. Our graduates are able to act as officers in infantry and artillery regiments, and I believe our system, as we are organized and taught by a West Point graduate, a most excellent and economical substitute for the ordinary militia system."

LOUISIANA STATE UNIVERSITY.

THE LOUISIANA STATE UNIVERSITY was founded as "a State Seminary of Learning and Military Academy" by the Legislature in 1855, near Alexandria, in the Parish of Rapides, on endowments of land made by the General Government at different times, from 1806 to 1827, for establishing "a Seminary of Learning." It was opened for the reception of students, January 2, 1860, and organized on a military basis, under the superintendence of Col. W. T. Sherman (now General-in-Chief, United States Army), who resigned his position, February 2, 1861, on the hostile demonstration of the State of Louisiana against the authority of the United States. The instruction of the institution continued under Col. W. E. M. Linfield, till April 22, 1863, when its operations were closed by the disasters of the War, to be reopened on the first of October, 1865, only to be closed again by the utter destruction of its extensive buildings by fire on the 15th of October, 1869. On the 1st of November following, its exercises were resumed at Baton Rouge, in the extensive building of the Asylum for the Deaf and Dumb, which was placed temporarily for the occupancy of the classes, and a portion of the students. The session of 1871, under the superintendence of Col. D. F. Boyd, closed with 217 matriculated Cadets, of whom 128 were admitted on the State Cadet warrants.

The Law of March 16, 1870, relative to the appointment of Beneficiary Cadets, provides that each parish shall delegate two, and the city of New Orleans, by its Board of School Directors, twenty cadets, to be selected from the members of the highest class in the public school of such parishes and city, distinguished for their scholarship and good conduct, and whose parents may not be able to provide for their necessary expenses for tuition and maintenance at the State Seminary; and at the expiration of their residence at the University which can not exceed four years, these Beneficiary Cadets are required to teach school within the State for two years, on penalty of default to the amount of the sum paid by the State.

WABASH COLLEGE, CRAWFORDSVILLE, INDIANA.

By arrangement with the Trustees of Wabash College, the Legislature of Indiana has authorized the County Commissioners of each county to appoint one person to receive the advantages of the institution for five years, free of tuition, in consideration of a portion of the State's quota of the United States Land Grant, for agricultural and mechanical Arts Colleges; and to meet the requirements of the law of Congress, the college has established a Scientific Course,

and under the superintendence of a Professor of Military Science, daily instruction in Tactics and Gymnastics is given to the students by divisions with a weekly drill of all, as a battalion. The *College Courant* thus notices the new hall for Gymnastics and Tactics:

The physical culture of this institution is under the charge of the Chair of Military Science, and for the purpose of this culture a building has been erected which is more comprehensive than usual in gymnasiums, and is quite unique in some particulars. Work was commenced last August, and in fifty days the roof was receiving the slate. The building presents the form of a cross, of equal members, and the ground service of seven thousand five hundred feet, is thus divided: A marching and running course, of three hundred feet, twelve feet wide, and seventeen feet high; a gymnasium sixty feet by twenty-six, and twenty-four feet high, ventilated and lighted by a central tower fifty feet in height; an armory and gun-room, for care of small arms and artillery; and a room for fencing, boxing, quoits and other manly exercises. In the four transepts above, are topographical room, model room; reading room, for maps, charts, etc., and bath rooms. All these, through interior glass fronts, furnish a full view of the Exercise Hall, within and below. The small-arms used, are the "light, cadet, breech-loading rifle," similar to those last issued to the Military Academy at West Point, and were manufactured by the United States at the Springfield Arsenal for the use of students receiving their instruction.

CALIFORNIA STATE UNIVERSITY.

The University of the State of California has a Military Department to meet the requirements of the Act of Congress, under the directions (1871) of Professor (General) Welcker and Assistant Professor F. Soulé, graduates of the West Point Academy. The Adjutant General (Thos. N. Cazneau) of the State in his Report to the Governor, dated September 1, 1870, remarks:

The gratifying success with which the military department of the State University has been conducted is worthy of special notice, and I am happy to announce that perfect discipline and a high state of proficiency pervade the department of military study at that institution. The cadets were incorporated with the National Guard of the State by Act of the last legislature, and have been formed into four companies of infantry, and instructed most fully and perfectly in that branch of military service. A personal inspection of the battalion enables me to speak of its condition with confidence. I find both officers and cadets thoroughly up to the requirements of the infantry soldier, perfect in carriage, most proficient in the use of arms, steady in marching and all company formations, and, in the manœuvres of the battalion, challenging an admiration worthy to be elicited by a veteran soldiery. Their *ensemble* is striking, and the effect of a thorough military training upon the young gentlemen of the University is largely manifested in their erect and graceful personal appearance and movements, apparent not only when upon duty but in their ordinary walks of every-day occupation; while the gentlemanly and high-toned courtesy that pervades the whole body may not unjustly be attributed, in a large degree, to their military studies and military habits. The young officers evince excellent characteristics of command, great dignity of deportment and admirable ability in imparting instruction. I can not too highly commend to your attention the whole military condition of the cadets of the State University, and to ask for them your fostering care and encouragement, and that of the Legislature.

There are several colleges in California in which military instruction is introduced; prominent among them is St. Augustine College at Benicia, and McClure's Academy at Oakland. At each there are about 100 boys, fully equipped and drilled as infantry soldiers.

INDIVIDUAL AND CORPORATE INSTITUTIONS

FOR

MILITARY INSTRUCTION.

ALDEN PARTRIDGE.

Alden Partridge, Captain in the United States Corps of Engineers, Professor and Superintendent of the Military Academy at West Point, and the Founder of a class of institutions in which the military element is recognized and provided for as an essential part of the training of the American citizen, was born at Norwich in Vermont, on the 12th of January, 1785. His father was a farmer, in independent circumstances, served in the war of the Revolution, and took part in the capture of Burgoyne and his army at Saratoga. He brought up his son in the New England fashion, at such district school as the times and the country afforded in the winter, and at all sorts of work about the house and on the farm at other seasons, until he was sixteen years of age, when, being of studious turn, and fond of reading, he was allowed to fit for college, and entered Dartmouth in August, 1802. We have no knowledge of his studies in college, but it is presumed that his predilections were for the mathematics, and from the lateness with which he commenced his Latin and his subsequent declarations, his aversion was for the languages. Before completing his collegiate course he received the appointment of cadet* in the regiment of artillerists in the United States service, with orders to repair to West Point, and report himself to the commanding officer of the Military Academy at that place.

The Military Academy at the time Cadet Partridge arrived at West Point was very inadequately equipped with the men and material aids of instruction, although the two teachers appointed

* A *Cadet* in the military organization of the Army denoted a junior officer between the grade of lieutenant and sergeant, and was introduced from the French service. An Act of Congress, passed May 7th, 1794, provided for a Corps of Artillerists and Engineers, to consist of four battalions, to each of which eight *cadets* were to be attached, and authorized the Secretary of War to procure at the public expense the necessary books, instruments and apparatus for the use and benefit of said corps. In 1798, an additional regiment of Artillerists and Engineers was raised, increasing the number of Cadets to fifty-six. In 1798, the President was authorized to appoint four teachers of the Arts and Sciences necessary to Artillerists and Engineers. No appointment was made till 1801, and in 1802, the Military Academy was established at West Point, where the corps of Engineers was directed to repair with fifty Cadets, and the Senior Officer of the Corps was constituted Superintendent. Col. Williams was then Senior Officer of Engineers, and became, *ex-officio*, Superintendent, and continued such until 1812.

were abundantly capable in their respective departments. Jared Mansfield, especially, the teacher of natural philosophy, had won such reputation in mathematical studies that he received his commission as a captain of engineers from Mr. Jefferson for the very purpose of becoming a teacher at West Point, which he did by appointment in 1802, although in reality he did not perform his duties regularly, and then only for one year, having been, in 1808, appointed by President Jefferson to the responsible post of Surveyor-General of the North-western territory. Such instruction as was given was received by Cadet Partridge in 1806, and in July of that year, he was transferred to the Corps of Engineers, and in October, commissioned as first lieutenant. In November, 1806, he was appointed assistant professor of mathematics, Fedinand R. Hassler, a little later, having been made Professor in place of Capt. Barron, retired. From Prof. Hassler, he received great help in his mathematical studies, as he afterwards repeatedly acknowledged. In 1808, Prof. Partridge was called to act in place of the Superintendent in the absence of Col. Williams, and continued to do so, with brief intervals, until January, 1815, when he was appointed to the office which he filled till March, 1816. In 1809, Mr. Hassler resigned the professorship of mathematics, and the instruction before given by him devolved on his assistant, Mr. Partridge. In 1810, he succeeded, after repeated applications to the Secretary of War, in obtaining two field pieces, for practical instruction of the Cadets as Artillerists.

In 1812, the Academy was re-organized, and was made to consist of the Corps of Engineers and the following Professors, in addition to the teachers of the French language and drawing, viz.: "one professor of natural and experimental philosophy; one professor of mathematics; and one professor of the art of engineering; each professor to have an assistant taken from the most prominent of the Officers or Cadets." The number of Cadets was increased to two hundred and fifty, and were directed to be arranged into companies of non-commissioned officers and privates, according to the directions of the commandant of Engineers, and be officered from that corps, "for the purposes of military instruction, in all the duties of a private, non-commissioned officer, and officer, and to be encamped at least three months of each year, and taught all the duties incident to a regular camp." The age of admission was fixed, the minimum at fourteen, and maximum at twenty-one, and preliminary knowledge to be well versed in reading, writing, and arithmetic. It was further provided that any Cadet who shall receive a regular degree from the Academical Staff, after going through all the classes,

shall be considered among the candidates for a commission in any corps, according to the duties he may be judged competent to perform. The sum of $25,000 was appropriated towards the buildings, library, implements, &c. On this broad basis the Academy was progressively enlarged to its present capabilities of usefulness.

Under the new arrangement of 1812, Mr. Partridge was appointed professor of mathematics, with the pay and emoluments of a major, which appointment was soon after, at the request of the Secretary of War, exchanged for that of professor of engineering, it being found more difficult to fill the latter post than the former. The duties of this professorship he continued to discharge from September 1, 1813, till December 31, 1816.

In 1808, Capt. Partridge was ordered by Col. Williams to take charge of the internal direction and control of the Military Academy as Superintendent, which duties he discharged until January 3, 1815, when, by regulations of that date, he was made the permanent Superintendent, which post he held till November 25th, 1816, and was finally relieved on the 13th of January, 1817.

By the regulation of January 3, 1815, the commandant of the Corps of Engineers was constituted *Inspector* of the Academy, and made responsible for instruction, and to report to the Department of War. Out of this appointment, and the instructions relating thereto, grew a difference of opinion, which resulted in the final withdrawal of Capt. Partridge from the institution, the resignation of his commission in the military service of the United States, and his subsequent devotion to the dissemination by lectures and personal efforts of the views which he had formed of the education required by the American citizen, and the establishment of institutions in which these views could be carried out.

After resigning his commission in the military service of the United States, Capt. Partridge was engaged, in the summer of 1818, as military instructor to a volunteer corps, and in giving a course of lectures on fortifications and other branches of military science to a class of officers and citizens in the city of New York. The views which he then presented on the best means of national defense were in advance of the "piping times of peace" in 1818, but have been since demanded to be eminently sound and practical by the terrible experience of 1861—1862.

His chief reliance for national defense was in the *military habits* of the great body of the American people—organized into suitable militia departments corresponding in the main to the limits of the several states, officered by men of the right capacity, scientific

education, and military training. The officers were required to assemble annually at stated periods, either in camps or rendezvous, at some central point in the department, to receive instruction from a few competent teachers of the military art. We give the plan in his own language as published at the time.

I. Let the United States be divided into military departments, say thirty in number; each of those departments to be wholly comprised within the same state, whenever this can be done.

II. To each of those departments let there be attached a military instructor, (under the authority of the United States,) who should receive the pay and emoluments of a colonel of infantry, and have the brevet-rank of a brigadier-general. These instructors to be gentlemen of established character and reputation, and who have received a regular scientific military education.

III. Let the officers of each brigade of militia in the United States be required to assemble annually at stated periods, either in camp or rendezvous, at some central point in the brigade, there to remain six days, for the purpose of military instruction. Let each instructor attend in succession at the several camps or places of rendezvous in his department, and devote himself assiduously to the instruction of the officers there assembled. One portion of the day might be devoted to practical drills, and field evolutions—also to the turning off, mounting, and relieving guards and sentinels, while the remainder could be most usefully employed in explaining and illustrating the principles of tactics generally, of artillery, of permanent and field fortification, the duties of troops in camp and in garrison, and such other branches as time and circumstances might permit, by means of familiar explanatory lectures.

IV. Let each officer receive from the government a reasonable allowance for his expenses while attending the instruction, and also while going to, and returning from, the camp or rendezvous.

Some of the principal advantages that would result from the adoption of the foregoing plan, I conceive would be as follows, viz.:—

1. The same system of tactics and discipline would pervade the whole mass of the militia—the instructors being imperatively required to adhere to one system. This would be a very important advantage.

2. By this means the country, in the course of a few years, would be furnished with a well organized military force, of at least one million of men, composed of the best materials in the world for soldiers; the whole of which, the officers having been regularly and correctly instructed, might be rendered, in the course of a few weeks, after being called into service, perfectly competent to the efficient discharge of all the duties of the field. This assertion is not founded upon conjecture. An experience of nearly fifteen years in military instruction, has convinced me, that any of our regiments of militia, in their present state of discipline, if brought into the field and placed under competent officers, could, by three weeks instruction, be prepared for discharging all the duties of regular troops. The instruction, then, in time of peace, of the officers, becomes an object of great importance;—that of the privates is of secondary consideration. There is no difficulty in making soldiers, when officers understand their duty, and are disposed to perform it.

It may perhaps be objected to the foregoing plan, that the time proposed for the officers to remain in camp or rendezvous, is too limited to admit of their deriving much advantage therefrom. In answer to this I will observe, that a due share of experience in this species of instruction, has fully convinced me, that they would acquire more correct military information in six days, under a competent and systematic instructor, than they usually acquire under the present system, during the whole period from eighteen to forty-five years of age; and that, after attending two or three similar courses, the great body of them would be perfectly competent to the correct, efficient, and useful discharge of all the duties of the field. From the best calculation I have been able to make,

I feel confident, that the whole necessary expense of carrying this plan into full and effective operation, would not exceed six hundred thousand dollars—it would probably fall short of that sum. Whether the expense, then, is to be considered as disproportionate to the object in view, and therefore to constitute a barrier to its accomplishment, must be decided by the sound discretion of the representatives of the people. It appears to me, however, to bear no greater ratio to it, than does a grain of sand to the globe we inhabit. The cultivation of military science must also be viewed as of the first importance in a system of military defense for our country. The plan already detailed, is calculated for the general dissemination of practical military information throughout the community, but is not adapted to the investigation of principles. This can only be done at seminaries, where it constitutes a branch of regular attention and study; and where theory and practice can, in due proportion, be combined. At those seminaries would be formed our military instructors, our engineers, and our generals; and from those, as from so many foci, would all the improvements in the military art be diffused throughout the country.

In the lectures delivered in 1818, Capt. Partridge, in view of the inevitable disintegration by frost and moisture, and the improvements in the science of attack, anticipated the insufficiency of permanent fortifications—of works of masonry, no matter how expensively or strongly constructed—to the defense of our principal harbors against the attacks of a foreign foe; his reliance was on the general diffusion of military science and training amongst the militia, on an efficient navy, and the following plan of marine defense.

I. At the most important and exposed points on our seaboard, let one or two principal works of the most permanent kind be erected: these works to be kept in perfect repair, to be plentifully supplied with all the munitions of war, and the guns and carriages well secured from the weather by means of pent houses.

II. In the vicinity of all the most exposed and vulnerable points on the seaboard, let spacious and permanent arsenals be constructed, in which, let there be deposited ample supplies of cannon, mortars, gun carriages, materials for platforms, and other munitions of war, where they would remain perfectly safe from the weather.

III. In case of war or threatened invasion, let temporary works, either of earth, or of wood, be constructed at all the most vulnerable points, which could be readily furnished with cannon, gun carriages, platforms, and all the necessary implements and munitions from the arsenals in their vicinity.

IV. As soon as peace is restored, these works should be dismantled, and all their apparatus returned to the arsenals from whence it was taken. In case of future emergencies, they could be restored, or others of the same descriptions constructed in their places, which could be supplied from the arsenals in the manner above stated. The efficacy in marine defense, of works of the above description, I presume will not be doubted by any scientific military man. Should any one, however, be disposed to doubt it, I would beg leave to refer him to the defense of Fort Moultrie, in the harbor of Charleston, South Carolina, when attacked by the British shipping, during the Revolutionary war, and also to the defense made by the small fort at Stonington, Connecticut, when attacked in a similar manner during the last war.

By adopting this system, I think the following advantages would result:—

1. A more secure defense would be obtained. By knowing the description of force we had to encounter, we should be enabled to construct our temporary works in a manner the best calculated to repel it; and as the gun carriages, platforms, and implements, when taken from the arsenals, would be sound and in perfect order, we might reasonably calculate these works would make a more

vigorous resistance than permanent ones, which, with their apparatus, are in a state of partial dilapidation and decay.

2. The system would be much less expensive than the one by permanent fortification. Those temporary works could ordinarily be constructed by the troops with very little, if any, additional expense; but in case of pressing emergency, the zeal and patriotism of the people might be relied upon with safety, to supply any amount of labor that might be necessary, as was the case at New York in 1814. As it is not proposed they should be retained as military stations in time of peace, the expense of keeping them in repair would be nothing.

In the early part of 1819, Capt. Partridge was engaged in the exploring survey of the North Eastern boundary, under the fifth article of the treaty of Ghent. While on this survey he determined from barometrical and thermometrical observations of the altitudes of the Highlands dividing the rivers which flow northerly into the St. Lawrence, from those which flow southerly into the Atlantic ocean; he also made a profile of the country between several points on the St. Lawrence, and corresponding position in the state of Maine.

In 1820, Capt. Partridge resigned his position in this survey, for the purpose of carrying into practical effect a plan of education, which had occupied much of his attention since 1810, and which in its main features was, doubtless, suggested by his experience at Hanover, and West Point, and was calculated to supply certain deficiencies which he and others had already noticed in our American colleges and higher seminaries of learning. His views both of the deficiencies and their remedies were set forth in a lecture delivered at this time, which was subsequently printed. After defining "education in its most perfect state to be the preparing a youth in the best possible manner for the correct discharge of the duties of any station in which he may be placed," in this lecture he proceeds to characterize the existing plan of instruction.

1. It is not sufficiently practical, nor properly adapted to the various duties an American citizen may be called upon to discharge. Those of our youth who are destined for a liberal education, as it is called, are usually put, at an early age, to the study of the Latin and Greek languages, combining therewith a very slight attention to their own language, the elements of arithmetic, &c.; and after having devoted several years in this way, they are prepared to become members of a college or university.

Here they spend four years for the purpose of acquiring a knowledge of the higher branches of learning; after which, they receive their diplomas, and are supposed to be prepared to enter on the duties of active life. But, I would ask, is this actually the case? Are they prepared in the best possible manner to discharge correctly the duties of any station in which fortune or inclination may place them? Have they been instructed in the science of government generally, and more especially in the principles of our excellent Constitution, and thereby prepared to sit in the legislative councils of the nation? Has their attention been sufficiently directed to those great and important branches of national industry and sources of national wealth—agriculture, commerce, and

manufactures? Have they been taught to examine the policy of other nations, and the effect of that policy on the prosperity of their own country? Are they prepared to discharge the duties of civil or military engineers, or to endure fatigue, or to become the defenders of their country's rights, and the avengers of her wrongs, either in the ranks or at the head of her armies? It appears to me not; and if not, then, agreeably to the standard established, their education is so far defective.

2. Another defect in the present system, is, the entire neglect, in all our principal seminaries, of physical education, or the due cultivation and improvement of the physical powers of the students.

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, I presume, must be evident to the most superficial observer. It is for want of this, that so many of our most promising youths lose their health by the time they are prepared to enter on the grand theatre of active and useful life, and either prematurely die, or linger out a comparatively useless and miserable existence. 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, capable of enduring exposure, hunger and fatigue, as it is to grow up puny and debilitated, incapable of either bodily or mental exertion.

3. A third defect in our system is, the amount of idle time allowed the students; that portion of the day during which they are actually engaged in study and recitations, under the eye of their instructors, comprises but a small portion of the whole; during the remainder, those that are disposed to study, will improve at their rooms, while those who are not so disposed, will not only not improve, but will be very likely to engage in practices injurious to their constitutions and destructive to their morals. If this vacant time could be employed in duties and exercises, which, while they amuse and improve the mind, would at the same time invigorate the body and confirm the constitution, it would certainly be a great point gained. That this may be done, I shall attempt in the course of these observations, to show.

4. A fourth defect is, the allowing to students, especially to those of the wealthier class, too much money, thereby inducing habits of dissipation and extravagance, highly injurious to themselves, and also to the seminaries of which they are members. I have no hesitation in asserting, that far the greater portion of the irregularities and disorderly proceedings amongst the students of our seminaries, may be traced to this fatal cause. Collect together at any seminary, a large number of youths, of the ages they generally are at our institutions, furnish them with money, and allow them a portion of idle time, and it may be viewed as a miracle, if a large portion of them do not become corrupt in morals, and instead of going forth into the world to become ornaments in society, they rather are prepared to become nuisances to the same. There is in this respect, an immense responsibility resting on parents and guardians, as well as on all others having the care and instruction of youth, of which it appears to me they are not sufficiently aware.

When youths are sent to a seminary, it is presumed they are sent for the purpose of learning something that is useful, and not to acquire bad habits, or to spend money; they should consequently be furnished with every thing necessary for their comfort, convenience and improvement, but money should in no instance be put into their hands. So certainly as they have it, just so certainly will they spend it, and this will, in nine cases out of ten, be done in a manner seriously to injure them, without any corresponding advantage. It frequently draws them into vicious and dissolute company, and induces habits of immorality and vice, which ultimately prove their ruin. The over-weening indulgence of parents, has been the cause of the destruction of the morals and future usefulness of many a promising youth. They may eventually discover their error, but alas, it is often too late to correct it. Much better does that person discharge the duties of a real friend to the thoughtless, unwary youth, who withholds from him the means of indulging in dissipated and vicious courses.

5. A fifth defect is the requiring all the students to pursue the same course of studies.

All youth have not the same inclinations, nor the same capacities; one may possess a particular inclination and capacity for the study of the classics, but not for the mathematics and other branches of science; with another it may be the reverse. Now it will be in vain to attempt making a mathematician of the former, or a linguist of the latter. Consequently, all the time that is devoted in this manner, will be lost, or something worse than lost. Every youth, who has any capacity or inclination for the acquirement of knowledge, will have some favorite studies, in which he will be likely to excel. It is certainly then much better that he should be permitted to pursue those, than, that by being forced to attend to others for which he has an aversion, and in which he will never excel, or ever make common proficiency, he should finally acquire a dislike to all study. The celebrated Pascal, is a striking instance of the absurdity and folly of attempting to force a youth to attend to branches of study, for which he has an utter aversion, to the exclusion of those for which he may possess a particular attachment. Had the father of this eminent man persisted in his absurd and foolish course, France would never have seen him, what he subsequently became, one of her brightest ornaments.

6. A sixth defect is the prescribing the length of time for completing, as it is termed, a course of education. By these means, the good scholar is placed nearly on a level with the sluggard, for whatever may be his exertions, he can gain nothing in respect to time, and the latter has, in consequence of this, less stimulus for exertion. If any thing will induce the indolent student to exert himself, it is the desire to prevent others getting ahead of him. It would be much better to allow each one to progress as rapidly as possible, with a thorough understanding of the subject.

Having stated what appeared to him the most prominent defects in the academies and colleges as organized and conducted, he next proceeds to point out the remedies.

1. The organization and discipline should be strictly military.

Under a military system, subordination and discipline are much more easily preserved than under any other. Whenever a youth can be impressed with the true principles and feelings of a soldier, he becomes, as a matter of course, subordinate, honorable, and manly. He disdains subterfuge and prevarication, and all that low cunning, which is but too prevalent. He acts not the part of the assassin, but if he have an enemy, he meets him openly and fairly. Others may boast that they have broken the laws and regulations of the institution of which they are, or have been members, and have escaped detection and punishment, by mean prevarication and falsehood. Not so the real soldier. If he have broken orders and regulations, he will openly acknowledge his error, and reform; but will not boast of having been insubordinate. Those principles, if imbibed and fixed in early youth, will continue to influence his conduct and actions during life; he will be equally observant of the laws of his country, as of the academic regulations under which he has lived; and will become the more estimable citizen in consequence thereof. I shall not pretend, however, that all who wear a military garb, or live, for a time, even under a correct system of military discipline, will be influenced in their conduct by the principles above stated; but if they are not, it only proves that they have previously imbibed erroneous principles, which have become too firmly fixed to be eradicated; or that nature has not formed them with minds capable of soaring above what is low and groveling.

2. Military science and instruction should constitute a part of the course of education.

The constitution of the United States has invested the military defense of the country in the great body of the people. By the wise provisions of this instrument, and of the laws made in pursuance thereof, every American citizen, from eighteen to forty-five years of age, unless specially exempted by law, is liable

to be called upon for the discharge of military duty—he is emphatically a citizen soldier, and it appears to me perfectly proper that he should be equally prepared by education to discharge, correctly, his duties in either capacity. If we intend to avoid a standing army, (that bane of a republic, and engine of oppression in the hands of despots,) our militia must be patronized and improved, and military information must be disseminated amongst the great mass of the people; when deposited with them, it is in safe hands, and will never be exhibited in practice, except in opposition to the enemies of the country. I am well aware there are amongst us many worthy individuals, who deem the cultivation of military science a sort of heresy, flattering themselves, and endeavoring to induce others to believe, that the time has now arrived, or is very near, when wars are to cease, and universal harmony prevail amongst mankind. But, my fellow-citizens, be not deceived by the syren song of peace, peace, when, in reality, there is no peace, except in a due and constant preparation for war. If we turn our attention to Europe, what do we behold? A league of crowned despots, impiously called holy, wielding a tremendous military force of two millions of mercenaries! Ill-fated Naples, and more ill-fated Spain, have both felt the effects of *their peaceable* dispositions, and were it not for the wide-spreading Atlantic, which the God of nature in his infinite goodness has interposed between us, we also, ere this, should have had a like experience. The principles of liberty are equally obnoxious to them, whether found in Europe, Asia, Africa, or America. If rendering mankind ignorant of the art of war, (as a science,) would prevent wars, then would I unite most cordially with those, usually termed peace-men, for the purpose of destroying every vestige of it. But such, I am confident, would not be the result. Wars amongst nations do not arise because they understand how to conduct them skillfully and on scientific principles; but are induced by the evil propensities and dispositions of mankind. To prevent the effect, the cause must be removed. We may render nations ignorant of the use of the musket and bayonet; we may carry them back, as respects the art of war, to a state of barbarism, or even of savageism, and still wars will exist. So long as mankind possess the dispositions which they now possess, and which they ever have possessed, so long they will fight. To prevent wars, then, the disposition must be changed; no remedy short of this will be effectual. In proportion as nations are rude and unskilled in the art of war, will their military code be barbarous and unrelenting, their battles sanguinary, and their whole system of warfare, destructive. War, therefore, in such a case, becomes a far greater evil, than it does under an improved and refined system, where battles are won more by skill than by hard fighting, and the laws of war are proportionally ameliorated. What rational man, what friend of mankind, would be willing to exchange the present humane and refined system of warfare, for that practiced by an Attila, a Jenghis Khan, a Tamerlane, or a Mahomet, when hundreds of thousands fell in a single engagement, and when conquest and extermination were synonymous terms. On the principles of humanity, then, it appears to me that, so long as wars do exist, the military art should be improved and refined as much as possible; for, in proportion as this is done, battles will be less sanguinary and destructive, the whole system more humane, and war itself a far less evil. But independent of any connection with the profession of arms, or of any of the foregoing considerations, I consider a scientific knowledge of the military art, as constituting a very important part of the education of every individual engaged in the pursuit of useful knowledge, and this for many reasons; viz.:—

First. It is of great use in the reading of history, both ancient and modern.

A large portion of history is made up of accounts of military operations, descriptions of battles, sieges, &c. How, I would ask, is the reader to understand this part, if he be ignorant of the organization of armies, of the various systems of military tactics, of the science of fortification, and of the attack and defense of fortified places, both in ancient and modern times? Without such knowledge it is evident he derives, comparatively but little information from a large portion of what he reads.

Second. It is of great importance in the writing of history. I presume it will not be denied, that in order to write well on any subject, it must be under-

stood. How, then, can the historian give a correct and intelligible account of a campaign, battle, or siege, who is not only unacquainted with the principles on which military operations are conducted, but is also ignorant of the technical language necessary for communicating his ideas intelligibly on the subject? This is the principal reason why, as it appears to me, the ancient historians were so much superior to the modern. Many of their best historical writers were military men. Some of them accomplished commanders. The account of military operations by such writers as Xenophon, Thucydides, Polybius and Cæsar, are perfectly clear and intelligible, whereas when attempted by the great body of modern historians, the most we can learn is, that a fortress was besieged and taken, or that a battle was fought and a victory won, but are left in entire ignorance of the principles on which the operations were conducted, or of the reasons why the results were as they were.

Third. It is essentially necessary for the legislator.

The military defense of our country is doubtless one of the most important trusts which is vested by the constitution in the general government, and it is a well known fact, that more money is drawn from the people and disbursed in the military, than in any other department of the government. Now as all must be done under the sanction of the law, I would beg leave to inquire, whether it be not of the greatest importance, that those who are to make such laws should be in every respect well prepared to legislate understandingly on the subject? That there has been, and still is, a want of information on this subject amongst the great body of the members of Congress, I think will be perfectly evident to any one who is competent, and will take the trouble to examine our military legislation since the conclusion of the Revolutionary war. I feel little hesitation in asserting, that from want of this information, more than from any other cause, as much money has been uselessly expended in our military department alone, as would cancel a large portion of the national debt.

Fourth. It is of great use to the traveler.

Suppose a young man, with the best education he can obtain at any of our colleges or universities, were to visit Europe, where the military constitutes the first class of the community, and where the fortifications constitute the most important appendages to nearly all the principal cities, how much does he observe, which he does not understand? If he attempt a description of the cities, he finds himself embarrassed for want of a knowledge of fortification. If he attempt an investigation of the principles and organization of their institutions, or of their governments, he finds the military so interwoven with them all, that they can not be thoroughly understood without it. In fine, he will return with far less information, than with the aid of a military education he might have derived. As it respects the military exercises, I would observe, that were they of no other use than in preserving the health of students, and confirming in them a good figure and manliness of deportment, I should consider these were ample reasons for introducing them into our seminaries generally; they are better calculated than any others for counteracting the natural habits of students, and can always be attended to, at such times as would otherwise be spent in idleness or useless amusements. Having expressed my views thus fully on this subject, I will next proceed to state more specifically the other branches which I would propose to introduce into a complete course of education: and—

1. The course of classical and scientific instruction should be as extensive and perfect as at our most approved institutions. The students should be earnestly enjoined and required to derive as much of useful information from the most approved authors, as their time and circumstances would permit.

2. A due portion of time should be devoted to practical geometrical and other scientific operations in the field. The pupils should frequently be taken on pedestrian excursions into the country, be habituated to endure fatigue, to climb mountains, and to determine their altitudes by means of the barometer as well as by trigonometry. Those excursions, while they would learn them to walk, (which I estimate an important part of education,) and render them vigorous and healthy, would also prepare them for becoming men of practical science generally, and would further confer on them a correct *coup d'œil* so essentially

necessary for military and civil engineers, for surveyors, for travelers, &c., and which can never be acquired otherwise than by practice.

3. Another portion of their time should be devoted to practical agricultural pursuits, gardening, &c.

In a country like ours, which is emphatically agricultural, I presume it will not be doubted, that a practical scientific knowledge of agriculture would constitute an important appendage to the education of every American citizen. Indeed the most certain mode of improving the agriculture of the country will be to make it a branch of elementary education. By these means, it will not only be improved, but also a knowledge of their improvements generally disseminated amongst the great mass of the people.

4. A further portion of time should be devoted to attending familiar explanatory lectures on the various branches of military science, on the principles and practice of agriculture, commerce and manufactures, on political economy, on the constitution of the United States, and those of the individual states, in which should be pointed out particularly the powers and duties of the general govern ment, and the existing relations between that and the state governments, on the science of government generally. In fine, on all those branches of knowledge which are necessary to enable them to discharge, in the best possible manner, the duties they owe to themselves, to their fellow men, and to their country.

5. To the institution should be attached a range of mechanics' shops, where those who possess an aptitude and inclination might occasionally employ a leisure hour in learning the use of tools and acquiring a knowledge of some useful mechanic art.

The division of time, each day, I would make as follows, viz.:—

Eight hours to be devoted to study and recitation; eight hours allowed for sleep. Three hours for the regular meals, and such other necessary personal duties as the student may require. Two hours for the military and other exercises, fencing, &c. The remaining three hours to be devoted, in due proportion, to practical agricultural and scientific pursuits and duties, and in attending lectures on the various subjects before mentioned.

Some of the most prominent advantages of the foregoing plan would, in my opinion, be the following; viz.:—

1. The student would, in the time usually devoted to the acquirement of elementary education, (say six years) acquire, at least, as much, and I think I may venture to say more, of book knowledge, than he would under the present system.

2. In addition to this, he would go into the world an accomplished soldier, a scientific and practical agriculturist, an expert mechanician, an intelligent merchant, a political economist, legislator and statesman. In fine, he could hardly be placed in any situation, the duties of which he would not be prepared to discharge with honor to himself and advantage to his fellow-citizens and his country.

3. In addition to the foregoing, he would grow up with habits of industry, economy and morality, and, what is of little less importance, a firm and vigorous constitution; with a head to conceive and an arm to execute—he would emphatically possess a sound mind in a sound body.

After much correspondence Capt. Partridge decided to carry out his principles of education in an institution organized on his own plan and conducted by himself, with such assistance as he could command, in his native village of Norwich, Vermont. Here he opened, on the 4th of September, 1820, the American Literary, Scientific and Military Academy, on which the pupils or their parents had their choice of studies, out of a course as extensive as that of any academy and college in New England combined—in which

military training formed a prominent feature, and the mathematics, especially as applied to surveying and engineering, received special attention. During the four years and half of its continuance in Norwich the Academy was attended by 480 pupils, representing twenty-one out of the twenty-four states, and of these, and especially of such as continued on an average two years at the institution, a large proportion became distinguished in military, public, and business life—as large it is believed as the records of any other institution for the same period of time can show. Its success demonstrated beyond cavil, that military exercises and duties are not inconsistent with ardent devotion, and the highest attainments in literary and scientific studies.

In 1824, the citizens of Middletown, Connecticut, made a liberal subscription to secure the location there, of a college about to be established in that State, under Episcopal auspices. Failing in that object, by the location of the institution at Hartford, where it now exists under the name of Trinity College, they invited Capt. Partridge to remove his Academy to their city, and offered to erect and place at his disposal suitable buildings for his accommodation. This invitation and offer were accepted, and on the 1st of April, 1825, he closed his institution at Norwich, and on the 1st of September following, opened his new course of instruction at Middletown, with an attendance of two hundred and ninety-seven pupils in the first year. During the three years—up to September 1828, the American Literary, Scientific, and Military Academy at Middletown remained under his superintendence, there were nearly twelve hundred pupils representing every State and Territory of the United States, the British Provinces, Mexico, several of the South American States, and the West Indies. This attendance shows conclusively, that the military and scientific element, together with an optional course of study, and a term of residence limited by the ability of the pupil to complete the course, met a want not provided for in existing colleges. Of those who completed the full course of study begun at Norwich, as large a proportion, as the corresponding graduates of any American college, attained a high degree of usefulness and eminence in widely diversified fields of labor. Among its graduates are to be found the founders or professors of several State Military Institutes, many officers of the highest rank in the military service of the United States, several eminent civil engineers, superintendents, of railroads, members of Congress, lawyers, and men of practical efficiency and success in every line of business.

One of the characteristic features of Captain Partridge's system

of instruction and discipline at Middletown, was the military marches and pedestrian excursions for scientific and recreating purposes conducted under his personal command, or in his company. Several of these excursions occupied three or four weeks, extending in one instance to Washington. The military marches amounted in the aggregate to over two thousand miles, and these and the various pedesterain excursions, included visits to nearly all points of military and historical interest in New England and New York. The immediate and controlling reasons which induced Capt. Partridge to leave Middletown, are not known to the writer of this memoir. He has however, understood it was owing partly to a desire for temporary relief from the cares and confinement of immediate superintendence, that he might start a similar institution in the neighborhood of New York, and partly from disgust at the refusal of the Legislature of Connecticut in 1828, to grant to the institution at Middletown, the usual privileges and powers of a college.

In 1833, 1834, 1837, and 1839, Capt. Partridge was elected representative from the town of Norwich, to the Legislature of Vermont, and in that capacity labored to give efficiency to the military system of the State. In 1834, he secured for certain petitioners a charter for the Norwich University, in which the Trustees are required "to provide for a constant course of instruction in military science and civil engineering," and are "prohibited from establishing any regulations of a sectarian character, either in religion or politics." Of this corporation, consisting of twenty-five trustees, Capt. Partridge was a member, and in organizing the institution in 1825, he was elected president of the Faculty. He continued to instruct in his own department of military science and engineering, and administered the affairs of the university till 1844, when owing to some difficulties arising out of the use of the building, arms, and accourtrements, which were his private property, he resigned.

In 1838, he was influential in calling together a convention of military officers and persons interested in giving greater efficiency to the organization of the militia of the several states, to meet for consultation. This convention met at Norwich on the 4th of July; and continued to meet annually for many years, to discuss plans for the organization and discipline of the militia, for the dissemination of a knowledge of military science, for the defense of the coast, &c. Many reports of this body were drawn up by him, and the proceedings were forwarded to, and printed by order of the Congress of the United States.

In 1839, on the request of many influential citizens, he visited

Portsmouth, Virginia, to establish a Military School, which he did, and which was soon after recognized by the Legislature of the State as the Virginia Literary, Scientific, and Military Institute, and aided by an appropriation out of the Literary Fund. This Institute, with an Institute of a similar character at Lexington, in the western part of the State, has been greatly instrumental in diffusing widely in Virginia a knowledge and taste for military affairs. The success of this institution, and the personal influence of many of his own scholars at Norwich and Middletown, led to the establishment of similar schools in other southern states.

In May, 1842, Capt. Partridge accepted the position of Camp Instructor for a large body of officers and men of the Pennsylvania volunteer militia in encampment at Reading, Berks County. Each evening he delivered a lecture to officers assembled in the General's marquee, and during the day exercised the troops in the manual of arms, and in company, regimental, and brigade movements in the field. On this, and many similar occasions, he demonstrated the correctness and practicability of his theory of national defense, so far as testing the qualifications of officers for command, and giving accuracy, rapidity, and steadiness of exercise and movements to troops, by assembling officers and men of the State Militia, once or twice in the year, in convenient numbers and places, under instructors properly qualified for the work. A few instructors, themselves trained in the best military institutions, and familiar with every improvement in military organization, equipment, and movement, and especially when clothed with the reputation of success in actual service, would soon bring the entire militia of the states into a uniform system, and give respectability and efficiency to this department of the public service. This result would be more speedily realized if a number of educational institutions similar to those which he had organized under many disadvantages and against many prejudices, could call out and cultivate military taste and accomplishments among a portion of the young men of each state.

In 1853, he opened at Brandywine Springs, near Wilmington, in the State of Delaware, another institution in which he fondly hoped his ideal of a National school of education would be realized—an institution in which physical training in connection with military exercises and movements, should accompany the acquisition of practical knowledge of the great principles of science that underlie all the arts of peace and war, and resorted to by students from every state of the American Union. His plan as developed in conversation with those directly interested, embraced his old ideas of scien-

tific, and literary studies with systematic pedestrian excursions,* and marches in vacations to the great objects of natural, economical, and historical interest in different parts of the country. In this latter particular, he unconsciously applied the suggestion of Milton in his letter to Samuel Hartlib, that "the students of his Academy should go out in companies with prudent and staid guides to all quarters of the land, learning and observing all places of strength, and all commodities (facilities) of building and of soil, for towns and tillage, harbors and ports of trade,—even sometimes taking sea as far as to our navy to learn there also, what they can in the practical knowledge of sailing and sea-fight." Arrangements were made for a class of ten or twelve of the most advanced and matured cadets to accompany him to Europe to study the strategy of the great battles of the world, and the armies, armories, and resources of the great nations of Europe—thus again realizing Milton's plan of gratifying "the desire of the more hopeful youth" "to see other countries at three or four and twenty years of age, not to learn principles, but to enlarge experience and make wise observation." But these hopes were darkened for a time by a great disaster, and soon extinguished in the sudden death of the great projector. In the autumn of 1853, the buildings at Brandywine Springs, were consumed by fire, and although arrangements were at once made to secure suitable accommodations at Bristol, Pennsylvania, and upwards of one hundred pupils enrolled their names to attend for a year at that place, still the great motive power of the enterprise was stricken down.

At the close of the year, 1853, Capt. Partridge returned to Norwich, where his family still resided, in apparently good health and the best spirits. A few days after he reached home, he was attacked by sharp and excruciating pains in his back, which were soon subdued by anodynes, but from the prostration and the cause, which proved on a post-mortem examination to be an aneurism near the base of the spine, and which had been exhausting his vitality for years—he never rallied, and on the 17th of January, 1854, he breathed his last—widely and deeply mourned by troops of friends, who loved and admired him as their teacher, or looked up to him as the best expounder of principles of military science and education, and of national defense.

* Captain Partridge attached much importance to pedestrian excursions in reference both to hygenic, and educational considerations. To these excursions he attributed his own robust health, and his familiar knowledge of all the details of American battles. In one year, (1830,) he made four excursions from Norwich, each occupying from four to six days—and from one hundred and fifty to four hundred miles—the last day's walk generally averaging over sixty miles. He had ascended and measured the altitude of all the highest mountain elevations in the Northern States.

Although living most of his life in the discharge of educational and public duties, under circumstances inconsistent with "a local habitation," he had strong domestic tastes and attachments, and was a genial companion in his own room and home. In 1837, he married Miss Swazey, the daughter of a merchant in Claremont, New Hampshire, and to this happy union were born two children. The oldest boy, George, was educated by the father on his own system, and had displayed vigorous health, and strong partialities and attainments in mathematical studies and their applications; but he survived his father only a few months—"long desolate months they were to the widow and children"—and the tenement of that bright intellect was laid by the side of that of his hardy and indefatigable father in the little village burying-ground. The other son Henry, as he grew up, showed a partiality for the profession of law, and was pursuing his studies in Warren, Penn., when the call of the President of the United States for volunteers, summoned him to the defense of the flag of the country. He enlisted for the war, and was promoted to a captaincy in a Pennsylvania regiment, which was attached to the army of the Potomac, whose varying fortunes he shared till, greatly weakened by exposure and disease, he was honorably discharged from the service. His superior officer in writing to his mother, says: "He is in every respect a model officer. How could he be otherwise? He has it all by right of inheritance, and I fully appreciate that you have made a very great contribution to the government and the country in sending him forth to fight the battles which have been forced upon us."

POPULAR OBJECTIONS TO A NATIONAL MILITARY SCHOOL.

NOTE.

As an Appendix to our Memoir of Capt. Alden Partridge, we republish the following Memorial by him to the Congress of the United States, not because we approve the objects or the arguments of either document, but as part of the educational history of the country.

MEMORIAL OF ALDEN PARTRIDGE,

Relating to the Military Academy at West Point, and praying that young men educated at other military schools may have an equal chance for admission to the army as those young men have who are educated at West Point. January 21, 1841. *Referred to the Committee on Military Affairs.*

To the Honorable Congress of the United States:—The memorial of Alden Partridge, President of the Norwich University, at Norwich, State of Vermont, respectfully showeth:

That your memorialist holds it to be a cardinal principle of our republican institutions, that stations of honor, trust, and emolument should be equally open to all our citizens, to which all have an equal right to aspire, and from which none can constitutionally be excluded by any law, rule, or regulation whatever. Your memorialist has, however, witnessed, with deep regret, a direct violation of this vital principle of our constitution, by the rules and regulations adopted for the organization and government of the Military Academy at West Point. The cadets of that institution, all of whom are educated at the *public* expense, have, for many years, *monopolized* nearly, if not quite, all of the stations of honor, trust, and emolument, above that of a non-commissioned officer, in the military establishment of the United States, to the utter exclusion of those who are equally well qualified, equally meritorious, and who are educated at their *own* expense. But, in order to place this subject more clearly before your honorable body, your memorialist would call your attention to the law of the 29th of April, 1812, entitled, "An act making further provision for the corps of engineers." By the provisions of this act, no candidate can be admitted into the Military Academy who is under fourteen, or over twenty-one, years of age. The effect of this provision is to exclude every young man in the United States who is above twenty-one years of age from the appointment of cadet, while the rules of the War department require that none except those educated at this academy can be commissioned in the army of the United States. The effect, then, of the law and regulation is to utterly exclude all the youth of our country, except such select few as the President may think proper to place in this "public charity school," from the military service of their country, who are above twenty-one years of age, unless they will enter in the humble capacity of *privates* or *non-commissioned officers*. And can such a system be in accordance with the principles of our constitution? Your memorialist believes not. On

the contrary, he feels confident in the assertion that it is a most flagrant and palpable violation of them. The direct and certain effect of this institution is to extend *Executive patronage;* for the President has the entire selection of the *chosen two hundred* and *fifty* who are to be placed in the institution, and also to establish an *aristocracy* of the most dangerous kind, viz.: a *military* aristocracy in the United States. What, your memorialist would ask, is an aristocracy? Is t not where any particular class in a State claims and exercises privileges of which the great body of the people are deprived? And do not the cadets at West Point enjoy such privileges? and if so, do they not constitute an aristocracy? Your memorialist believes that neither the fact nor the inference can be controverted. But your memorialist will go further, and aver that the regulations at West Point have not only constituted an aristocracy in the United States, but that this aristocracy has already become, in a great degree, *hereditary*. How many individuals, your memoralist would ask, who have held offices of honor, trust, or emolument, under the Government, for the last twenty-five years, have had their sons, brothers, nephews, or other relatives, educated at the public expense at West Point, to the entire exclusion of those who (to say the least,) were equally meritorious, and equally capable of rendering service to the republic? And how many of those thus educated have ever rendered any service whatever? A reference to the rolls of the institution will answer these inquiries. Your memorialist has *personal* knowledge of many instances. Your memorialist is well aware that it has been attempted, by the friends of this monstrous invasion of the rights of the people, to cast around it the mantle of Mr. Jefferson. Your memorialist is ready to grant that the institution was established during the early part of the first term of Mr. Jefferson's administration; but denies that any inference can be drawn from that circumstance to sustain the present system. The institution *then* consisted only of the corps of engineers, which was limited to sixteen officers and four cadets, without any of those exclusive privileges which have since been conferred upon it. On the 29th of April, 1812, (just previous to the declaration of war,) a law was, however, passed, entitled "An act making further provision for the corps of engineers;" by the provisions of which, the whole number of cadets, whether of infantry, artillery, or riflemen, was not to exceed two hundred and fifty; and the President to appoint a limited number of cadets, and conferring on him a *discretionary* power to attach them to the Military Academy, was evidently induced by the certainty of immediate war with Great Britain, and had a direct reference to a *war* establishment. Your memorialist would respectfully call the attention of your honorable body particularly to the provisions of the law of 1812 just referred to; and, if he does not much mistake, it will satisfactorily appear that the President is not *required*, but simply authorized, to appoint a single cadet; and that it is left entirely discretionary with him, after they are appointed, to attach them to the Military Academy, or to attach them to their respective companies, agreeably to the provisions of other laws then in existence. And here your memorialist would observe that, in the *peace*-establishment of the army previous to the late war, two cadets were allowed to each company of artillery, light infantry, and infantry, amounting, in the total, to a *larger* number than was authorized by the law of 1812. But neither President Jefferson, nor President Madison considered that the law required of them to fill those vacancies so long as they considered their services were not required: and they con

sequently did not fill them. The largest number of cadets ever in service at the same time, previous to the late war, did not exceed forty, and seldom exceeded twenty-five. Do the necessities of the country require that any larger number should be retained in service now, than were deemed necessary by Presidents Jefferson and Madison during a time of peace? Your memorialist believes not. But it is urged, in favor of this academy, that it presents a most favorable opportunity for the education of meritorious young men who are poor, and, consequently, unable to educate themselves. Your memorialist, however, has yet to learn by what *constitutional* authority Congress is empowered to appropriate any portion of the public revenue for the support of a *national charity school* for the education of the poor. Besides, if this power did exist, (which your memorialist presumes no reasonable person will contend does,) *all* the poor in the United States have an equal right to the benefits to be derived from its exercise, and that, consequently, the institution at West Point is on quite too limited a plan for the accomplishment of the contemplated object. Either, then, the institution should be very much enlarged, or several others established in different parts of the United States, which would be far more convenient for the great body of the poor. If, however, the rolls of this institution for the last twenty years be examined, it will be found that many more of the *rich* and *influential* have been educated there, than of the *poor*. Poverty, however meritorious the subject of it may be, is but a sorry recommendation for admission to this aristocratic establishment.

But it is further urged, that this institution is *necessary* for the education of the officers of the army; and that, were it abolished, the candidates for commissions would not be properly qualified for the discharge of their duties as officers. Before your memorialist proceeds to exaime the truth of this position, he would inquire, at what institution, and at whose expense, Generals Washington, Greene, Knox, Putnam, Lincoln, Sullivan, Morgan, Wayne, Sumter, Pickens, Marion, and all the other officers of the revolutionary army, by whose valor, skill, and patriotic exertions, these United States now constitute a free and independent nation, received their education? The answer is ready: at the ordinary institutions of the country, and at their *own* expense; just as every *American citizen* should be educated. And have the *proteges* of the West Point Academy, on whose education so many millions of dollars of the peoples' money have been expended within the last twenty years, exhibited more skill, more valor, or more patriotism, than did the officers of the revolutionary army? Let the events of the Florida war, as compared with those of the Revolution, answer the question. The truth is, (and it can not be much longer concealed from the view of the people, by the reports of *boards of visitors*,) that the whole system of education at West Point is well calculated to form *military pedants* and *military dandies*, but will never form *efficient soldiers*. Much more important to them is their attention to the *cut* of the *coat*, the placing of a *button*, and the *snowy whiteness of gloves and pantaloons*, than to those *physical* and *moral qualities* which are absolutely necessary to the correct and efficient discharge of the active duties of the field.

But your memorialist denies the truth of the position, that the West Point Academy is necessary for the education of young men for the army. There are other institutions where military science and instruction constitute a branch of education for the pupils. Of these institutions, however, your memorialist will

particularize but one—and that is the Norwich University, at Norwich, Vermont, over which he has the honor to preside. This institution was incorporated by the Legislature of Vermont, in November, 1834, with full power to confer diplomas, &c. By the act of incorporation, military science is made a part of the education of all the pupils. They are consequently correctly and thoroughly instructed in the theoretical part of military science, and also in the *practical* duties of the soldier, and every one who graduates at this institution is well qualified to discharge the duties of a company officer (and even, if necessary, to command a battalion) in any corps of the army. In order further to prepare them to discharge the more hardy and active duties of the soldier, they occasionally perform military marches. In the month of July, 1840, they performed a march, under the personal command of your memorialist, to the celebrated *military post* of Ticonderoga, carrying their arms, accoutrements, knapsacks, &c.; the whole length of which was one hundred and sixty-five miles. Of this distance, one hundred and forty miles was on foot, and twenty-five miles by steamboat. The march on foot was performed in a little more than five days, crossing the Green Mountain range twice, and the ground, with the heavens for covering, constituted their only resting-place at night. The weather, during the whole march, was hot; and they were enveloped in a cloud of dust, occasioned by the severe drought, nearly the whole distance. They all returned in excellent health and spirits. The youngest member of the corps was thirteen years of age. The other branches of literature and science are attended to as extensively, and the latter much more practically, than at any other institution in the United States; and the students are consequently equally well qualified to discharge their duties in the *cabinet* and in the *field*. But notwithstanding the members of this institution are, to say the least, as well qualified for commissions of any grade, and in any corps of the army, as those of any other institution in the country, and have also obtained the necessary qualifications at their own expense, they are virtually excluded therefrom by the *arbitrary* and *monopolizing* regulations (established without the least sanction of law,) of the Military Academy at West Point. In the month of September, 1840, a member of the Norwich University, the son of a highly respectable gentleman in the city of New York, well recommended, applied to the Secretary of War for a commission in the army, but was informed that there were *no vacancies*, and that the cadets from West Point were *more than sufficient to fill all the vacancies*. On the 21st of December, 1840, your memorialist wrote to the Secretary of War, recommending three young gentlemen, members of the Norwich University, for commissions in the army of the United States; and received an answer, dated War Department, December 29, 1840, from which the following is an extract: "I acknowledge the receipt of your letter of the 21st instant, recommending Messrs. Morris, Stevens, and Dorne, for appointments in the army; and I have here to inform you, in reply, that there being no vacancies at present, the application will be filed for consideration, when any occur, *to which they can be appointed.*" Now your memorialist feels confident that the records of the War Department will show that a large number of cadets at West Point are commissioned every year; and he presumes that such will continue to be the case, unless a radical change is effected. But when young gentlemen of equal respectability and attainments, who have not been of the *favored few* whom *Executive favor* has admitted into this nursery of aristocracy, to be edu-

cated at the expense of the honest working men of the country, become applicants, their claims are entirely set aside. Against this *unconstitutional*, *unequal*, and *monopolizing* practice, your memorialist deems it his duty respectfully, but most decidedly, to protest; and to ask of your honorable body the establishment of some rule whereby the members of the Norwich University, at least, (to whom, in many respects, he stands in the relation of guardian,) may be restored to their *constitutional rights*; that when they become applicants for stations of honor, trust, or emolument, in the military service of their country, they shall stand on terms of equality with the cadets at West Point.

Your memorialist deems it proper here to remark, that in October, 1840, he addressed a communication to the President of the United States, on this subject, requesting to be informed whether, in the opinion of the President, he possessed the power to remedy the grievance of which your memorialist complains; and, if so, whether such power would be exercised for that purpose. To this communication no answer has been received. Your memorialist, availing himself of the privileges granted to every American citizen, by the first amendment of the constitution of the United States, would beg leave to call the attention of your honorable body to some subjects, which he considers grievances of a high order, and respectfully but earnestly solicits that they may be redressed, viz:

1st. Your memorialist considers the Military Academy at West Point a grievance. Under its present organization, it is unconstitutional, calculated to foster a military aristocracy in the country; calculated to depress the militia, (our only constitutional defense,) by engrossing all the patronage of government; and is entirely unnecessary, as military science can be attained at other institutions, from which the necessary officers for the army can be supplied without any tax on the people. Your memorialist, therefore, asks that this institution may be abolished, and that the money that is annually appropriated for its support may be applied to aid in disciplining the militia, and disseminating military information amongst the people, who are its constitutional and safe depositories.

2nd. Your memorialist considers the Board of Visitors that annually assemble at West Point a grievance. This board never had any *existence whatever in law*, but was established by Executive usurpation; yet, to pay the expense of this illegal board, your memorialist believes that more than fifty thousand dollars has been drawn from the public treasury. Your memorialist earnestly solicits that this appropriation, the making of which is a direct sanction to Executive *usurpation*, should be discontinued.

3rd. Your memorialist considers the removal of the head-quarters of the corps of engineers from West Point to Washington a grievance, because it is a direct violation of the law of the 16th of March, 1802, establishing that corps. That law requires the commandant of engineers to reside at West Point, unless ordered, by the President of the United States, on duty at some other place in the line of his profession; and, when at West Point, the law makes him superintendent of the Military Academy; and when he is absent, the next in rank (who is then present,) is made the *legal* superintendent. The appointment, therefore, of any particular officer as permanent superintendent, is evidently illegal, as the law has clearly specified who the superintendent shall be.

All of which is respectfully submitted,

A. PARTRIDGE,
President of Norwich University.

JANUARY, 13, 1841.

REMARKS BY THE EDITOR.

We publish the foregoing Memorial of Capt. Partridge, asking Congress to redress "the grievance" of the Military Academy, not because we have the slightest sympathy with the object or main arguments of the memorialist, but as specimens of the opinions held and propagated by a graduate, professor, and superintendent of the Academy, who did more than any other individual to introduce military instruction and exercises in schools not national or professionally military. We can not, however, put it forth without accompanying it with a few brief remarks.

To Capt. Partridge, more than to any one man, and to his pupils, and personal friends, as we believe, is due the popular objections which prevail respecting the United States Milltary Academy, except so far as the objections spring from the abuse of the mode of apppointing Cadets. For nearly twenty years Capt. Partridge was never known to express any doubt of the constitutionality or usefulness of this institution. His objections first took shape and utterance when he was superceded in the superintendence by Colonel Sylvanus Thayer. Of the circumstances and results of his removal, and of the appointment of Col. Thayer, and the subseqnent reorganization of the Academy, something has already been said in the History of West Point, in this volume, (p. 17–48,) and more will be said when we come to speak of the labors of Col. Thayer.

So far as these objections are directed to the constitutionality of the laws for establishing the Cadet Corps, as distinct from any other Corps of the army, or against training officers collected together and organized as a school, we think them preëminently frivolous. If any friend of the Academy would assure his doubtful faith in its constitutionality, let him read Capt. Partridge's Memorial, asking the same Congress to establish a system of National Education, which he petitions to redress the grievance of a special school, that every civilized government holds to be indispensable to the right organization of its armies.

So far as these objections are aimed at the mode of appointment and promotion,—confining both to the patronage of one man in the country, or one man in a Congressional District, acting in either case without personal examination of the party to be admitted or promoted, and excluding others, it may be, better qualified,—we hold them to be valid. A more disgraceful record of failures, where an opportunity of selecting the most meritorious candidates existed, can not be shown.

While we believe that candidates are too often recommended and nominated to the appointing power, from family and party considerations, we have seen no reason to believe that the social condition or occupation of parents has influenced the appointments. On the other hand, the records of the Academy, as made out in this particular by the Cadets themselves, exhibit a fair representation from all classes and occupations of society.

According to an official Statement, prepared by Capt. Boynton, and published in his History of the Academy, of [illegible] cadets admitted from 1842 to 1863 inclusive, the fathers of 1,300 were farmers or planters; of 681, were lawyers; of 672, were merchants; of 377, were mechanics; of 69, were physicians; of 256, were in the civil service; of 116, were clergymen; of 467, were in the army or navy; of 572, were editors, masters of vessels, &c. Of the whole number, 1,136 were orphans, 1,585 were in moderate, 534 in reduced, 62 in indigent, and 324 in independent circumstances. We shall publish the Statement in our next Number.

The views presented in the memorial of Capt. Partridge in 1841, have found advocates in and out of Congress before and since. They were anticipated by the Secretary of War (John C. Calhoun), under whose energetic administration of the Department in 1816, the Academy first assumed the organization of an efficient military school—a place of thorough scientific instruction in the knowledge not simply of military drill, but of the duties of an accomplished artillerist and military engineer; and they have been deepened by the radically vicious system of appointment to cadetship, in which personal and political considerations have in too many instances outweighed the merits of young men, whose natural aptitude and generous ambition would have found here the special field for their largest development and usefulness. These views found expression in the elaborate speech of Franklin Pierce, then a member of the House from New Hampshire, in the discussion of an amendment to the appropriation bill in 1836 (June 30), who "felt bound to oppose the bill in every stage of its progress"—mainly on the ground that "the institution conferred exclusive and gratuitous privileges."

It is *gratuitous*, because those who are so fortunate as to obtain admission there, receive their education without any obligation, except such as a sense of honor may impose, to return, either by service or otherwise, the slightest equivalent. It is exclusive, inasmuch as only one youth out of a population of more than 47,000 can participate in its advantages at the same time; and those who are successful, are admitted at an age when their characters cannot have become developed, and with very little knowledge of their adaptation, mental or physical, for military life. The system disregards one of those great principles which, carried into practice, contributed perhaps, more than any other, to render the arms of Napoleon invincible for so many years. Who does not perceive that it destroys the very life and spring of military ardor and enthusiasm, by utterly foreclosing all hope of promotion to her soldier and non-commissioned officer? However meritorious may be his services, however pre-eminent may become his qualifications for command, all are unavailing. The portcullis is dropped between him and preferment, the wisdom of your laws having provided another criterion than that of admitted courage and conduct, by which to determine who are worthy of command. They have made an Academy, where a certain number of young gentlemen are educated annually at the public expense, and to which there is, in consequence, a general rush, not so much from sentiments of patriotism, and a taste for military life, as from motives less worthy—the avenue, and the only avenue, to rank in your army.

I deny utterly the expediency and the right to educate at the public expense, any number of young men who, on the completion of their education, are not to form a portion of your military force, but to return to the walks of private life. Such was never the operation of the Military Academy until after the law of 1812; and the doctrine, so far as I have been able to ascertain, was first formally announced by a distinguished individual, at this time sufficiently jealous of the exercise of executive patronage, and greatly alarmed by what he conceives to be the tendencies of this Government to centralism and consolidation. It may be found in the report of the Secretary of War, communicated to Congress in 1819.

Mr. Pierce, afterwards President Pierce, quotes with approbation the suggestion of Col. Williams in a report to Mr. Jefferson in 1808

—that the plan should be large enough to take not only minor officers, "but also any youth from any of the States who might wish for such an education whether designed for the Army or Navy, or neither, and let them be assessed to the value of their education, which might form a fund for extra or contingent expenses."

These are the true doctrines upon this subject; doctrines worthy of the administration under which they were promulgated, and in accordance with the views of statesmen in the earlier and purer days of the Republic. Give to the officers of your army the highest advantages for perfection in all the branches of military science, and let those advantages be open to all in rotation, and under such terms and regulations as shall be at once impartial toward the officers, and advantageous to the service; but let all young gentlemen who have a taste for military life, and desire to adopt arms as a profession, prepare themselves for subordinate situations at their own expense, or at the expense of their parents or guardians, in the same manner that the youth of our country are qualified for the professions of civil life.

I am far from desiring to see this country destitute of a Military Academy; but I would have it a school of practice, and instruction, for officers actually in the service of the United States; not an institution for educating, gratuitously, young gentlemen, who, on the completion of their term, or after a few months' leave of absence, resign their commissions, and return to the pursuits of civil life.

There has already been expended upon the institution more than three millions, three hundred thousand dollars. Between 1815 and 1831, thirteen hundred and eighteen students were admitted into the Academy; and of all the cadets who were ever there, only two hundred and sixty-five remained in the service at the end of 1830. Here are the expenses you have incurred, and the products you have realized.

When the War of Secession broke out, and graduates of the Academy then in the army,—like many other Southern men, in the civil service of the United States, imbued with the political doctrines and sympathizing with the domestic institution, on which the War was based—sided with the political leaders of their several states, the opposition to the institution took another direction. The record of the War silenced these objectors. According to Gen. Cullum's *Biographical Register of the Graduates of the Military Academy*, out of 1,249 graduates living at the beginning of the Rebellion, 99 in civil life and 184 from the army, joined in the war against the United States. Three-fourths remained faithful. Of 821 graduates in the Army at the time, 184 (about one-fifth) joined in the Rebellion. Of the 99 in civil life all but one were residents in slave territory. Of 350 graduates who were born in or appointed from slave States, 162 remained loyal. Of the 292 loyal graduates in civil life, at the date of secession, 115 re-entered the Army—all below the age of 45, except those who were disabled for active duty, and most of these served in civil capacities. One-fifth of all the graduates who served in the battles of the Rebellion, one-fifth laid down their lives, and more than one-half were wounded in defence of the flag.

IV. AMERICAN LITERARY, SCIENTIFIC, AND MILITARY ACADEMY.

AT NORWICH, VERMONT.

THE AMERICAN LITERARY, SCIENTIFIC, AND MILITARY ACADEMY, at Norwich, Vermont, was opened on the 4th of September, 1820, by Capt. Alden Partridge, and continued under his personal superintendence and instruction, assisted by several professors, until April 1st, 1825, when it was discontinued at Norwich, and reopened at Middletown, Connecticut. The catalogue of the officers and cadets published August, 1821, contains a prospectus from which we make extracts to exhibit the aims of that school and of this particular class of institutions at that date.

TERMS OF ADMISSION.

The requisite qualifications for becoming members of the Institution are the following, viz: That the candidate be of good moral character, that he be able to read and spell correctly, to write a fair, legible hand, and work the ground rules of arithmetic.

COURSE OF INSTRUCTION.

Young gentlemen destined for a college education, can be prepared at this seminary for admission into any college or university in the country, either as freshmen, or one or two years in advance, and in the mean time will be enabled to acquire a good military and practical scientific education. Young gentlemen also, destined for the navy, can here be instructed in the scientific part of their profession, and at the same time, obtain a correct knowledge of fortification, and of military operations generally, on land, which it is believed they would find highly useful in future life. Parents and guardians who are desirous of placing their sons or wards at this seminary, are requested to state whether they wish them to go through with the full course of education; and if not, to specify, particularly, those branches to which they desire them to attend, and also to mention their ages.

The course of Latin, Greek, Hebrew, French, and English languages, Arithmetic, the construction and use of Logarithms, Algebra, Geometry, Plane and Spherical Trigonometry, Planometry, Stereometry, Mensuration of heights and distances by Trigonometry, and also Geometrically, practical Geometry generally, including particularly Surveying and Leveling, Conic Sections, the use of the Barometer, with its application to measuring the altitudes of mountains and other eminences, Mechanics, Hydrostatics, Hydraulics, the elements of Chemistry and Electricity, Optics, Astronomy, Navigation, Geography, including the use of Maps and the Globes; Composition, Logic, History, Ethics, the elements of Natural and Political Law, the Law of Nations, Military Law, the Constitution of the United States, and of the states severally, Metaphysics; Agriculture, Permanent and Field Fortification, Field Engineering generally, the construction of Marine Batteries, Artillery duty, the principles of Gunnery, a complete course of Military Tactics, the attack and defense of fortified places, Castrametation, ancient Fortification, the ancient modes of attacking and defending fortified places, the ancient Tactics, particularly those of the Greeks and Romans, with a description of the organization and discipline of the phalanx and legion; Book-Keeping, Music, Fencing, Military Drawing, Topography, Civil Engineering, including the construction of Roads, Canals, Locks, and Bridges; Architecture.

The Hebrew and French languages, Fencing and Music will not be considered as comprised in the regular course of education, and consequently those who attend to them will be charged separately.

MILITARY EXERCISE, AND DUTIES.

The students will be regularly and correctly instructed in the elementary school of the soldier, and also in those of the company and battalion; they will likewise be taught the regular formation of military parades, the turning off, mounting, and relieving guards and sentinels; the duties of officers of the guard, officers of the day, and adjutants; the making out correctly the different descriptions of military reports; in fine, all the duties incident to the field or garrison. The military exercises and duties will be so arranged as not to occupy any of the time that would otherwise be devoted to study; they will be attended to at those hours of the day which are generally passed by students in idleness, or devoted to useless amusements, for which they will be made a pleasing and healthful substitute. Practical scientific operations will be frequently attended to, which will conduce equally to health and improvement.

The students will be required to sleep on matrasses, or straw-beds; no feather-beds will be allowed in the establishment.

For the purpose of giving to the students a military appearance, when engaged on military duty, and also on a principle of economy, they are required to wear a uniform dress, a description of which is hereunto annexed. In prescribing a dress, it has been endeavored to combine as far as possible, cheapness and a neat military appearance, with such a form as, while it leaves the student the free and unrestrained use of his limbs, will at the same time encumber him the least possible. The discipline will be strict, but correct; and particular attention will be given to the full development and due cultivation of all those liberal, manly, noble and independent sentiments which ought to characterize every American, whether citizen or soldier. The strictest attention will be given to the health, manners and morals of the students. They will be continually under the personal inspection of the superintendent, who will bestow upon them all that care and attention which it is believed their parents, under similar circumstances, would bestow.

MILITARY LECTURES.

For the accommodation of gentlemen, (particularly of those holding commissions in the volunteer corps and militia,) who may not wish to go through with a regular course of military studies and instruction, and also for the purpose of diffusing military science more generally, Capt. Partridge will deliver annually at the before-mentioned seminary, three courses of public lectures; the first course to commence on the second Monday in May, the second course on the second Monday in July, and the third course on the first Monday in October, annually. These lectures will embrace the following branches of military science and instruction, viz.:—

1st. Permanent and field fortification, the construction of field works generally, and also of marine batteries.

2d. The attack and defense of fortified places.

3d. The use of artillery, with a general exposition of the principles of gunnery.

4th. Military Tactics.

5th. Garrison and field service of troops, embracing particularly their police and rules for turning off, mounting and relieving guards and sentinels, and also for guard duty, likewise castrametation.

6th. General rules for the attack and defense of a province or country embracing an exposition of the principles of base lines of operation.

7th. Rules for the inspection and review of troops.

8th. A summary of ancient fortification, and also of the ancient modes of attacking and defending fortified places.

9th. A summary of the ancient tactics, particularly those of the Greeks and Romans.

10th. A description of some of the most celebrated battles and sieges, both of ancient and modern times, for the purpose of practically illustrating the principles explained in the lectures. In order to render the lectures on fortification perfectly intelligible, plans will be prepared, on which the several parts of a work will be clearly and distinctly exhibited.

Particular attention will be given to a full explanation of all the technical terms used in fortification, as well as in the other departments of military science. A full course will comprise about twenty lectures; five to be delivered in each week until the course be finished. The terms for attending a course will be ten dollars. Gentlemen subscribing for two courses, will be allowed ever after to attend gratis. All those attending the lectures, will be entitled, during the time of such attendance, to practical military instruction, and also to the privilege of the reading-room, without any additional charge.

On the 1st of April, 1825, Capt. Partridge was induced by liberal overtures from citizens of Middletown, Conn., to leave his institution at Norwich, and remove to Middletown, Conn., and reopen it in that city. Before doing so he published a card in which he exhibits the progress and results of his labors at Norwich.

This seminary was opened at Norwich, in the state of Vermont, on the 4th of September, 1820, under my immediate direction and superintendence; and although the plan was new and untried, besides containing principles, which were by many considered discordant with each other, viz., the connecting of mental improvement with a regular course of bodily exercise, and the full development of the physical powers, the whole conducted under a military system of discipline; still its success has exceeded, rather than fallen short, of my most sanguine expectations.

The following extract from a recent report of the adjutant of the institution, compiled from the rolls and other authentic documents, will enable the public to form their conclusions, from facts on this subject.

1st. The total number of cadets who have joined the institution, since its organization, is 480.

2d. The numbers from the respective states, and other sections hereafter mentioned, are as follows, viz.:—

From Maine,	28	From South Carolina,	45
Massachusetts,	89	Kentucky,	2
New Hampshire,	57	Georgia,	7
Vermont,	115	Ohio,	1
Connecticut,	33	Louisiana,	4
Rhode Island,	10	Mississippi,	5
New York,	40	Missouri,	1
Pennsylvania,	15	Michigan,	2
New Jersey,	6	District of Columbia,	2
Delaware,	2	Lower Canada,	2
Maryland,	4	Havana, Island Cuba,	1
Virginia,	1	Island Scio, Greece,	1
North Carolina,	7		

3dly. Of the above number, twenty are commissioned and warrant officers of the U. S. Navy, viz., 4 lieutenants, 1 assistant-surgeon, and 15 midshipmen.

4thly. Out of the whole, 441 have been engaged in the study of the Mathematics, and out of this number 145 have completed a full course of "*Hutton's Mathematics.*" Of these, 80 have, in addition, attended to practical Mathematics, 56 have continued their course through the study of Philosophy, and others are now fast progressing in the accomplishment of those higher branches also.

5thly. The whole number who have studied the Greek and Latin languages, is about 150. Of these, 25 have advanced far towards completing a course, although none have gone entirely through. Of those not included in the last-mentioned number, many have fitted for college, or progressed still farther, and many are progressing. What is here considered a course, is the same which is laid down in the prospectus, which could be scarcely completed in the period since the establishment of the institution.

6thly. The number of those who have attended to the French language, is about 130. Twenty have become well acquainted with the language—30 are very well advanced, and many of the remainder have made respectable progress.

7thly. About ten or twelve of those who have been, or are now members of the institution, have devoted considerable time and instruction of the militia or volunteer corps, in this and various other sections of the country, and many of them are still engaged in that useful employment.

Of those who have been, or are now, engaged in the study of the Latin and Greek languages, I flatter myself there are several who would not suffer by a comparison with any of the same degree of advancement at our older and most approved seminaries; and as a school of practical science, I have little hesitation in asserting, that it is second to none in our country. In confirmation of this assertion, I would observe, that since the establishment of the seminary, my pupils, in addition to their usual exercises in practical geometry, and many operations of minor consequence, have executed, in a very handsome manner, a profile of the country, exhibiting the perpendicular altitudes of all the prominent points, above tide water, as determined by actual observation, from the summit of Manchester mountain, in the state of Vermont, to the summit of mount Washington, the highest elevation of the White Mountains, in the state of New Hampshire, a distance of 165 miles. They have also executed a similar profile from Norwich to Whitehall, in the state of New York, a distance of sixty-eight miles, and

have further executed a trigonometrical survey of the country around Norwich, for a distance in some directions, of about twenty miles. This survey was commenced, and has been prosecuted, in such a manner as to serve as a basis for any further operations that may be thought necessary. A handsome topographical plan of this survey is finished.

In the department of French, it is believed, the pupils have made as rapid progress as at any seminary in our country, and in Mineralogy, Botany, &c., although but recently commenced, there appears to be much zeal, and a corresponding improvement, amongst the classes which have attended, and those still attending, numbering about sixty.

Music and fencing have been attended by a large proportion of the members, and with a progress highly creditable to them.

The military exercises and duties are common to all the cadets, and it is believed very few have left the seminary, who were not competent to instruct from the elementary drill of the soldier, to embrace the school of the battalion, and who, in addition, did not possess a very competent knowledge of the principles of the grand tactics, of the elements of permanent and field fortification, of the principles of gunnery, &c. The beneficial effects of the regular system of exercise and active duty, to which my pupils are subject, upon their health, has been fully equal to my expectations. But one death has happened at the institution, since its commencement; and this was a youth who had just entered his name on the rolls, but was attacked by a prevailing epidemic, of which he died, before commencing his studies or regular duties. Several who joined the seminary feeble and debilitated, have in a short time been entirely restored to vigorous health. Indeed, such has been the result, I believe, without a single exception. That a youth may, by means of a regular system of exercise, preserve all his bodily activity and vigor, and at the same time apply himself most assiduously to study, I have never had any doubts; but if I had, the facts developed since the establishment of this seminary, would have dispelled them. Many of my pupils, and those the closest applicants to study, walk with facility forty miles per day. In the summer of 1823, several of them left Norwich at day-break in the morning, walked to the summit of Ascutney mountain, and returned to Norwich about 9 o'clock in the evening of the same day—the whole distance forty-six miles: which, considering the fatigue and difficulty of ascending and descending the mountain, (upwards of 3,000 feet high,) may reasonably be estimated as equivalent to sixty miles on the usual roads of the country. They continued their regular studies and other duties the following day. In September, 1823, a party of nearly thirty accompanied me on a pedestrian tour to the summit of Manchester mountain, in the state of Vermont, a large portion of whom traveled 150 miles in four days, and on the fourth day one of the party, a youth of sixteen years of age, walked by my side forty-five miles. On a recent excursion to the summit of the most elevated of the White Mountains, with a party of fifty of my pupils, a large portion of them, on the last day, walked forty-two miles. Belonging to this party, was a youth of but twelve years of age, who walked the whole distance, (160 miles,) carrying his knapsack, with clothes, &c., and returned in perfect health.

Since the latter part of June, 1821, the cadets, as a military corps, have executed, under my personal command, six military marches, amounting, in the aggregate, to 637 miles. Different detachments from the corps have also, within the same time, in addition to several of minor importance, performed, under my personal direction, four pedestrian excursions, for practical scientific purposes, amounting in the aggregate to 684 miles, and which, added to the former, gives $637 \times 684 = 1321$ miles. To this may be added an excursion to the White Mountains, whole distance 170 miles, by a party which I did not accompany, and which will make the total distance traveled in those marches and excursions, 1491 miles.

The foregoing facts are stated for the purpose of illustrating and confirming the correctness of the opinion I have so often advanced in my lectures on education, relative to the practicability, and even facility, of combining the full development and perfection of the physical powers of youth, with a due cultivation and improvement of the mental faculties. Whether a young man, who enters on the grand theater of active life, with a mind and body equally vigorous and improved, who, while he has a head to conceive, possesses also an arm to execute, will or will not possess advantages in the discharge of the various duties he may be called upon to perform, over one, who has grown to the age of manhood, puny and debilitated, destitute of physical energy, and incapable of bodily exertion, I shall leave to the sound discretion of the American people to decide.

As it respects the effect of the system on the morals of youth, I would observe, that I feel confident no one has left the institution worse than he joined it, and that I flatter myself, several have, in this respect, been improved. Next after the influence of religion, I consider habits of industry and economy as constitut-

ing the surest basis of morals amongst youth. To instill these into the minds of my pupils, ever has, and ever will be, a leading object; and I consequently shall imperatively require the strictest adherence to all the regulations bearing on those points, by all concerned. I would therefore beg leave to assure the parents, guardians, and relatives of my pupils, that the regulations prohibiting the cadets being furnished with money, otherwise than by the superintendent, or by his express permission, is to be taken in its literal meaning, (without exception,) and must be adhered to under all circumstances; and that any deviation from it will be followed by immediate dismission. I would much prefer that the great body of my pupils should enter young, and grow up under my system. The mind and body are then more susceptible of improvement, than at a more advanced period. Few, if any, vicious habits have then been formed, and the morals, under a strict and regular discipline, may easily be preserved. It is my fixed determination not, knowingly, to admit any young man of confirmed vicious or dissipated habits into the institution. I would accordingly recommend to parents and guardians not to send me any of this description; for if they should gain admission, and did not immediately reform, (which seldom occurs when the habits are confirmed,) it would only eventuate in their dismission, and consequent disgrace. It is much easier to prevent a youth from acquiring bad habits, than to correct them after they are acquired. If parents and guardians will send me their sons and wards free from habits of dissipation, immorality, and vice, I will guarantee, as far as human agency will authorize, that they shall be preserved free from such habits, while they remain under my care. Every requisite means will be used to correct the foibles and faults incidental to youth—to accomplish this object no pains will be spared. With their foibles I will bear as much as any person, but with their vices I will make no compromise. For the purpose of enabling me the more readily and the more certainly to accomplish this important object, I must request parents and guardians, if their sons or wards have foibles or faults, frankly to state them to me. On this subject there should be no reserve; as, with such information, I should know much better what course to pursue with them.

The favorable view taken of the aims, progress, and results of the scientific and military training provided by Capt. Partridge in his Academy at Norwich, was amply justified by the success of his pupils at Middletown, as practical men in various departments of business and public life.

On account of the condition on which he held a portion of his property at Norwich, Capt. Partridge was obliged to maintain there a literary institution, after his removal to Middletown. When he discontinued his labors at the latter place, and not succeeding in his plans for establishing a scientific and military school in the neighborhood of New York, he returned to Norwich, and in 1832, made preparation to reëstablish his Academy on its old basis, and with enlarged premises. With this view he erected the building known as the North Barracks, which were occupied for two years by Rev. Amasa Buck, for the purposes of a Methodist school, known as the Franklin Seminary.

NORWICH UNIVERSITY.

In the spring of 1834, a number of gentlemen associated to establish at Norwich, not an academic, but a collegiate institution, after Capt. Partridge's views, and in the autumn of that year, obtained from the Legislature of Vermont, a charter by which the petitioners were constituted a Board of Trustees of an institution by the name of the *Norwich University*. The charter further provides "that the said Board shall be required to furnish at said institution constantly a course of Military instruction, both theoretical and practical, and also in Civil Engineering, and the practical sciences generally; and the President of said institution, with the consent of the Trustees, *shall have power to give and confer all such diplomas, degrees, honors, or licenses, as are usually given or conferred in Colleges or Universities*, at their discretion; provided, however, that in so doing they shall have respect to the morals and merits of the candidate alone."

This act of incorporation named fourteen gentlemen, and provided for the election of eleven others, which twenty-five should constitute the Board of Trustees of Norwich University. The first meeting of the Trustees was held at Norwich, Vt., January, 1835. The vacancies in the Board were then filled, and the first members of the Faculty were elected, viz.:—ALDEN PARTRIDGE, "President and Professor of Moral and Intellectual Philosophy, History, Science of Government, Political Economy, and Military Science and Tactics;" TRUMAN B. RANSOM, Vice-President, and Professor of Natural and Experimental Philosophy, Mathematics, Theoretical and Practical, and Civil Engineering; M. NORAS, Professor of Ancient and Modern Languages; and FRANKLIN MARSH and I. M. HORR, assistants in the English Department. These gentlemen were authorized to form a course of study and laws for the government of the institution.

In May, 1835, the University was opened under the auspices and in the buildings owned by Capt. Partridge, with a full course of literary, scientific, and military studies. Among those enumerated in the first prospectus were Military Law, Military Drawing, Civil and Military Engineering. "Military Science being considered an important appendage to the education of every American youth is taught theoretically in all departments of the University. The military exercises are attended at those hours of the day which are generally passed by students in idleness or devoted to useless amusements, for which they will be made a pleasing and healthful substitute." "The discipline will be strict, but correct; in principle, military. It will be a great and leading object to instill into the minds of students liberality of sentiment and principles of honorable integrity and attachment to our republican institutions. Everything of a sectarian character in religion will be entirely excluded and all literary honors will be conferred in accordance with scholarship and moral worth alone."

At the close of the academic year, 1835–6, (August 18, 1836,) the first Annual Commencement took place, and the class of 1836 then graduated, consisted of one person, Alonzo Jackman, now Brigadier-General in Vermont, and Professor of Mathematics, Military Science, etc., at the University. Professor Ransom, entered the United States Navy about this time, and Mr. Jackman was appointed to fill the vacant Professorship. Soon after this, Rev. Zerah Colburn, succeeded Professor Noras. August 17, 1837, the second Annual Commencement was held, and Hon. George McDuffie, of South Carolina, delivered the address; the next year Robert Rantoul, Jr., of Massachusetts, was the orator; in 1839, John Wentworth, of Illinois, and Thomas H. Seymour, of Connecticut, were speakers; and in 1840, Benjamin F. Hallett, of Boston. The catalogues of each of these years show that the number of students, or cadets, averaged a little less than a hundred, and in all the catalogues, the regulations for the Police of the Cadets' Quarters were given in full. They provided for all the military duties of the students, for the wearing of uniform, etc., etc.

In July, 1840, the Corps of the University under the command of Captain Partridge, performed a military march across the State to Fort Ticonderoga. They were just a week on the excursion, and in that time, they marched nearly a hundred and fifty miles on foot, about twenty-five miles per day. Notwithstanding the excessive warmth of the day, and the exposure to the air of the night, with no other covering than the soldiers' blanket, the Cadets all returned in good health and spirits.

During the year 1843, several changes took place in the University. From

the time Mr. Ransom resigned the Vice-Presidency, until May, 1843, that office was filled by Hon. Aaron Loveland. Mr. Ransom returned at this time, and was again made Vice-President, and Professor of Civil and Military Engineering, etc. The buildings and land used up to this time, were the property of Capt. Partridge. During May, arrangements were made for the purchase of this property by the University, but some misunderstanding occurred before this was done, and in November, President Partridge resigned, and took from the armory all the arms and accoutrements, attempted to revive his old Academy in another part of the village, and finally, when the University could not purchase his property at his prices, obliged the students to remove from the buildings. On his resignation, Truman B. Ransom was chosen President, and for the two years the institution was carried on in other buildings in the town. The Legislature was applied to, and appropriated a hundred stand of arms, sets of accoutrements, etc., for the use of the students. At last an arrangement was made with Capt. Partridge, for the purchase of his property, and the University returned to its old quarters. The number of students was small during these difficulties, but the military department was always active, a good military education was given, and men were graduated who now hold responsible places in the military service of the United States among the Federal troops.

In May, 1847, President Ransom, then Major-General of the Vermont Militia, resigned his place at the University, accepted that of Colonel of the "New England regiment," ninth infantry, and went with that body to Mexico. September 13th of the same year, he was shot while gallantly leading the charge of his regiment upon the fortifications of Chapultepec. When Gen. Ransom left, Prof. James D. Butler was appointed President, *pro tem.*, and in January, 1848, Gen. Henry S. Wheaton, of Massachusetts, was elected President, and served as such till August, 1849; he was succeeded in September, 1850, by Rev. Edward Bourns, LL. D., who still (1863,) holds that office.

Soon after 1850, the opposition to anything of a military education became very strong, the number of Cadets at this institution diminished, and the tone of the prospectus changed to suit the public. "The discipline is military in principle and form. The Cadets are under military organization, they dress in uniform, are regularly drilled with arms. But they are not made lovers of war! They are not found to adopt the profession of arms more than others of the same age, however educated; oftentimes the harmless practice of handling arms at this age, is found to satisfy the craving for the use of them, and these young men settle down into the ranks of peace more easily and more contentedly than those that have had no such training. The drill is an agreeable exercise. The system of discipline is strict, though not oppressive, its sole object is to preserve order and promote study." "The object is not to make soldiers, but to strengthen the body." During these years (from 1850 to 1860,) the prospects of the University were not bright. It was at once engaged in lawsuits, and troubled with debt and opposition. In 1853, it was proposed to move the University to Montpelier, but the project was finally abandoned, the last of the old Academy property was bought, the buildings were repaired and the institution freed from debt. Previous to 1850, the finances were in a very confused state. When the charter was obtained, land to the value of fifteen hundred dollars was brought and deeded to the University. The sale of this, and subscriptions from Trustees and citizens of Norwich, produced enough to purchase the North Barracks.

The money received of students for tuition was always, and is still, all used for paying the salaries of the instructors. The room-rents scarcely paid the rent and repairs of the South Barracks, and the University ran slightly into debt. The State, in 1853–4, gave the institution about thirteen hundred dollars of an unappropriated school fund, and enough more was raised by friends of the University to purchase the South Barracks, and pay off old debts, and put all the buildings in good repair. For several years it was obliged to struggle against a load of popular prejudice on account of its military feature, but since 1861, it has brushed up its uniform, and its Military Department no longer seeks to hide itself. No such semi-apologies for the military training of its students appear in its catalogues and prospectus for 1861 and 1862.

"The Norwich University differs from most colleges in two respects. These are its double system of study, consisting in an Academic and a Scientific course; and its department of Military Science. The Academic course comprises those studies usually pursued in other colleges; the Scientific embraces Mathematics, Natural Sciences, Belles-Lettres, Surveying, and Engineering. Four years are required to complete the former, and three, the latter course of study. Students are also allowed to take a partial course in either department. The students of all departments are regarded as equals.

"The feature, however, which more than any other distinguishes Norwich University from other Collegiate institutions, is the department of Military Science and Tactics.

"Agreeably to the provisions of its charter, the students are all under Military discipline—are called Cadets—dress in uniform, and are instructed in Infantry, Rifle, and Artillery Drill, Bayonet Exercise, Fortification, Reconnoissance, Castrametation, Guard and Out-Post duty, &c., &c. All the arms and equipments necessary for drills are furnished by the State of Vermont. * * *

"The military feature of this institution is one which should particularly commend it to the notice, and patronage of the public at this time. The want of men skilled in Military Science and Tactics, to take command of volunteer forces, and discipline them into effective soldiers, has been severely felt in organizing the present army of the United States. The reverses with which it has met are, without doubt, owing largely to this cause. To guard against this defect in the future, it is now generally felt that young men should be educated thoroughly in every department of Military Science. In times of peace this knowledge would not incapacitate men for nor interfere with any other business;—while in times of war, it would become invaluable to the country in training an army for efficient service."

The following persons constituted the Faculty in 1862. Rev. EDWARD BOURNS, LL. D., President, and Professor of Moral Sciences, Ancient Languages, and Literature; ALONZO JACKMAN, A. M., Brigadier-General Vermont Volunteer Militia, Professor of Mathematics, Natural Philosophy, Military Science, and Tactics; THOMAS R. CROSBY, M. D., Professor of Anatomy, Physiology, and Natural History; CLINTON S. AVERILL, A. M., Acting Professor of Natural Sciences; GEORGE BAILLARD, Professor of Modern Languages, and Linear and Architectural Drawing; SAMUEL W. SHATTUCK, B. S., Tutor in Mathematics and Military Tactics; ALONZO JACKMAN, A. M., Librarian.

MILITARY ELEMENT IN SCHOOLS OF ALL GRADES.

INTRODUCTION.

In all ages and in all countries there have been educators who recognized the importance of the physical, and more specifically, of the military element in their schemes of individual and collective teaching. No higher authority in English pedagogical literature of the liberal type, can be named in this connection, than John Milton, who, in his brief but masterly outline of "a virtuous and noble education," includes this in the means of a complete and generous culture, that is "to fit a man to perform justly, skillfully, and magnanimously all the offices, both private and public, of peace and war." In the outset he demands that the number of pupils, for whose accommodations a spacious house and grounds were to be provided, should be large enough for "the convenience of a foot company or interchangeably two troops of cavalry," so that systematic exercise could alternate with the studies and diet. In his general progamme he includes studies which shall "stir up their spirits to manly and liberal exercise," and "inflame their hearts with high hopes of living to be brave men and worthy patriots." In the enumeration of studies he specifies mathematics, the practical aid of instruments in surveying and engineering, and their application to fortification and navigation. Living in the midst of a civil war like our own, when the preservation of constitutional liberty had summoned troops from the field, the shop, and the study, and placed men in command who had not been trained to the profession of arms, Milton directs or points out the value of studies, the mastery of whose general principles "may at some time or other save an army," and not let the healthy and stout bodies of young men rot away under them for want of this discipline, which is a great pity, and no less shame to the commander." In treating specially of physical culture, Milton assigns to military drill, and use of sword and other weapons, at least an hour and a half each day, that his pupils may be equally good both for peace and war. "The exercise which I commend first is the exact use of these weapons to guard and strike safely with edge or point. This will keep them healthy, nimble, strong, and well in

breath; is also the likeliest means to make them grow large and tall, and to inspire them with a gallant and fearless courage, which being tempered with seasonable lectures and precepts to make them of true fortitude and patience, will turn into a native and heroic valor, and makes them hate the cowardice of doing wrong." With the use of the sword Milton would associate all athletic sports "wherein Englishmen are apt to excel." And after the day's study has been thoroughly done, "with minds in good tune and satisfaction," he would occupy the "two hours before supper in military motions, under sky, or cover, according to the season, as was the Roman wont; first on foot, then as their age permits, on horseback to all the art of cavalry; that having in spirit, but with much exactness and daily muster, served out the rudiments of their soldiership in the skill of embattling, marching, encamping, fortifying, besieging and battering, with all the helps of ancient and modern strategems, tactics, and warlike maxims, they may, as it were, out of a long war come forth renowned and perfect commanders in the service of their country. They would not then if they were trusted with fair and hopeful armies, suffer them for want of just and wise discipline to shed away from about them like sick feathers, though they be never so oft supplied; they would not suffer these empty and unrecruitable colonels to quaff out or convey into secret hoards the wages of a delusive list and miserable remnant. No, certainly, if they knew aught of that knowledge which belongs to good men or good governors, they would not suffer these things." To these school studies and practical exercises, Milton would add excursions "to all quarters of the land, learning and observing all places of strength, all material for building, all soil for towns and tillage, harbors and ports of trade. These ways would try all their peculiar gifts of Nature, and if there is any secret excellence among them, would fetch it out and give it fair opportunities to advance itself by."

The views of Milton in favor of military exercises can not be attributed to any professional bias, for his tastes and his habits of life were in the shaded walks of the academy, "contemplating the serene countenance of truth in the still air of delightful study."

The example of Switzerland can be cited on the side of their practicality, on a scale as liberal and much more popular than their author at the time contemplated; and quite recently (1871), the Federal war authorities propose that the older boys in the secondary and superior schools shall be instructed in outpost and skirmishing duties.

X. PHYSICAL AND MILITARY EXERCISES IN PUBLIC SCHOOLS.

A NATIONAL NECESSITY.

BY EDWARD L. MOLINEUX.

Major and Inspector in New York Militia.

From a long and unexampled period of political and commercial prosperity we suddenly find ourselves called upon to struggle for national existence, and while a noble response from the people to the necessity of the struggle has strengthened the hand of government with an intelligent army, and developed the resources of the country, yet the occasion has laid bare defects which call for correction.

Without a standing army of any magnitude we have found our militia laws defective, and have been obliged to create ourselves a military people by the sufferings and bitterness of an experience bought on the field of active warfare.

Military necessity has compelled the loss of invaluable time in the organizing and preparing of our troops, which would not have been required had we been able to meet the rebellion at the commencement with well trained officers and an experienced and carefully drilled militia.

"*The first object*," says Daniel Webster, "*of a free people is the preservation of their liberty:*" a noble truth which must speak home to the heart of every American, and if, as it is asserted, "the future life and character of a nation is to be seen in its system of schools," then we may well listen with some degree of alarm to the warnings and unmistakable evidences by which we are surrounded, that the American race is physically deteriorating.*

The question arises, has our National system of Education been such as to qualify and prepare us to maintain successfully, the noble inheritance which was won by the physical energies of the men of the Revolution, and with our success in the field of intellectual culture, have we kept the physical advantages possessed by our forefathers?

Let us not mislead ourselves in this matter, but calmly look at the facts, that as a rule, our present system of Public Education is devoted *solely* to the mental and moral improvement of the scholars, and that the encouragements and rewards held out by committees and teachers, stimulate to the overexertion of the brain, and sacrifice in too many instances, the health and growth of the body.

Although great improvement has been made of late by the shortening of the time devoted to study, and by the introduction of more frequent periods of recreation, yet still little has been attempted for giving exercise and activity to the body; this important training being left to the care of parents or the pupils themselves.

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*Miss C. E. Beecher's "Appeal to American Women," "Calisthenics," &c.

Is it not too true that the increase of ill health, broken constitutions, and early deaths, among the growing portion of our population, especially in cities, warns us, year after year, that the thirst for knowledge, and the restless seeking after mental and intellectual improvement, have been bought at the expense of the vital energies of the great body of youth who throng the colleges and public schools of our land?*

If any one denies this, let him visit our institutions of learning, and while he may well admire the wisdom and forethought which has established our prosperity on a noble system of National Education, he can not but notice the debility evinced in the frames of so many youthful votaries of intellectual training; the exceptions making the contrast still more strikingly painful. Then let him go to the counting-house or the close confinement of some mechanical employment, where the evils from mental activity, unaccompanied by physical recreation, are yet more strongly developed. These evils assail not only the happiness of families, but the prosperity of the nation and the well-being of the race. Is this right or necessary? Can it be avoided?

The solution of these momentous questions may well engage the serious attention of the reflecting teacher, parent and patriot; and to them we assert that, *unless physical exercises are enforced upon our system of Public School education, our intellectual culture will be of little avail, and that our nationality stands in danger of sinking a prey to designing opponents.*

That enfeebled races are invariably conquered by those more powerfully developed, is proved by innumerable instances in history. That physical training was an important branch of education among the Greeks and Romans, is well known. The system inculcated by the iron-hearted Lycurgus, among the Spartan youth, was of a nature admirably adapted to fit them for all the sterner realities of life, whilst the athletic games and exercises of the youth of Rome, comprising, as it did, walking, running, wrestling, swimming, and military drill, were the means of improving, to the utmost, their physical powers Upon reaching manhood, the advantage of this training was indicated by the robustness of form, and the constitutional vigor which enabled them to undertake labor, fatigue and hardship of every kind, with perfect indifference.

The Spartan and the Roman soldiers were by this early training, not only qualified to surmount with ease the various obstacles and difficulties incident to a state of active warfare, but they also became gifted with precision and rapidity in every movement, and each man was likewise endowed with that confidence in himself, and that unbounded reliance upon order, subordination and combined action, which nourish audacity, yet temper it with coolness and steadiness.

Unfortunately this system, by which the vigor and valor of a Spartan or a Roman has passed into a proverb, fell into disuse, and as it was neglected for more intellectual pursuits, so the grand empires founded by its vigor crumbled before the assaults of more athletic barbarians.

The influence of health upon the faculties of the mind is acknowledged by all, and yet how few in this country devote attention to those all important exercises which are necessary to the preservation of health, and without which intellectual power can not be applied to its highest use. The talents, the expe-

*[We do not share this alarm, or believe that hard study, apart from open or secret vice, has had much, if any thing, to do with such physical deterioration as does exist.—Ed *Am Jour of Ed*]

rience of our best educators of youth, are taxed to devise exercises to develop the *mental* faculties, forgetting that too close application to study is detrimental to the growth of the body.

But few thoughtful teachers will deny the extent to which this evil has reached, or be unwilling that the strain upon the intellectual powers of children, by absorbing studies, should be counteracted by cheerful and relaxing exercises by which the mind will be relieved and at the same time strengthened. The testimony of physicians, the valuable works on health by Dr. Warren, Miss C. E. Beecher, and many other able writers, furnish incontestable evidence of the necessity of systematic exercise for children. To accomplish this it is absolutely necessary to adopt it in our course of education, for in the majority of cases it can not, or will not, be attended to at their homes.

What then is the most simple, feasible and useful plan to adopt for physical exercises in our Colleges, Normal and Public Schools?

We unhesitatingly say, that the only successful, orderly, and systematic method is, *to engraft them upon the course of studies during school hours, and to carry it out under strict military discipline;* the exercises being such as are best suited to the age, strength and capabilities of the pupils, namely: calisthenics and walking for the girls and younger children, and *military exercises* for the elder boys.

Let not the kind hearted parent exclaim against his boy learning the military drill, for fear of his acquiring a taste for warfare; or the lover of peace imagine we would re-establish the stern laws of Lycurgus. We would have moderation in this respect as in mental studies, and while we would not, as some may imagine, displace the bust of Howard in our school rooms for a Napoleon, yet we would impress upon the minds of boys the image and example of Washington, and in cultivating their intellectual faculties, likewise prepare them in mind and body to develop in manhood those virtues and powers which constitute a true and noble citizen;—a sincere love of country, of national probity and justice, beyond selfish considerations or personal aggrandizement. They should be brought up to a sense and knowledge that it will be their honorable duty and privilege to protect their native land, that she fosters and educates them in their youth, and that upon their manhood her nationality depends.

We can never become an aggressive military people; the fields for successful enterprise in art, science, commerce and agriculture, are too broad and inviting to render military pursuits very attractive, and unless we cultivate such exercises and discipline in youth, they will be, as they have been, neglected when engaged in the active pursuits of business. The clear, common sense of the American parent will acknowledge, not only the national necessity, but the moral advantages of this; for what fond mother is there but would prefer to see in her son a manly, patriotic spirit, rather than a timid, mercenary one, which, shunning danger, would sacrifice the honor and greatness of his country to the base love of gain and ease.

We have suggested that the exercises be conducted under strict military discipline, because it is impossible for a large body of children to be exercised in the usual school limits, unless the greatest decorum and order is observed; and if conducted under the supervision of a teacher, dangers and accidents will be avoided, which always occur when children are rash and thoughtless in attempting to accomplish too much. Thus conducted, they will prove an

invaluable aid to the teacher in the enforcement of discipline in the school room, and teach that invaluable lesson which it seems so difficult for children to learn,—unhesitating obedience.

For the advantages of this system let us examine the practical testimony afforded in the European schools, where considerable attention has been paid to this important matter.

On the continent the advantages of physical training are appreciated to their fullest extent, especially in the Industrial Reform schools, where the admirable principle has been adopted of teaching "what they will have occasion to use when they become men,"* and thus render them useful members of society. To Dr. Barnard's National Education in Europe, we are indebted for the following extracts and illustrations of this position.

In the Reform School of Rauhen Haus, near Hamburg, "they are taught to develop their bodily and mental powers in various practical ways; to use the fire engine, to swim, to save persons from drowning, and use remedies to recover them, to climb a mast and handle the sail, of a ship. They act as a jury among themselves. Their chief reward is to be enrolled in the table of honor. In the great fire of Hamburg, their conduct was physically, as well as morally, heroic, and while bravely saving life and property, they steadily refused rewards." Parents who, perhaps justly owing to the numerous accidents in Gymnasiums, are timid of their children becoming injured by these exercises, should carefully read the system pursued in Fellenberg's celebrated establishment at Hofwyl. "A great variety of exercises of the body and the senses are employed, so that every boy shall acquire a knowledge of his physical strength, and attain confidence with regard to those efforts of which he is capable, instead of that foolhardiness which endangers the existence of many who have not learned to estimate their own powers correctly." At Ruysselde, Belgium, the following plan was pursued: In summer, from 5½ to 6½ A. M., Exercises and Manœuvres; from 7½ to 8¾ P. M., Gymnastics. In winter, several hours were devoted to these exercises, and the result found (as in this report,) was, that "rickets, scrofula, want of elasticity in the limbs, difficulty of walking, all rapidly disappeared under the drill, which confirmed the health and increased the strength and activity of the children, and accustomed them to discipline. It predisposed the pupils to sleep, and was an effective safeguard against shameful habits and secret vices. The battalion movements were performed with as much precision as that of the army, a platoon armed with condemned carbines, marched at the head. The bayonet exercises and skirmishing were as good as play to the boys." A remarkable instance of the moral effects of military discipline upon the lads of the *Colonie Agricole*, at Mettray, is related by M. Demetz, and was published in Barnard's Journal, Vol. 1, p. 623. "During the revolution of 1848, a band of workmen came to Mettray, with flags flying and trumpets sounding, and meeting the youths returning, tired from field labor, their pickaxes on their shoulders, thus addressed them:—'My boys, do not be such fools as to work any longer. Bread is plentiful; it is ready for you without labor.' The *chef*, who was conducting the boys, and who behaved with the greatest calmness and tact, immediately cried, 'Halt! form in line.' The lads, being accustomed to march like soldiers, immediately formed. The *chef* then

*Aristippus.

said to the men, 'My friends, you have learned to labor; you have a right to rest; but leave these lads; let them learn now, and when their turn comes they may rest as you do.' The men gave way, the youths marched home, and Meltray was saved,—saved, as I believe, by our habit of military discipline." It was the heroic exertions of these young *colons* during the inundation of 1856, which won for them the praises of all France. These instances might be multiplied, but are sufficient to show the moral and physical benefits of military exercises and discipline upon boys, even of the lowest class.

The governments of Europe being upheld by the bayonets of large standing armies, and requiring, as they do, in many of the kingdoms, the compulsory service of all young men, renders it unnecessary for the daily public schools to teach military exercises to that extent, which it is well for our Republican government to do. Yet in Europe they watch with the greatest assiduity and care the bodily powers of the children, knowing its great advantage not only in health, but the maintenance of order.

In Great Britain much interest has of late been evinced on this subject, and Mr. Edwin Chadwick becoming convinced that the studies and confinement in their schools were generally prolonged beyond the powers of the children, and in violation of the laws of health, devoted himself to collecting testimony respecting the advantages of the military drill upon the health of children. His investigations have elicited much valuable information, the more interesting to us as they mark its advantages to a nation which, like our own, depends for its defence mainly upon a volunteer force.

The following synopsis of his pamphlet we extract from the N. Y. Evening Post, November 1st:

Mr. Chadwick considers "In a sanitary point of view that a systematized drill is good, and for defective constitutions requisite for the correction of congenital bodily defects and taints, with which the youth of a very large proportion of the population, especially among the poorer town populations, are affected: and that for these purposes the climbing of masts, and other operations of the naval drill, and swimming, are valuable additions to the gymnastic exercises of the military drill, and when properly taught are greatly liked by boys. From a moral point of view, also, this drill will give the pupil an early initiation into all the acquirements of discipline—namely, duty, order, obedience to command, self-restraint, punctuality and patience."

The evidence furnished by English drill officers shows its national value, and "That at school it may be taught most economically, as not interfering with productive labor, and that thirty or forty boys may be taught the naval and military drill at one penny farthing (two and a half cents) per week per head as cheaply as one man, and the whole juvenile population may be drilled completely in the juvenile stage, as economically as the small part of it now taught imperfectly on recruiting or in the adult stage; and that, for teaching the drill, the services of retired drill sergeants, and naval as well as military officers and pensioners, may be had economically in every part of the country.

That the middle and higher class schools should have, in addition to the foot drill, the cavalry drill, which the parents of that class of pupils may afford.

That the drill, when made generally prevalent, (without superseding,) will eventually accomplish, in a wider and better manner, the objects of volunteer corps and of yeomanry, which, as interrupting productive occupations now

becoming more absorbing, is highly expensive, rendering all volunteer forces dependent in fitful zeal, and eventually comparatively inefficient; that the juvenile drill, if made general, will accomplish better the objects even of the militia; that the juvenile drill will abate diffidence in military efficiency, and will spread a wide predisposition to a better order of recruitment for the public service, will tend to the improvement of the ranks of the regular forces, whether naval or military, and will produce an immensely stronger and cheaper defensive force than by the means at present in use or in public view.

And, finally, that the means of producing this defensive force, instead of being an expense, will be a gain to the productive powers and value of the labors of the country."

Lieutenant-General Shaw Kennedy, in a letter expressing his high approval of the plan, states, "that the inferences drawn can not be controverted. He is of opinion that if the measure is carried out it will be the means of bringing two million of men actually under arms in Great Britain alone, that is, excluding Ireland. He conceives that the effects of military drill and exercises, and the use of fire-arms taught at schools, would never be forgotten; that a youth so trained would, at any future period, with a slight degree of practice, renew his knowledge of what he had been taught."

Nor has the training of a better class of seamen been neglected. This is of vital importance to the well-being of a commercial people, and it is well for us to see what steps England is taking in the matter.

"For the purpose of giving instruction in the naval drill, old masts and tackle have been obtained for some of the training schools in England, and Mr. Taffnell has received expressions of satisfaction from naval men of the way in which some of the boys have by these means been tutored as seamen in pauper schools. In order to form sailors, it is necessary to have masts and sails rigged in the playgronnd, and a regular seaman must be engaged to drill the boys.

Mr. Baker has observed that the naval drill as given at Greenwich is highly effective. "He states that he was on board the Ganges and the Conway at a time when many boys came on board who had been taught the naval drill at Greenwich naval schools; and that they proved to be as ready and well trained as man-of-war's men; they were clean and orderly, and as a class were first-rate seamen, becoming petty and warrant officers in greater proportion than others."

Of its consequence upon the national health and industry, "Professor Owen has stated that even in the best-warmed and ventilated schools, five or six hours' enforced stillness of growing children is a violation of the primary laws of physiology; whilst Miss Nightingale and others agree that, under the present system, children are placed under conditions which impair good bodily health and generate epidemic disease. Mr. Rahnson, a school commissioner at Amsterdam, states that the physical evils attendant upon the present amount of sedentary confinement in schools, required from young children, is beginning to attract attention in Holland, and that they have under trial a system of exercises for schools advocated by Dr. Schrieber, of Leipsic. 'The chief question,' says the latter gentleman, 'is, How are our children to be brought up? Is it according to the laws of nature? The answer is, No; or we should not see so many children who were rosy and healthy before going to school, become pale and bloodless after school has begun;' and he prescribes the limitation of the hours of school confinement.

Mr. Robert Rawlinson, civil engineer, gives the following as his opinion of the advantages of school drill in connexion with manual labor:

"In my opinion, based on experience and observation, I think school drilling and training would prove of the utmost consequence to the boys in after life. I may give a few instances. In all engineering and building, tradesmen are frequently required to use their strength in concert, lifting, carrying and drawing; men, to use their joint strength not only effectively but safely, must have confidence in each other. Two trained men will lift and carry more easily and safely than four untrained men. I have frequently seen trained men weed out unskilled men where heavy lifting has been required, because they dare not risk the danger arising from unskilled strength, and few have performed with more safety work which would have been lighter and easier if all had been equally skilled. Men frequently reject the assistance of unskilled men, as there is absolutely danger in having them near. Frequent accidents arise from using men unskilled in lifting, in hoisting, and at capstan work. * * * Boys should not only learn to march, but to lift, carry and pull in concert. There are many necessary feats of strength in all trades, which are more matters of knack and tact than of brute strength. Brute strength frequently fails to do that which comparative weakness can accomplish easily with skill and confident concert. There is no regular system of training in concert to use human strength in the best manner in any trade, so far as I know; acting in concert is a matter of necessity, and practice gives facility and confidence. Drill and training would probably double the effective human power of any establishment, especially if numbers are instructed in joint feats of strength. That which is taught to youth is never forgotten in after life."

"As regards its fitness as an appendage to the highest branches of education, we have the testimony of experienced examiners at the University of Oxford, England, who state that six hours mental work, instead of ten or twelve, for adults, was the time of the great majority of the prizemen; and it was always found that those who were the foremost in mental labor were commonly the foremost in boat-rowing and physical exercise. The Vice-Chancellor of Oxford testifies that the institution of the systematized exercise of the volunteer drill in that college had been attended by an improvement of the mental labors, and of the whole of the order and discipline, as well as of the health of the University; and that, encouraged by these results, he was considering of making provision for cavalry exercises."

Mr. Chadwick has also furnished incontestable proofs of the absolute necessity of more active physical training for females and of its bearing upon the future welfare of the race. But this subject has been rendered so familiar to American readers by the able pen of Miss Catherine E. Beecher, that we need not touch upon the European view, except to say that the noble labors of Professors Ling and Branting, of Sweden, have been ably seconded by very many of the governments of Northern Europe, where a method of gymnastics for females, has been systematized and practically adopted. From this brief sketch of the practical working of physical military exercises in Europe, let us turn to what has been accomplished among our own countrymen, whose activity in behalf of public education called forth the compliment from Prof. LeRoy, which we wish was better deserved, especially by the class which he specifies.

that "the improvement of schools is, so to speak, the fixed idea, the constant preoccupation of the statesmen of America."

We have indeed a noble and liberal system of education, but we would see its fostering care so extended as to invigorate the bodies as well as develop the mental faculties and intellectual powers of the pupils. The military exercises would best accomplish this, and at the same time form our public schools into A NURSERY FOR A BRAVE AND EFFECTIVE MILITIA.

Early in October last a communication was addressed by the writer to the different governors, and various other persons connected with the executive departments of the Northern States, in regard to the advantages to be derived from the introduction of infantry drills in the public schools, and by early preparation in school-days to strengthen the *militia* of the different States. At the same time it was placed before the New York and other City Boards of Education, and referred by them to special committees. The subject was also agitated through the columns of the daily press. The warm responses which have been accorded to these communications, prove the deep interest which is felt in this important matter, and it is to be hoped by the time this article appears in print,* some legislative action will have been taken.

In New York, the energetic Judge Advocate General, William H. Anthon, being engaged in a report upon the militia laws, and taking a warm interest in all matters relative to the efficacy of the militia, thus speaks of the importance of some alteration in the present system, in a letter addressed to Mr. Curtis, President of the Board of Education in the city of New York:

"The entire system, in my judgment, needs revision and reform, in order to make the militia what the Father of the Republic intended it should be.

It has been suggested by several persons, and among others Col. Richard Delafield, U. S. A., and Maj. E. L. Molineux, that an excellent foundation for an improved militia system would be the introduction of 'The Manual of Arms,' and 'The School of the Soldier and of the Company,' into our public schools.

I am disposed to consider these suggestions as valuable, and shall feel obliged to you if you will, as early as may be convenient, inform me how far you deem them practicable, and how they may be most conveniently introduced into the institutions under the charge of your Board."

Mr. Curtis, whose personal observations on the European school systems, and whose long experience at the head of the Educational Board of the largest city in the Union, renders his views of the greatest value, replied:

"It has been my opinion for years that military instruction should, under certain restrictions, and to a certain extent, be given to the older boys in all the schools and institutions that are supported or draw funds from the public treasury. It is but just to the State whose munificence sustains these schools, that the pupils should be instructed in those branches of knowledge that will make them useful and effective in defending and protecting the State. A well organized militia, receiving from year to year into its ranks the disciplined and instructed youth who have passed through the public schools, and to whom the duties of the soldier are familiar, will always be sustained by the public confidence and esteem."

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* Written December, 1861. Recommended by Governors Andrew and Morgan in their messages in January

Military discipline and exercises are by no means an untried experiment in the annals of American education; some of our best private schools and institutes having long since adopted it, and with a good degree of success as it will be our endeavor now to show.

To the admirable regulations of our National Military and Naval Academies, we need not refer; the systematic course pursued by them for the development of health, for discipline of mind and body, being well known to the majority of our readers.

One instance which came under the writer's personal observation, will sufficiently illustrate the dependence which can be placed upon well-drilled boys in case of emergency.

In April last, when Washington was defenceless, Baltimore in riot, and all Maryland in a state of revolt, communication being cut off at Annapolis, there was great fear of attack upon that important strategetic point. The pupils were prepared for any exigency, and slept with their loaded rifles over their cots. At an alarm of a night attack, there was no hesitation among those gallant little fellows. They were up directly; fell in their ranks and off at a *double-quick* for the point of danger, in an almost incredible short space of time. The elder boys dragged their howitzer with them. Had an attack taken place, those pupils would have given a good account of themselves and have stood their ground with courage and steadiness. The secret of this is the *discipline*, for which they are indebted to the assiduity of their brave and experienced superintendent, Captain Blake of the Navy.

Let us read the opinion of this able officer in respect to the applying of this *discipline* to public schools:

"My experience at this institution long since impressed me with the importance of this subject, and I intended to have given my views publicly, but you have left nothing more to be said upon it, and I can only hope that those who have the control of our public schools will view the subject as we do. We have received about a hundred and forty acting midshipmen this year, some of them very young, and although they have not been here two months, they present a beautiful example of such results as the system would produce all over the country."

It must be acknowledged that the States now in rebellion have devoted much more attention to military instruction in special schools, than we have, many of them pursuing the European plan of State Academies devoted to military science. Thus while we have been obliged to *create* officers from the small nucleus afforded us from West Point, they have had the students from State Colleges to officer their regiments.

For a long time back Virginia has annually expended upon her Military Institute nearly $50,000; South Carolina, $30,000; Kentucky and other States have likewise institutions, founded in whole or part, upon a military basis.

Although several attempts have been made to obtain legislative action for similar institutes in the Northern States, they have not, up to the present time, been successful, owing, we think, to the groundless opinion that it would prove a heavy tax, without a corresponding advantage. We shall endeavor to prove in this article how economically an academy could be supported. It is, therefore, to private enterprise, we are indebted for any experiments which have been made in this respect.

Several of our best boys' boarding-schools in this portion of the country, have for a long time employed a military instructor for the pupils and been managed on a semi-military organization; they have been well sustained by the patronage of the public. We instance two or three schools of the present time.

Dr. Russell's Collegiate and Commercial Institute of New Haven, is one which has already been of national advantage to us, for according to Prof. Daniel C. Gilman, "the scholars were of great service in drilling the recruits of Connecticut at the outset of the war, and many of them now hold important posts in the army. The scholars formerly trained as infantry and are now at artillery practices." Mr. Gilman very justly observes, that in a country like ours with no standing army, every able-bodied man should learn to bear arms, and there can be no cheaper or efficient way of doing this than by teaching boys in schools.

The Eagleswood Collegiate and Military School, near Perth Amboy, N. J., has been recently organized on the military plan. The scholars are formed into a battalion under a superintendent and colonel commanding, the rest of the officers being taken from the scholars. The State of New Jersey has supplied the institute with arms, and the military regulations apply to the conduct of the pupils in their general deportment. The reasons given for employing this discipline are the same that apply in every instance, that it is the most orderly and effective, increases the energy, vigor and manly attitude of the boys, and induces cheerful obedience.

To Major J. P. Prall, Military Instructor, we are under obligations for the following account of Mr. Tracy's *Military Boarding School, at Tarrytown, N. Y.:*

"There is no question, in my mind, of the utility of military instruction in schools, and if I had any doubts, they would speedily be removed by the fact that the very exigency you propose to provide for is being developed, only in a less degree, in the volunteer army now fighting our country's battles. There are a number holding honorable positions in the army of the Potomac, and elsewhere, who have more particularly come under my own observation, that have passed through a course of similar instruction to what you propose, in private military boarding schools, who give evidence of superior knowledge as soldiers, and with a little preparation were *ready* to assume the duties and responsibilities of the field and camp. They have more particularly distinguished themselves as drill masters and thorough disciplinarians, the very ground you proposed to cover in your articles in the N. Y. Tribune of Nov. 20. I have especially noticed, of late, the facility with which youth acquire military knowledge since the outbreak of the rebellion, when the occasion seems to impress them more strongly with its importance.

Independent of the military availability of youth thus instructed, the promptness and precision that the system induces is apparent. A simple sketch of the routine of duties in a school over the military department of which I have the supervision, may give an idea of its utility, as well as its usefulness. This department is conducted in such a way as to make the military feature an auxiliary to the classical and preparatory. Part of two days in each week is more especially devoted to military drill and instruction, when the flag is raised on the flag-staff on the parade ground with the roll of the drum, and the sunrise gun is fired. At sunset it is lowered with the same ceremony by a file of boys, in charge of an officer, or non-commissioned officer. On other days of the week

a drill of about an hour is held, in command of the company officers,—always in presence of the Principal. The utmost strictness is required in all the military features. The "Assembly," when beaten for drill or parade, occupies one minute—*immediately* after, "*fall in*" is given by the orderly, when *entire* silence is required. Boys being naturally playful, much more care in these particulars is necessary than in grown persons. *Tattoo* begins at 9 o'clock precisely, when the minute of its duration expires every cadet is required to be in line for "roll call," and the three squads, each in charge of an officer, are marched by flank to their quarters, (the whole not occupying more than two minutes.) They halt opposite their beds, and salute their officer as he passes out;—in five minutes the lights are extinguished. Their clothing is uniformly arranged, and in such way that if called up at night they can dress without lights and without loss of time. The officer in command of each, being held responsible for the condition of his squad. The military instructor inspects at unexpected times, and directs the chiefs of squads to report the result to the officer of the day, through whom all reports to the Principal must be made at 9 o'clock A. M. each day. *Revielle* at day break, and they march by squads to wash room, where twenty minutes is allowed for necessary ablutions, blacking boots, &c., and then the march to the Assembly-room for "*roll call.*" Inspection of boots twice a week, at unknown times.

The squads for the *mess-room* march in order, filing each side of the tables, face inward, and "*sit down*" by command; *rise*, march out and *break ranks*, observing the same military precision. These various duties are performed with pleasure and pride by the cadets, and the same promptness and regularity is apparent in every movement.

The *armory* and arms are in charge of a detail of four, and are inspected in turn on the roll, each week, and reports are made of disabled pieces, and the general condition of the arms and armory, to the officer of the day, and through him to the Principal. The various reports are embodied into one, by this officer, so that the Principal is not burdened with the details unless he calls for them.

Orders are issued from time to time, by the Military Instructor, and engrossed in a book, which is open for inspection of visitors, announcing promotions, results of inspection, and noting cases of military merit and demerit, &c. This has a tendency to stimulate to exertion, and to efforts to avoid unfavorable notice.

Military classes 1st, 2d and 3d, graduated according to military merit are established, and promotions to them made after strict examinations. All company officers are selected from the 1st class.

A class of Honor, consisting of members of the First class who have escaped being reported for disobedience and improper conduct, is also formed. A given number of military demerits reduces a cadet, and the badge which is worn on the left breast is taken from him. He may, however, be reinstated.

Military demerits are punished by military penalties.

Cadets are taught to observe the position of the soldier when off duty also; the benefit of this is very marked. When the machinery is properly set in motion, the labor generally attending the minutiæ of school duties is greatly reduced, and much more pleasantly and thoroughly performed.

I have not entered into all the details, (and have given the military only) but enough to give a general idea of the plan adopted by this school. There are

different modes in use in other schools. Some partaking more of the military, and some less. I think there is danger, often, of *too much* military being engrafted so as to make it burdensome; great care should be taken in this particular, as the cadet wearies of it when the novelty is past."

Mr. N. W. Taylor Root, in his admirable book on School Amusements, furnishes practical testimony "that it fosters habits of promptness, exactness, and unanimity of action; teaches implicit obedience to commands, erectness of carriage, a neat and clean appearance, and a gentlemanly and respectful behavior."

It will thus be seen that a system of military drill has been tested morally and physically, in private schools, and found of decided advantage.

Why should these benefits be denied to the pupils of Public Day Schools?

Why should this vast defensive power be lost to the Government?

As a national military necessity; as a protection to the health and constitutional vigor of American youth; and as a powerful agent upon their moral behavior, their energy, self-reliance and spirit of enterprise, let PHYSICAL TRAINING BE ENGRAFTED ON THE COURSE OF STUDIES FOR ALL THE PUPILS EDUCATED AT THE EXPENSE OF THE STATE. Let us not hesitate at the magnitude of the undertaking, for it is a *necessity*, and under proper regulations and restrictions can be successfully and economically accomplished.

The greatest difficulty to be surmounted is the successful working of a system at once applicable to the requirements of a small district school, with a limited number of scholars, attending only at certain seasons of the year, and of those of the larger cities, with numerous schools, in which a great number are under instruction.

Let us commence at the foundation, in the Primary Schools.

The moment the child enters the school care should be taken that the mental exercises which are given should be relieved by frequent intermissions for running and playing, under the supervision of the teacher. This we are glad to say is the case in very many of our best primary schools; but it is when the child becomes more advanced, when there are lessons to commit to memory at home, that some simple physical *exercises* should be taught him every day; exercises calculated to develop the growth and expand the muscles. The calisthenics recommended in Miss Beecher's work are excellent, simple, and easily fitted to the limits of the school house. The report of Mr. W. H. Wells, Superintendent of Public Schools for Chicago, for 1860, gives some interesting particulars of simple exercises which have been attempted in that city.

There would be but little difficulty experienced in selecting movements and gymnastics suitable for the strength and ability of the classes of younger boys and girls under instruction, provided the method was established as an imperative duty which *must* be regularly put in practice, and that no lack of interest on the part of teachers, or laziness of the pupils would be accepted as an excuse for non-compliance with the regulation. We trust if Physical Training is carried out in our system of education, that a carefully prepared Manual of all kinds of exercises, embracing the military drill, will be compiled for the use of schools; in a word, a text-book to which our teachers can turn with confidence to find exercises suitable for all classes of pupils.

From the Girls and Primary, we pass to the Boys Grammar departments, for

* Such a Manual will soon be published by J B Lippincott & Co., Philadelphia.

which we propose military exercises, as being the most economical and advantageous for public schools; for *tactics* manœuvre large bodies in a small space, in an orderly manner, whereas gymnasiums are too expensive, and can not be made large enough to accommodate many scholars at once. This opens to us our most difficult, but at the same time most useful, field for prompt and energetic action.

Suppose we take for an example one of our large cities. The lower and female departments having simple physical exercises in use, it is wished to introduce military exercises into the grammar schools. Let us see how simply it can be organized, and how far it is possible to extend these studies if desired.

The following interesting letter from the Mayor of Bangor, will show the movement in that city, an example well worthy of being imitated.

CITY OF BANGOR,
Mayor's Office, Dec. 21st, 1861.

DEAR SIR:—In reply to yours of the 19th inst., I would say that, upon my recommendation, through a communication I made to our City Council, on the first Monday of the present month, an Order was passed directing the military drill to be introduced into a portion of the Public Schools of this city.

I had given the subject some thought and investigation, and was prepared to recommend the adoption of the drill for the physical training, no less than for the military instruction it might impart. The prevalent idea that education consists in training the intellect only, is gradually becoming superseded by the more rational theory that true education consists in training the moral and physical, no less than the intellectual faculties.

For the physical training of boys, I think the military drill has much to recommend it besides the military instruction it imparts. It will tend to give them a better command of their muscles, and impart a manly gait and bearing. It will also, if properly conducted, teach them self-control, and give them true ideas of order, discipline, and subordination, and whilst it will relieve them from the monotony of their ordinary studies will, by a grateful change, enable them to return to them with renewed interest.

We are entering upon the new experiment with caution, and have commenced by devoting an hour, twice a week, to the drill. We began in the school rooms, but found, after a few lessons, that the space these afforded was too small, and for the present shall use the large Gymnasium Hall. In summer, the grounds in connection with our school houses may be found well adapted for the purpose.

The boys, with scarcely an exception, manifest much interest in their drills, and receive the instruction much more readily than men. Two or three of our public spirited citizens, well qualified for instructors, have generously consented to devote the necessary time for drilling the boys, for the present winter, without compensation.

Some of our teachers are also disposed to qualify themselves for drill masters, and we are thus enabled to try the experiment without much expense.

I have had no communication with Gov. Washburn in relation to this subject, and was quite unaware of your interest in the matter. I however noticed the article in regard to it in the Evening Post of Nov. 8th, and was gratified with the important facts which it contained. I shall be glad to receive any further

communication you may make to the public on this important subject, and should you wish, will be pleased to communicate to you the further progress of our experiments.

Yours respectfully,

ISAIAH STETSON, Mayor.

EDWARD L. MOLINEUX, Esq., New York.

To establish thoroughly and economically this military culture, the Board of Education should appoint some competent person as Chief of the Staff to organize and carry out a system of instruction and drill; he to have under him two or three assistant instructors of experience, under whose guidance *a teacher, or teachers from each school*, should be fully instructed in the tactics, so as to be able to superintend the drill of the boys, which should always take place during school hours, and thereby form a recreation from mental study, and not encroach upon their play time. These are the only persons connected with the department beyond the scholars themselves, as it should be managed on the principle of obtaining *the whole working force* of the military organization from among the pupils.

The grammar department of each school should be formed into a company, or where the size of the school rendered it necessary, two companies; the officers to be selected from the most deserving and competent boys.

The officers thus selected to be instructed theoretically and practically by extra drills, in their respective duties. This would not occupy much time, and any boy objecting to devote this time would not be worthy of holding his position, and should be replaced by some one more deserving. Every school should possess within its limits space for a parade ground and for a few simple fixtures for gymnastic exercises. In stormy weather the exercises could be carried on indoors; for the drill possesses the advantage of affording exercise to a great number in a *small* space without disturbance and noise.

No uniform would be required, and the only expense would be the loan or purchase of 500 or 1000 short muskets, which could be used in turn at the different schools for drill or parade. A simple musket can be manufactured very cheaply, which will answer for all purposes.

The care and cleaning of the arms, the escorting and carrying them from school to school, or point to point, as required, should be the military duty of the pupils; thus expense will be saved, and the duty of prudent soldiers to take care of their equipments and do their own work inculcated.

These different school drills, always in charge of the teachers, should be visited in turn by the instructors, who would exercise a close and careful supervision over them.

Every ten companies or schools should be formed into a regiment, officered by those selected as the most capable, and who had passed the necessary examination.

Occasionally on Saturdays the regiments, in rotation, should be exercised by the instructors, in battalion movements, field manœuvres, skirmish drills, camp duties, &c. These Saturday exercises should not be compulsory, but would be eagerly looked for by the boys as an amusement.

In the proper seasons they could be marched to the suburbs for their exercises, and thus a pleasant holiday, with healthy amusements, be given them un-

der proper guidance. Any father will appreciate the advantages of such exercises and enjoyment to his boys.

In the summer season it should be found out which of the boys could not swim, and had no parents able to teach them. All such should be classed together, and means taken to instruct them in this most requisite art.

If found desirable to teach them to move together in *large masses*, (in which our militia are certainly deficient,) it can be accomplished by organizing two, three, or more regiments, into a brigade, to be commanded by the chief instructor, he selecting for his *staff* the most intelligent of the scholars who could relieve him of much of the labor which the systematic working of this large military department would render necessary. Thus those assigned to the staff would be learning the technicalities of the department and the duties of aids, secretaries, &c.

These staff officers, and any other of the pupils who showed a decided talent, should be assisted in acquiring knowledge in the military science by means of lectures, &c., from the chief instructor. An orderly system once organized, with the incentive to improvement by promotion for correct deportment, and of military disgrace for ungentlemanly and unsoldierly conduct, would soon render this military instruction of great assistance to *teachers in the schools.* Let the boys understand that disobedience or improper behavior debarred them from military honors and the whole tone of their conduct would be improved.

Of the exigencies of this war, if complicated by foreign interference, it is impossible to foresee, but every one is aware of the importance of early training upon the destinies of nations, and but few will deny the value of a well-trained battalion of selected elder boys, in case of INVASION or trouble, by their relieving the fatigue of regular troops in mounting guard at the least exposed positions, at the camps, on baggage, or for convoys; likewise to act as drill-masters for the recruits.

The above plan, which was submitted to several Boards of Education last fall, was offered as being the best adapted for *immediate use*, and is therefore provided for the instruction of the *teachers.* If, however, the *Normal Schools and Colleges* would provide systematically for this instruction, it would be far better as they are the proper fields for *permanent benefit*, as each graduate would there become fully prepared to instruct in these exercises in the public schools.

The views of the Hon. Joseph White, of Massachusetts, respecting military studies in colleges, are well worth noting. He says, "let the drill be regular and compulsory, taking the place of the very irregular and insufficient physical exercises now taken, and our colleges would be vastly improved in their educational power, and the commonwealth would in a short time have a numerous body of educated men well skilled in the military science and art, who will become teachers in our lower grades of schools and in our military companies and associations, and be competent when the alarm is sounded, to lead our citizen soldiers to the field." New Jersey has just offered a noble example by making an appropriation for military instruction in her State Normal School.

But we must look at the practical working of physical and military training in small district schools. Of necessity they are far behind, in intellectual culture, those in the cities, and owing to the small and uncertain attendance, physical and military drill would also have to be simplified. The duties of a country

life are such as not to render these exercises so necessary on the score of health, nor are the pupils wearied by such constant application to study. But how beneficial it would be in smoothing the rough, clownish manners of the country pupil by teaching him the *position of a soldier*, and correct *walking*. In respect to this, it should be the duty of the trustees to see that the drill was taught as far as practicable to the boys (calisthenics to the girls) by the teacher himself, who, if he were not already instructed from a Normal School, would find but little difficulty in mastering the details of tactics sufficiently for his purposes. With as small a number as twelve boys, company and skirmish drills could be taught; the latter is admirably suited for country schools, and would be a delight to the boys. If near the water they should be taught to swim.

It is thus we would teach our public school boys when they reach a certain age, to act together as citizen soldiers and be prepared when called upon, to do yeomen service in the country; to make it their pride as well as their duty, to defend the Country and State which so liberally educates them, let us cultivate in them a lofty and noble patriotism, which shall have its effect upon future generations, for it is upon these qualities, their intelligence and enterprise, aided by *physical strength and health*, that the FUTURE of our country depends.

Although a course of military training in the public schools would soon furnish our State with an intelligent class of soldiers and line officers, yet the *art* of war in many of its branches, such as artillery, engineering, &c., requires a scientific education, which can not be given in a private institution. Our colleges undoubtedly could, to a certain degree, supply this want. New York city possesses in its Free Academy a college which needs but the addition of two or three professorships to carry out in part this requirement, yet a *State Military and Scientific* College seems a necessity to which early attention should be given, but to prevent its becoming a tax upon the State, it should be managed somewhat upon the plan of the Polytechnic of France, namely, that pupils at large may be admitted upon passing an examination and paying the annual fee.

Offer inducements in the way of superior education and careful training, and sufficient income would be received from the *paying* scholars to cover the expense to the State. Thus, from this college, might annually graduate men educated for the most scientific and skillful pursuits of life, and who, in time of war, would richly repay the State for the care devoted to their culture.

As an incentive to the public-school boys, several of the most deserving should annually be sent to this college by the State, and to the National Military and Naval Academies.

There is yet another important matter to be considered in physical exercises for public education, more particularly in sea ports, viz., *Naval Training*.

A late report of the Shipmaster's Association has shown us that the reputation of our American vessels is deteriorating so rapidly, that unless something is done, quickly and effectually, to provide a remedy, foreign vessels will supersede ours in freighting. The necessities of our navy are too well known to need notice here, and surely these evils which assail the country at this trying moment of peril, should arrest attention.

In large seaboard cities the naval training school, which has worked so advantageously in England and Belgium, could be established very economically by the fitting up of some hall, at a slight expense, with spars, sails, &c. Here of an *evening*, lectures and classes for instruction in navigation and sea-

manship could be formed. This would be the means of improving our sailors and of forming useful citizens from those who now idle away their time around the streets and docks. The expense would be but light, and the advantages obvious to our merchant marine and navy. This would soon improve our class of sailors and officers, reduce the rate of insurance upon American vessels, and relieve us from the stain which is being cast upon us as a commercial and naval power.

The evening schools of New York city cost $73,000 per annum; a small per centage of this sum would place in successful operation an *evening nautical* school, which would enable, in less than three months, American sailor boys to acquire sufficient knowledge of navigation to aspire to the quarter deck. The handling of heavy guns and the principles of naval gunnery could also be taught. If a war with Great Britain breaks out, are we to be found slumbering in this respect, and must we wait for the *first gun* before taking active measures!

We are a peace-loving and domestic people, and we have indulged in the delusive fancy that peace was to shine over us forever, until rudely awakened from our dreams by a formidable attack at the very foundation of our nationality. Every family circle is represented in that mighty army which is battling for the Union, and we know that much of the suffering caused to our brothers by this new and unexpected calling, is due to the defects of their physical education, and to the want of a sufficient number of well trained officers. But the war is upon us and we must meet it as may best become a free nation and be better prepared for the future.

It is the proud boast of England that in time of war she is "Ready, aye Ready," but a much prouder and nobler cry for us would be, the prompt "Here" at the roll-call of our militia when summoned, like the minute men of the Revolution, to the defense of the country. We want no large standing army. In times of peace let our merchants, artisans, farmers, and mechanics, enrich and develop the resources of the country. It needs their industry and will amply repay their toil. But let them be trained and educated from school-days to their military duties, and at the first note of war let that response of "Here" come cheerfully from our rich prairie lands, from our counting-houses, from our machine shops, from the decks of far off vessels and from our public schools,—one mighty cry of POWER and SELF-RELIANCE from a noble militia, possessing a thorough *knowledge of its duties;* intelligent and earnest in the right; patriotic and strong in its devotion to freedom.

A few words to those who fear the tendency of these exercises to instil a warlike and blood-thirsty spirit, and we will close. To them we say, we would emulate the ancients only so far as we can obtain from them some of their earlier and nobler traits of patriotism, courage, strength, endurance, and health. Let us picture what effect this training would have upon individual character.

Let us take the example of a young lad, entering the public school in the primary department, with perhaps a sickly, indolent disposition, and somewhat careless and slovenly in his appearance.

We know very well from the present system of studies, that his mind will be well cared for, and therefore pass to the effect of the physical training upon him.

The first lesson then is to stand in an erect and commanding attitude, with his chest well expanded, then his careless, slouching steps, with hanging head,

are soon changed to the brisk, smart *walk* of a young gentleman. Calisthenics and exercises proportionate to his strength, and tending to develop his limbs very soon improve his health and impart a youthful vigor and energetic purpose to his motions, which are so much to be admired in young lads and give such rich promise of the future manhood. He soon learns exact and unhesitating obedience, and is taught by precept and example, that no small advantage in appearance is to be derived from a clean face and well brushed clothes. Is it to be denied that he thus learns habits of order, activity and cleanliness, which will be invaluable to him in after years?

But his greatest ambition, the goal of all his hopes,—the reward for which he studies diligently, is active and neat in his deportment, docile and obedient to his teachers,—is to be promoted to the grammar department or higher classes, where the boys have military exercises. He looks with longing eyes at their neat, orderly ranks, as they form for drill or parade; their brightly polished shoes, neatly brushed clothes and well kept arms. All this is something to look forward to, and when he has accomplished it, has he not to strive by activity to win his *grade* and by self-control and obedience prove himself deserving to command others? Manhood, when it arrives, finds him bright, active, self-reliant and ready to become a public spirited member of society.

Let the necessity of military exercises be placed before the boy in a patriotic light and it will induce him not only to take greater care in the execution, but likewise implant a still greater love of country from the very knowledge that some day he may be of use to her,—of use to her in the pulpit, in the legislative forum, in the busy pursuits of industry and the various walks of life. And if the necessity again calls for action, or if the present war is of long duration and tests the strength and perseverance of our national character, let us not shrink from the ordeal, but with a firm reliance upon an Almighty God and a righteous cause, let us go forth in this good fight, we of this generation and our children, and faithfully discharge the duties of Christian soldiers in defense of truth, justice, and our country.

U. S. MILITARY AND COMMERCIAL MARINE SCHOOLS.

NAVY AND NAVAL AFFAIRS.

By the Constitution of 1789, Congress is empowered "to regulate commerce, to provide and maintain a navy, and make rules for the government and regulation of the land and naval forces." The initiatory steps for establishing and regulating a navy were taken by the Continental Congress in November and December, 1775. The management of naval affairs was first assigned to a Marine Committee of Congress, appointed Dec. 11, 1775, which in 1779 (June 9), was converted into Commissioners, and before the close of that year, into a Board of Admiralty, which consisted of five members, two of whom were members of Congress, with a secretary, who was appointed by Congress. In 1781 (Feb. 7), a Secretary of Marine was created to execute all the duties and powers of the Board of Admiralty. In the condition of the public treasury, and "in the dilatory and parsimonious action of the several States in forwarding funds for the construction of ships, docks, and naval arsenals, and for the support of the naval service," Congress voted in August, 1783, "that it was not advisable to purchase ships for the present."

The necessities of a disordered commerce, and of a sufficient naval force to protect the navigation of the country, and repel the first approach of a hostile army from abroad, were among the motives for establishing a more efficient federal government. But until the danger of war with England became imminent, a large party in the country, in and out of Congress, opposed the necessary appropriations for putting the Navy of the United States on a respectable footing.

In constituting the executive departments of the national government under the Constitution, the administration of the navy and naval affairs were committed to the War Department, where it remained till 1798, when (April 30) an Act was passed "to establish an executive department to be denominated the Department of the Navy."

The Act of March 27, 1794, by which the construction and man-

ning of four ships of 44 guns each, and two of 36 were ordered, was called for by the depredations on our commerce, and particularly in the Mediterranean Sea. In this Act the appointment of eight midshipmen, to rank with the warrant and petty officers, was authorized, and the Navy Register bears the names of only eight officers holding that rank prior to 1800. In 1801, the naval force of the United States consisted of 13 ships, viz.: 4 of 44 guns each (*United States*, *President*, *Constitution*, and *Philadelphia*); 4 of 36 guns each (*Chesapeake*, *Constellation*, *Congress*, and *New York*); 5 of 32 guns each (*Benton*, *Essex*, *Adams*, and *John Adams*); and by an Act of that year all others were ordered to be sold, and the completion of any more in the yards, was suspended. But the insults to our flag and destruction of our commerce by the Barbary powers, and the privateers of England and France, aroused such a feeling in the country that Congress ordered a squadron to be fitted out for the Mediterranean in 1803, which proved to be the school in which the seamanship of the Navy was trained, and the gallantry of its officers signally displayed. In the legislation of this period originated the "gun-boat" policy as an auxiliary means of harbor defense. In 1805 the first vessel of this class was added to the Mediterranean squadron, and in 1806 the President announced that 50 more could be relied on for the naval service. Gun-boats, properly constructed and armed, are now part of the system of harbor defense in all countries.

By an Act of Congress approved April 21, 1806, the whole number of able seamen, ordinary seamen and boys, for the United States Navy was not to exceed 925. March 3, 1807, the President was authorized to employ 500 additionals, increasing the authorized number to 1,425. January 31, 1809, the President was authorized to employ 3,600 able seamen, ordinary seamen and boys, in addition to the number of petty officers, seamen, etc., previously authorized, which increased the number of enlisted men allowed to 5,125.

In 1810 an appropriation was made to test the value of torpedo or submarine explosives, as engines of war, and in 1842 to test the submarine battery ignited by a submerged electric wire, devised by Samuel Colt. The introduction of these "engines of war" into the defense of Southern harbors, in 1861–65, demonstrated their efficiency and inaugurated a new system of not only harbor defense, but of attack.

March 30, 1812, the President was further authorized to increase the seamen, etc., and as far as necessary to equip the frigates *Chesapeake*, *Constellation*, and *Adams*, any law to the contrary notwith-

standing. In this Act provision was made for the appointment of a schoolmaster to each ship having a complement of 12 midshipmen.

March 3, 1813, he was authorized to have built six sloops-of-war, and to have them manned and equipped, and to employ the number of seamen which were necessary for such vessels as were authorized by law to be put in commission.

In 1816, in the appropriation annually of $1,000,000 for eight years to the gradual increase of the Navy by nine 74 gun-ships, and twelve 44 gun-frigates, provision was made to procure the steam-engines and build and equip three steam-batteries for the defense of ports and harbors—the introduction of a new element into the naval service. In 1839 the Secretary was authorized to construct three steam-vessels of war, "according to the best advices that could be obtained."

In 1837, after strenuous efforts to enlist Congress in some systematic plan for supplying the navy with well instructed and thoroughly disciplined seamen, the Secretary was authorized to enlist under certain conditions, boys between the ages of 13 and 18, who should receive special opportunities for school and professional training.

In 1844, $100,000 was appropriated to build at Pittsburg an iron steamer (the *Alleghany*); and the appearance and exploits of the *Merrimac* and the *Monitor*, in the waters of the Chesapeake, in 1863, introduced a new system of naval construction and armament, not only into our navy, but in less than ten years revolutionized the ship-yards and ordnance foundries of the world.

By Act of March 3, 1845, it was provided "that the whole number of petty officers, seamen, ordinary seamen, landsmen and boys, in the naval service, shall not exceed 7,500 at any one time during the fiscal year," for which appropriation was then made.

By Act of March 3, 1857, the Secretary of the Navy was authorized to enlist 8,500 men for the Navy, instead of 7,500. During the late civil war the limitation of enlisted men was suspended; and in his annual report, December, 1862, the Secretary states the number of persons employed on board our naval vessels, including receiving ships and recruits, as about 28,000; and in his report of December, 1865, he says the number was increased to 51,509 at the close of the war, which in 1867 had been reduced to 11,900.

In 1864 the Secretary of the Navy revived the system of naval apprenticeship, which was inaugurated under the Act of March 2, 1837, but suspended because the favorable results anticipated from a fair trial were not realized at once, under various disadvantages of a new enterprise, and because Congress, in 1845, by limiting

the whole number of persons employed in the naval service, compelled the Department to discharge boys instead of men.

By Act of June 17, 1868, the number of persons enlisted into the Navy, including apprentices and boys, was limited to 8,500—a limitation actually below the maximum which existed prior to the war, and compelled the department to reduce the number of naval apprentices, and finally to again abandon that system.

The number of line officers is now (1871) limited by law to one admiral, one vice-admiral, 10 rear admirals, 25 commodores, 50 captains, 90 commanders; total flag and commanding officers, 177. To these are added 80 lieutenant commanders, 280 lieutenants, 200 masters and ensigns—making the total line officers of all grades, excepting midshipmen (309 including those at Annapolis), 737.

The medical staff consists of 180, viz.: 15 medical directors (captains); 15 inspectors (commanders); 50 surgeons (lieut.-commanders), and 100 passed assistant and assistant surgeons.

The engineers' department (total 250) includes 10 chief engineers (captains); 15 *do.* (commanders); 45 *do.* (lieut.-commanders); 100 assistants (masters and ensigns). There are 126 paymasters, 13 ranking as captains; 13 as commanders; 50 as lieut.-commanders. The number of chaplains is limited to 24, and of professors to 12.

Although, strangely enough, not under the administration of the Navy Department, the inauguration of the Coast Survey in 1807, and its thorough prosecution since 1844, when the employment of officers of the army and navy in the work was authorized; the recognition of the Naval Observatory at Washington city, and authorizing the making astronomical and meteorological observations, in the Act of August 3, 1848; the assignment of a competent officer of the navy to the preparation of the Nautical Almanac; the institution of the bureau of Hydrography and Ordnance, in 1842; the employment of three suitable vessels of the navy to test and perfect the plans of Lieutenant Maury in his investigations of the winds and the currents of the ocean, by Act of March 3, 1849; the concentration of the teaching staff of the corps of midshipmen preparatory for their examination at the Naval Asylum at Philadelphia, and their removal to separate accommodations at the old military station of Fort Severn, in Annapolis, by order of Secretary Bancroft in 1845, and the formal recognition of the institution as the Naval School, in the appropriations for the navy in 1847—these and other acts of Congress, and the action of the Department under them, are important data in the history of the Navy and Naval Education—especially of their scientific character.

GROWTH IN SHIPS, OFFICERS AND MEN.

The following Tables, prepared by Capt. George H. Preble, U. S. N., which are copied from the Army and Navy Journal for Nov. and Dec., 1871, exhibit in a condensed view the expansion of the military and merchant marine of the United States, from 1816 to 1871 inclusive, as well as its condition in each year from 1816.

TABLE I.—*Naval Vessels, Tonnage, Officers, Seamen, and Cost. Tonnage.*

Year.	Number of Vessels United States Navy.	Number of Guns.	Tonnage of Vessels belonging to the United States Navy.	Total number of Navy Officers, including Midshipmen and Mates.	Total number of Petty Officers, Seamen etc.	Total Expenditures for the Navy and Marine Corps.	Total Tonnage of U. S. Enrolled, Licensed and Registered.
1816....	....	....	40,032	868	unknown.	$3,908,278	1,372,219
1817....	111	1,267	39,642	954	.....	3,314,598	1,399,911
1818....	115	1,383	39,682	948	.....	2,953,695	1,225,184
1819....	90	1,243	36,512	926	.....	3,847,640	1,260,752
1820....	88	1,384	38,057	895	.....	4,387,990	1,280,166
1821....	36	1,017	33,851	876	.....	3,319,243	1,290,959
1822....	38	1,047	34,413	848	.....	2,224,459	1,324,670
1823....	45	1,085	36,039	812	.....	2,503,766	1,336,566
1824....	49	1,122	36,338	843	.....	2,904,581	1,389,163
1825....	44	1,107	36,174	856	.....	3,049,087	1,423,111
1826....	46	1,104	39,577	859	.....	4,218,902	1,534,190
1827....	49	1,163	42,708	877	.....	4,263,878	1,620,608
1828....	53	1,243	44,149	898	.....	3,918,786	1,741,392
1829....	52	1,315	40,865	996	.....	3,988,643	1,260,798
1830....	51	1,257	40,845	1,051	.....	3,239,429	1,191,776
1831....	50	1,269	41,953	990	.....	3,856,183	1,276,846
1832....	52	1,292	42,147	987	.....	4,947,718	1,439,450
1833....	53	1,872	60,002	1,022	.....	4,274,184	1,606,149
1834....	53	1,872	67,804	1,012	.....	4,613,657	1,758,907
1835....	53	1,872	66,479	1,035	3,627	4,209,836	1,824,940
1836....	51	1,969	66,281	1,044	3,804	6,252,145	1,882,685
1837....	55	1,982	69,043	1,048	5,201	6,646,915	1,886,684
1838....	55	1,982	69,233	1,104	5,650	6,131,581	1,985,649
1839....	56	2,022	71,396	1,157	6,932	6,182,294	2,096,479
1840....	62	2,106	74,776	1,171	7,072	6,113,896	2,180,764
1841....	67	2,106	72,418	1,222	7,419	6,001,077	2,130,744
1842....	69	2,044	73,895	1,482	9,784	8,397,243	2,092,391
1843....	71	2,022	77,031	1,493	10,321	3,727,712*	2,158,603
1844....	74	2,464	78,221	1,448	10,000	6,498,199	2,280,095
1845....	76	2,400	79,592	1,434	7,500	6,297,178	2,417,002
1846....	76	2,345	80,992	1,398	7,500	6,455,014	2,562,084
1847....	81	2,398	86,456	1,391	7,500	7,900,636	2,839,046
1848....	92	2,401	95,755	1,425	7,500	9,408,477	3,154,042
1849....	78	2,380	92,391	1,465	7,500	9,786,706	3,334,016
1850....	77	2,370	91,591	1,423	7,500	7,904,725	3,535,454
1851....	74	2,336	90,786	1,416	7,500	8,880,582	3,772,439
1852....	75	2,346	90,992	1,432	7,500	8,918,842	4,138,440
1853....	75	2,320	91,814	1,417	7,500	11,067,790	4,407,010
1854....	73	2,115	91,787	1,423	7,500	10,790,096	4,802,902
1855....	78	2,355	112,715	1,433	7,500	13,327,095	5,212,001
1856....	76	2,350	111,803	1,196	7,500	14,074,835	4,872,652
1857....	73	2,332	109,234	1,206	8,500	12,651,695	4,940,842
1858....	78	2,231	113,765	1,287	8,500	14,053,265	5,049,803
1859....	86	2,273	132,489	1,351	8,500	14,690,927	5,145,038
1860....	91	2,329	133,832	1,436	8,500	11,514,650	5,353,868
1861....	90	2,309	133,842	1,497	10,000	12,387,157	5,539,813
1862....	383	2,876	284,377	3,493	28,000	42,674,569	5,112,165
1863....	449	2,926	333,841	4,613	.....	63,211,105	5,155,055
1864....	617	4,088	463,107	6,170	51,500	85,733,293	4,986,401
1865....	681	4,662	470,362	7,296	.....	116,781,676	5,096,783
1866....	320	2,688	336,874	2,847	13,600	43,324,526	4,310,778
1867....	273	2,235	313,056	2,770	11,900	31,034,011	4,304,486
1868....	229	1,704	281,629	2,420	8,500	20,120,395	4,351,758
1869....	203	1,701	255,217	1,921	8,500	18,985,165	4,144,639
1870....	186	1,443	183,217	1,853	8,500	15,870,531	4,246,507
1871....	177	1,446	181,738	2,020†	8,500	19,431,027	4,111,412

* Change of the fiscal year.

† From this number should be deducted 130 mates not permanent officers of the Navy.

TABLE II. *Line Officers*—1816 *to* 1871.

Year.	Admirals.	Vice-Admirals.	Rear Admirals.	Commodores.	Captains.	Master Command'ts or Commanders.	Lieut. Command'rs.	Lieutenants.	Masters.	Passed Midshipmen or Ensigns.	Midshipmen.	Cadet Midshipmen.	Mates.	Total Line Officers.
1815....	....	....	....	....	....	.....	.....	.....	..	..	...	..	..	...
1816....	....	....	....	....	32	18	.....	150	..	..	495	..	..	695
1817....	....	....	....	....	31	22	.....	157	87	..	415	..	4	716
1818....	....	....	....	....	34	26	.....	182	83	..	404	..	7	736
1819....	....	....	....	....	35	23	.....	213	76	..	362	..	7	716
1820....	....	....	....	....	34	22	.....	202	76	..	350	..	4	688
1821....	....	....	....	....	32	21	.....	193	62	..	364	..	2	674
1822....	....	....	....	....	31	31	.....	196	58	..	336	..	1	653
1823....	....	....	....	....	30	30	.....	183	53	75	249	..	1	621
1824....	....	....	....	....	28	30	.....	172	51	71	312	..	..	664
1825....	....	....	....	....	24	30	.....	228	48	..	356	..	..	680
1826....	....	....	....	....	32	29	.....	209	43	15	361	..	..	689
1827....	....	....	....	....	31	27	.....	228	36	..	374	..	..	696
1828....	....	....	....	....	33	29	.....	229	33	..	392	..	..	716
1829....	....	....	....	....	35	33	.....	263	30	10	435	..	..	806
1830....	....	....	....	....	37	39	.....	258	32	41	425	..	..	842
1831....	....	....	....	....	37	34	.....	255	31	54	377	..	..	788
1832....	....	....	....	....	40	37	.....	259	32	74	345	..	..	787
1833....	....	....	....	....	37	41	.....	259	31	94	356	..	..	818
1834....	....	....	....	....	37	41	.....	259	29	133	317	..	..	807
1835....	....	....	....	....	37	41	.....	257	27	178	272	..	..	812
1836....	....	....	....	....	38	40	.....	257	27	199	251	..	..	812
1837....	....	....	....	....	40	41	.....	258	27	200	241	..	..	807
1838....	....	....	....	....	50	49	.....	276	27	181	247	..	..	830
1839....	....	....	....	....	52	55	.....	285	27	196	249	..	..	844
1840....	....	....	....	....	55	55	.....	290	29	191	231	..	..	851
1841....	....	....	....	....	55	55	.....	288	28	195	262	..	..	883
1842....	....	....	....	....	68	96	.....	328	30	103	460	..	4	1089
1843....	....	....	....	....	67	94	.....	324	31	133	410	..	7	1066
1844....	....	....	....	....	67	96	.....	324	30	147	356	..	12	1032
1845....	....	....	....	....	68	96	.....	327	31	159	314	..	11	1066
1846....	....	....	....	....	67	97	.....	326	28	181	264	..	11	974
1847....	....	....	....	....	64	97	.....	324	31	206	240	..	9	970
1848....	....	....	....	....	67	97	.....	327	31	208	228	..	8	966
1849....	....	....	....	....	68	97	.....	327	31	270	181	..	8	982
1850....	....	....	....	....	68	97	.....	327	32	208	152	..	5	940
1851....	....	....	....	....	68	97	.....	327	33	233	171	..	3	932
1852....	....	....	....	....	68	97	.....	325	32	205	144	55	3	929
1853....	....	....	....	....	68	97	.....	327	32	197	122	76	3	892
1854....	....	....	....	....	68	97	.....	326	18	198	89	94	2	892
1855....	....	....	....	....	68	97	.....	326	32	190	66	128	2	912
1856....	....	....	....	....	68	97	.....	326	19	..	46	124	1	681
1857....	....	....	....	....	64	96	.....	311	24	24	30	145	1	696
1858....	....	....	....	....	76	106	.....	319	1	23	45	174	1	745
1859....	....	....	....	....	81	116	.....	338	20	..	47	187	..	789
1860....	....	....	....	....	80*	114	.....	325	34	..	49	238	..	840
1861....	....	....	....	....	79*	114	.....	321	36	..	55	267	..	872
1862....	....	....	4	18	40	91	144	90	..	..	67	220	..	664
1863....	....	....	4	14	37	72	144	96	..	30	9	382	..	788
1864....	....	....	6	18	36	72	144	96	..	88	2	457	..	913
1865....	....	1	5	19	35	67	139	113	..	53	31	458	..	931
1866....	....	1	4	19	35	71	142	90	11	39	84	450	..	946
1867....	1	1	10	24	46	90	165	22	53	54	72	421	..	959
1868....	1	1	9	24	49	90	136	45	29	52	157	344	..	937
1869....	1	1	10	25	50	89	171	46	80	154	77	286	..	990
1870....	1	1	10	25	50	90	180	64	99	160	74	251	..	1103†
1871....	1	1	12	25	50	89	178	141	151	69	69	240	..	1256‡

* One senior flag officer.

† Including 98 mates, temporary officers not eligible for promotion and not properly belonging to the Regular Navy, and should be classed as Volunteers.

‡ Including 130 mates, temporary officers not eligible for promotion and not properly belonging to the Regular Navy, and should be classed as Volunteers.

TABLE III. *Warrant or Forward Officers, and Marine Corps*, 1816 *to* 1871.

	Warranted or Forward Officers, 1815 to 1871 inclusive.					Officers of the United States Marine Corps, 1815 to 1871 inclusive.						
Year.	Boatswains.	Gunners.	Carpenters.	Sailmakers.	Total.	Colonels.	Lieut-Colonels.	Majors.	Captains.	Lieutenants.	Second Lieutenants.	Total.
1815	28	24	18	12	82	1	.	2	20	21	18	62
1816	28	24	6	2	60	1	.	1	20	21	18	61
1817	28	22	6	2	58	1	.	1	16	19	13	50
1818	22	22	17	11	72	1	.	.	9	23	16	49
1819	22	22	16	11	71	.	.	.	9	23	16	48
1820	19	22	17	12	70	.	1	.	9	24	9	43
1821	14	18	12	8	52	.	1	.	8	24	16	49
1822	16	17	13	10	56	.	1	.	8	21	15	45
1823	16	18	13	11	58	.	1	.	9	24	16	50
1824	15	18	14	12	59	.	1	.	9	24	15	49
1825	16	16	10	10	52	.	1	.	9	24	14	48
1826	13	12	10	9	44	.	1	.	9	23	17	50
1827	15	14	11	9	49	.	1	.	9	24	16	50
1828	14	18	14	11	57	.	1	.	9	24	16	50
1829	17	19	13	14	63	.	1	.	9	24	16	50
1830	18	20	16	16	70	.	1	.	9	24	16	50
1831	18	19	13	17	67	.	1	.	9	24	16	50
1832	21	16	12	18	67	.	1	.	9	24	16	50
1833	16	19	15	13	63	.	1	.	10	24	16	50
1834	18	17	16	14	65	.	1	.	10	24	16	50
1835	18	20	20	19	77	1	1	4	13	20	19	58
1836	21	20	20	19	80	1	1	4	13	20	19	58
1837	22	23	20	19	84	1	1	4	13	20	20	59
1838	25	29	23	24	101	1	1	4	13	19	20	58
1839	32	35	27	26	120	1	1	4	13	20	19	58
1840	32	37	24	25	118	1	1	4	13	20	20	59
1841	29	36	28	27	120	1	1	4	13	20	20	59
1842	32	41	36	33	142	1	1	4	13	20	19	58
1843	37	40	38	35	150	1	1	4	13	20	20	59
1844	32	39	35	33	139	1	1	4	13	20	20	59
1845	30	42	36	34	142	1	1	4	13	20	20	59
1846	31	42	36	34	143	1	1	4	13	20	20	59
1847	32	42	36	31	141	1	1	4	13	20	20	59
1848	38	44	40	29	151	1	1	7	14	23	24	70
1849	39	44	42	33	158	1	1	7	18	24	24	75
1850	39	43	42	34	158	1	1	7	18	23	23	73
1851	43	46	45	37	171	1	1	7	17	23	21	70
1852	41	45	45	38	169	1	1	7	16	21	21	67
1853	44	46	49	41	180	1	1	7	16	20	20	65
1854	38	48	51	41	178	1	1	7	14	20	20	63
1855	37	45	32	40	174	1	1	7	14	19	20	62
1856	39	40	48	39	166	1	1	7	14	20	20	63
1857	38	40	48	39	165	1	1	7	13	19	20	61
1858	38	44	47	42	171	1	1	7	14	19	20	62
1859	40	44	48	41	173	1	1	7	15	20	19	63
1860	41	46	46	42	175	1	1	7	14	20	20	63
1861	43	47	45	40	175	1	1	7	14	20	20	63
1862	54	93	60	46	253	2	2	7	24	30	30	95
1863	53	84	56	45	238	2	2	7	20	28	29	88
1864	49	71	53	40	213	2	2	7	21	30	22	84
1865	46	65	47	36	194	2	2	7	22	30	24	87
1866	39	63	43	32	177	2	2	7	22	30	24	87
1867	52	59	40	30	181	2	2	7	22	30	30	93
1868	52	55	36	31	174	.	2	7	21	30	27	88*
1869	51	50	32	30	163	1	2	7	22	30	23	86*
1870	46	52	38	31	167	1	2	7	23	30	26	90*
1871	46	57	39	34	176	1	2	7	22	30	30	93*

* One brigadier-general since 1868. The senior officer has always been styled the lieutenant-colonel-commandant, colonel-commandant, or brigadier-general commandant. Since 1868, in the number of majors and captains is included those of the staff ranking with the line. At present there are three staff officers holding the rank of major, and two that of captain.

STAFF OFFICERS, 1815 TO 1842 INCLUSIVE.

Year.	Medical Dep't. Surgeons.	Passed Ass't Surg'ns.	Assistant Surgeons.	Surgeons's Mates.	Pursers or Paymas'rs.	Chaplains, Professors of Mathematics, and Teachers.	Total Staff Officers.
1815..	43	..	..	44	39	4	130
1816..	45	..	..	44	40	4	133
1817..	48	..	..	72	53	7	180
1818..	44	..	..	44	45	7	140
1819..	52	.	..	33	45	9	139
1820..	47	..	..	34	44	12	137
1821..	47	..	..	46	44	13	150
1822..	46	..	..	41	42	10	139
1823..	42	..	..	32	40	9	123
1824..	35	..	..	38	39	8	120
1825..	34	..	..	40	40	10	124
1826..	39	..	..	35	42	10	126
1827..	40	..	..	40	43	9	132
1828..	37	..	..	37	42	9	125
1829..	43	..	34	..	41	9	127
1830..	39	..	58*	..	43	9	149
1831..	37	..	46	..	43	9	135
1832..	44	..	38	..	42	9	133
1833..	44	..	45	..	43	9	141
1834..	43	..	46	..	43	8	140
1835..	44	15	31	..	43	13	146
1836..	43	15	35	..	42	17	152
1837..	44	26	23	..	44	20	157
1838..	49	20	37	..	45	22	173
1839..	60	16	51	..	49	27	193
1840..	61	17	53	..	51	30	202
1841..	59	17	57	..	53	33	219
1842..	69	11	55	..	64	52	251
.....	..	..	..	..	..	..	...

STAFF OFFICERS, 1842 TO 1871 INCLUSIVE.

Year.	Medical Dep't. Surgeons.	Passed Ass't Surg'ns.	Assistant Surgeons.	Pay Department. Paymasters.	Pass'd As't Paym'er.	Ass't Paymasters.	Engineer Dep't. Chief Engineers.	1st Asst. Engineers.	2d Asst. Engineers.	3d Asst. Engineers.	Chaplains.	Professors and Teachers of Language.	Total of Staff Officers.
1843	69	9	60	64	..	..	5†	8	5	5	22	29	277
1844	69	26	39	64	..	..	5†	9	5	10	22	26	277
1845	69	26	41	64	..	..	5†	11	9	11	23	25	286
1846	69	29	36	64	..	..	5	5	13	13	23	24	281
1847	69	33	34	62	..	..	4‡	5	13	13	22	24	280
1848	68	41	37	63	..	..	6‡	9	18	24	24	23	308
1849	69	39	41	64	..	..	6‡	12	17	38	24	14	325
1850	68	37	43	64	..	..	8‡	8	18	33	24	12	316
1851	68	34	44	63	..	..	9‡	7	17	35	23	12	313
1852	69	34	45	64	..	..	10‡	19	29	28	24	12	334
1853	69	40	37	63	..	..	13‡	18	34	34	24	12	345
1854	69	37	42	64	..	..	11‡	24	25	44	24	12	353
1855	69	35	44	64	..	..	12‡	22	23	41	24	12	347
1856	69	36	43	64	..	..	13	21	28	39	24	12	349
1857	69	43	37	64	..	..	17	24	20	35	24	12	345
1858	69	41	39	62	..	..	18	31	21	54	24	12	371
1859	69	41	39	64	..	..	21	33	23	63	24	12	389
1860	69	37	42	64	..	..	24	36	23	92	23	11	421
1861	69	43	36	64	..	..	28	43	29	92	24	12	450
1862	80	2	118	62	..	31	48	32	78	246	16	12	724
1863	80	1	117	63	..	31	49	32	92	264	18	12	759
1864	80	7	108	64	..	23	52	48	149	252	20	12	815
1865	78	22	108	63	..	33	59	65	235	115	21	12	811
1866	79	44	33	62	..	30	54	65	175	64	19	12	637
1867	79	38	37	80	39	11	54	86	146	37	19	11	637
1868	80	42	28	80	39	26	59	88	131	24	18	11	617
1869	80	35	33	79	38	18	49	91	112	35	16	11	597
1870	80	33	35	80	40	20	48	81	122	1	21	10	571
1871	80	32	38	80	39	29	56	98	93	...	23	9	575

VOL. OFFICERS, 1862 TO 1871 INCLUSIVE.

LINE.

Year.	Acting Lieutenants and Lieut.-Commanders.	Acting Vol. Lieutena'ts.	Acting Masters.	Acting Ensigns.	Acting Master's Mates and Mates.	Acting Boatswains and Gunners.	Total.
1862..	14	28	581	60	572	..	1255
1863..	15	50	581	336	754	31	1767
1864..	4	81	516	896	901	47	2445
1865..	14	112	583	1280	843	75	2907
1866..	8	39	133	258	192	9	619
1867..	4	36	140	251	201	2	634
1868..	4	26	114	163	142	2	451
1869..	..	..	12	9	76	..	97
1870..	..	1	1	1	..	..	3
1871..	..	1	1	2	..	..	4

STAFF.

Year.	Act. Passed Assistant Surgeons.	Act. Asst. Surgeons.	Act. Asst. Paymasters.	Act. Chief Engineers.	Act. Asst. Engineers, 1st,2d,&3d.	Act. Carp'rs.	Total.
1862	..	93	140	..	364	..	597
1863	..	142	217	21	665	16	1061
1864	..	197	330	44	1185	23	1784
1865	..	246	372	55	1751	28	2453
1866	12	60	80	14	301	1	468
1867	20	18	18	7	296	1	360
1868	19	16	2	2	205	..	242
1869	7	5	1	..	61	..	74
1870	2	2	..	..	5	..	9
1871	2	7	..	..	..	..	9

* Sixteen acting assistants.
† Also one engineer-in-chief and one principal engineer in 1843, '44, and '45.
‡ Also one engineer-in-chief, 1847 to 1855 inclusive.

TABLE V. *Sailing Vessels of United States Navy*—1817 *to* 1839.

Year.	Ships of the Line.	Razees.	Frigates.	Corvettes.	Sloops-of-War.	Brigs-of-War.	Schooners.	Gunboats.	Galleys.	Barges.	Store Vessels.	Block Ships.	Unarmed Vessels.	Bomb Vessels.	Steam Frigates.	Steam Gallioys.	Exploring Vessels.	Total No. of Vessels.
1817	5	....	9	2	13	12	11	11	8	24	....	1	9	5	1	....	....	111
1818	5	....	10	3	11	13	10	9	8	34	....	1	7	3	1	....	....	115
1819	5	....	9	3	5	13	13	7	8	21	....	1	3	1	1	....	....	90
1820	5	....	9	3	5	13	13	5	8	21	....	1	3	1	1	....	....	88
1821	7	7	7	2	4	2	6	6	....	....	1	....	....	....	1	....	....	36
1822	7	7	7	2	4	2	8	6	....	....	1	....	....	....	1	....	....	38
1823	7	7	8	2	4	2	15	5	....	....	1	....	....	....	1	....	....	45
1824	7	7	8	2	4	2	13	5	5	....	2	....	....	....	1	1	....	49
1825	7	....	8	2	5	1	8	5	5	....	1	....	....	....	1	1	....	44
1826	12	....	14	2	8	1	5	....	....	....	1	....	....	....	1	1	....	46
1827	12	....	14	2	13	....	5	....	....	....	1	....	....	....	1	1	....	49
1828	12	....	16	....	17	....	5	....	....	....	1	....	....	....	1	1	....	53
1829	12	....	16	....	16	....	5	....	....	....	1	....	....	....	1	1	....	52
1830	12	....	16	....	16	....	5	....	....	....	1	....	....	....	....	1	....	51
1831	12	....	16	....	15	....	5	....	....	....	1	....	....	....	....	1	....	50
1832	12	....	17	....	15	....	7	....	....	....	....	....	....	....	....	1	....	52
1833	12	....	17	....	15	....	8	....	....	....	....	....	....	....	....	1	....	53
1834	12	....	17	....	15	....	8	....	....	....	....	....	....	....	....	1	....	53
1835	12	....	17	....	15	....	8	....	....	....	....	....	....	....	....	1	....	53
1836	11	1	16	....	15	....	7	....	....	....	....	....	....	....	....	1	....	51
1837	11	1	16	....	14	2	6	....	....	....	....	....	....	....	....	1	4	55
1838	11	1	16	....	14	4	7	....	....	....	1	....	....	....	....	1	....	55
1839	11	1	16	....	16	4	7	....	....	....	1	....	....	....	1	1	....	56

TABLE VI. *Sailing and Steam Vessels*—1840 *to* 1861.

Year.	SAILING VESSELS.										STEAM VESSELS.							Total Number of Vessels.
	Ships of the Line.	Razees.	Frigates.	Sloops-of-War.	Brigs-of-War.	Schooners.	Store Vessels.	Bomb Vessels.	Permnn't Rec'g Vessels.	Total Sailing Vessels.	Screw Steam'r, 1st Cl's.	Screw Steam'r, 2d Cl's.	Screw Steam'r, 3d Cl's.	Screw Steamers.	Side Wheeled, 1st Class.	Side Wheeled, 2d Class.	Side Wheeled, 3d Class.	Steam Tenders.	Total Steam Vessels.	
1840..	11	1	16	21	4	8	1	..	..	62	..	..	..	..	2	1	1	..	4	66
1841..	11	1	16	21	4	9	1	..	..	63	..	..	..	..	2	1	1	..	4	67
1842..	11	1	16	21	4	9	3	..	..	65	..	..	..	..	2	1	1	..	4	69
1843..	11	1	15	18	4	8	3	..	..	65	..	1	..	..	2	1	1	..	6	71
1844..	10	1	15	22	4	7	5	..	..	69	..	1	..	..	2	1	1	..	5	74
1845..	10	1	14	23	4	8	4	..	..	68	..	1	..	..	1	1	2	2	8	76
1846..	11	1	14	23	4	6	4	..	..	67	..	1	..	..	1	1	2	5	9	76
1847..	11	1	14	22	6	9	6	..	..	68	..	1	..	..	1	1	10	6	13	81
1848..	11	1	14	22	7	6	6	4	..	77	..	1	2	..	1	1	2	1	15	92
1849..	11	1	14	22	5	6	6	..	..	64	..	4	2	..	4	1	7	7	14	78
1850..	11	1	14	22	4	5	6	..	..	63	..	4	2	2	4	1	3	5	14	77
1851..	11	1	14	21	4	5	5	..	..	59	..	4	1	2	4	1	3	6	15	74
1852..	11	1	14	21	4	3	5	..	..	59	1	4	2	..	4	1	3	5	16	75
1853..	11	1	13	21	4	4	5	..	..	59	1	4	2	2	4	1	3	5	16	75
1854..	10	1	13	20	4	1	7	..	2	58	1	4	2	2	4	1	3	5	15	73
1855..	10	1	13	20	4	1	7	..	2	58	1	3	2	2	3	1	3	5	20	78
1856..	10	1	12	19	3	1	6	..	2	54	1	3	2	2	3	1	3	5	22	76
1857..	10	1	12	19	3	1	5	..	2	51	1	3	2	2	3	1	3	5	22	73
1858..	10	..	10	21	3	3	3	..	5	53	1	3	2	2	3	1	3	5	25	78
1859..	10	..	10	21	3	3	3	..	5	53	1	3	2	2	3	1	3	5	33	86
1860..	10	..	10	21	3	3	3	..	5	52	1	3	2	2	3	1	3	5	39	91
1861..	10	..	10	20	3	3	3	..	6	52	1	3	2	2	4	1	4	5	38	90

TABLE VII. *Sailing and Steam Vessels*—1862 *to* 1871.

Year.	SAILING VESSELS.					STEAM VESSELS.												Total No. of Vessels in the U. S. Navy.
						Screws.					Iron-Clads.				Side Wheel.				
	First Rates.	Second Rates.	Third Rates.	Fourth Rates.	Total Sailing.	First Rates.	Second Rates.	Third Rates.	Fourth Rates.	Total Screws.	First Rates.	Second Rates.	Third Rates.	Fourth Rates.	Total.	First Rate.	Second Rate.	Third Rate.	Fourth Rate.	Total.	
1862..	7	10	19	65	101	5	16	29	69	119	5	5	37	6	53	2	19	40	51	112	383
1863..	4	7	12	83	106	6	15	24	96	141	4	6	37	6	53	2	10	52	85	149	449
1864..	3	5	16	84	108	12	35	37	129	213	9	5	56	4	74	2	16	52	152	222	617
1865..	3	6	16	84	109	23	32	42	168	265	3	6	6	56	71	3	8	56	169	236	681
1866..	1	6	16	19	42	23	31	17	64	135	3	7	6	53	69	3	4	47	20	74	320
1867..	2	6	15	15	38	20	18	15	53	106	3	6	6	47	62	3	4	43	17	67	273
1868..	6	9	12	5	32	19	21	17	43	100	7	4	41	3	55	3	4	23	12	42	229
1869..	6	9	11	5	31	19	21	16	40	96	7	4	38	3	52	3	1	11	9	24	203
1870..	..	2	17	11	30	5	24	19	40	88	..	6	5	40	51	..	4	1	12	17	186
1871..	..	2	17	10	29	3	24	18	42	87	..	4	6	40	50	..	4	..	7	11	177

The following Table, prepared from the official Navy Register for January of each year, by Capt. G. H. Preble, U. S. Navy, exhibits the number of midshipmen graduates, and midshipmen attached to the Naval Academy, with their classification and the number of resignations, deaths, and dismissals, from 1851 to 1871, inclusive.

TABLE VIII. *Midshipmen in Naval Academy.*

Year.	Midshipmen.	First Class.	Second Class.	Third Class.	Fourth Class.	Total.	Resignations.	Deaths.	Dismissals.
1851...	171	..	..	..	..	171	14	5	13
1852...	144	..	..	..	28	172	7	.	16
1853...	122	..	..	28	48	198	17	1	13
1854...	89	6	16	30	42	183	9	3	17
1855...	66	12	26	16	74	194	23	1	15
1856...	47	20	17	38	49	171	31	4	2
1857...	30	15	24	28	78	175	34	1	2
1858...	45	15	24	35	100	219	38	.	7
1859...	47	20	28	56	83	234	30	.	1
1860...	49	25	39	57	117	287	22	.	3
1861...	55	35	38	70	124	324	33	3	4
1862...	67	21	31	120	79	318	112	1	14
1863...	9	21	31	118	212	391	45	2	14
1864...	2	39	63	137	218	489	20	4	53
1865...	31	60	99	133	163	486	74	.	53
1866...	84	78	110	115	147	534	70	2	12
1867...	72	89	87	98	147	493	68	2	7
1868...	157	81	82	88	93	501	57	2	3
1869...	77	80	77	76	53	363	25	1	5
1870...	74	68	54	37	92	325	45	1	4
1871...	69	51	33	48	108	309	42	1	3

U. S. NAVAL ACADEMY AT ANNAPOLIS.

I. HISTORICAL NOTICE.

THE history of the United States Naval Academy, as an institution, opens October, 1845, but its germ and growth in suggestions, for the practical instruction of midshipmen, dates back to the beginning of the century. A school of the Navy constituted one of the departments, or group of schools, in the plan of a Military Academy drawn up by Alexander Hamilton, as Inspector General of the Army, and submitted to Congress, January, 1800, in the Report of the Secretary of War (James McHenry), whose department was at that time charged with the management of naval affairs.

In 1808, General Williams, in a report on the enlargement of the Military Academy at West Point, of which he was Superintendent, recommended "that nautical astronomy, geography, and navigation should be taught by the professor of mathematics," and that the plan of the institution should "take in the minor offices of the navy; but also any youths from any of the States who might wish for such an education, whether designated for the army or navy, or neither, and to let these be assessed to the value of their education." This plan was doubtless suggested by the Polytechnic School of France, and if adopted at the time, would have not only have given to the army and navy a much broader and firmer basis of scientific attainments, but would have hastened the construction of roads, bridges, canals, and railroads, and the development of the mineral and other industrial resources of the country, by turning out every year a number of young men, qualified in scientific culture, to enter on the duties of civil, mining and mechanical engineers, and become superintendents of manufacturing and other corporate enterprises. In the absence of any special school of preparation for such civil services, officers of the army were induced to resign their commissions to superintend the construction of canals and railroads under state and corporate auspices.

In the measures which grew out of the war of 1812, was the act of January, 1813, "to increase the Navy of the United States," in which authority was given to the Secretary of the Department to

employ a schoolmaster for each vessel to which 12 midshipmen were assigned. By these, so far as appears in any published document, was given the first formal employment of this class of officers.

In 1814 the Secretary (William Jones) suggested "the establishment of a Naval Academy with suitable professors, for the instruction of the officers of the Navy in those branches of Mathematics and experimental philosophy, and in the service and practice of gunnery, theory of naval architecture, and art of mechanical drawing, which are necessary to the accomplishment of the naval officer." This suggestion was renewed by his successor, Smith Thompson, of New York, and a distinct proposition to locate it on Governor's Island, in the harbor of New York, by Secretary S. L. Southard, in 1824. In a special communication to the Senate in 1825, he says:

> The younger officers enter at so early an age, that they can not be accomplished, or even moderately accurate scholars. They are constantly employed on ship-board, or in our navy-yards, where much achievement in learning can not be expected. And yet the American naval officer is, in fact, the representative of his country in every port to which he goes, and by him is that country in greater or less degree estimated. "The science and information requisite for a navy officer," he repeats in his Report for 1827, "is in no respect inferior to that required by the army officers and engineers, and the interest as well as the honor of the country are not less concerned in the correct performance of their duties."

President Adams (J. Q.) in his Annual Message, Dec. 5, 1825, remarks that "the want of a Naval School of instruction corresponding with the Military Academy at West Point, for the promotion of scientific and accomplished officers, is felt with daily increasing aggravation." In his message, Dec. 4, 1827, he returns to the subject "as still soliciting the sanction of the legislature," adding—

> Practical seamanship, and the art of navigation, may be acquired upon the cruises of the squadrons, which, from time to time, are dispatched to distant seas; but a competent knowledge, even of the art of ship-building, the higher mathematics and astronomy; the literature which can place our officers on a level of polished education with the officers of other maritime nations; the knowledge of the laws, municipal and national, which in their intercourse with foreign states and their governments, are continually called into operation; and above all, that acquaintance with the principles of honor and justice, with the higher obligations of morals, and of general laws, human and divine, which constitute the great distinction between the warrior patriot and the licensed robber and pirate; these can be systematically taught and eminently acquired only in a permanent school, stationed upon the shore, and provided with the teachers, the instruments, and the books, adapted to the communication of these principles to the youthful and inquiring mind.

In 1841, Secretary Upshur renewed the recommendation of his predecessors, and a bill to establish a naval school at or near Fortress Monroe, passed the Senate, but was not acted upon in the House.

The nucleus of a school was formed when the midshipmen were first ordered to the Naval Asylums at Philadelphia and other places, to prepare for their examination, and several of the professors of Mathematics repaired there to give instruction.

In 1845 the Secretary of the Navy (George Bancroft), inaugurated and completed in four months an arrangement by which a Naval School, with its corps of professors, was instituted in a suitable location, without any special appropriation, and with only the existing authority of acts of Congress. The original plan is best set forth in Mr. Bancroft's letter to Commodore Franklin Buchanan, whom he appointed superintendent of the institution.

NAVY DEPARTMENT, August 7th, 1845.

SIR:

The Secretary of War, with the assent of the President, is prepared to transfer Fort Severn to the Navy Department, for the purpose of establishing there a school for midshipmen.

In carrying this design into effect, it is my desire to avoid all unnecessary expense—to create no places of easy service—no commands that are not strictly necessary—to incur no charge that may demand new annual appropriations; but, by a more wise application of moneys already appropriated, and officers already authorized, to provide for the better education of the young officers of the navy. It is my design not to create new officers, but, by economy of administration, to give vigor of action to those which at present are available; not to invoke new legislation, but to execute more effectually existing laws. Placed by their profession in connection with the world, visiting in their career of service every climate and every leading people, the officers of the American navy, if they gain but opportunity for scientific instruction, may make themselves as distinguished for culture as they have been for gallant conduct.

To this end it is proposed to collect the midshipmen who from time to time are on shore, and give them occupation during their stay on land in the study of mathematics, nautical astronomy, theory of morals, international law, gunnery, use of steam, the Spanish and the French languages, and other branches essential, in the present day, to the accomplishment of a naval officer.

The effect of such an employment of the midshipmen, can not but be favorable to them and to the service. At present they are left, when waiting orders on shore, masters of their own motions, without steady occupation, young, and exulting in the relief from the restraint of discipline on shipboard.

In collecting them at Annapolis for purposes of instruction, you will begin with the principle that a warrant in the navy, far from being an excuse for licentious freedom, is to be held a pledge for subordination, industry and regularity,—for sobriety, and assiduous attention to duty. Far from consenting that the tone of the discipline and morality, should be less than at the universities or colleges of our country, the President expects such supervision and management as shall make of them an exemplary body, of which the country may be proud.

To this end you have all the powers for discipline conferred by the laws of the United States, and the certainty that the department will recommend no one for promotion, who is proved unworthy of it from idleness or ill-conduct or continuing ignorance, and who can not bear the test of a rigid examination.

For the purpose of instruction, the department can select from among twenty-two professors and three teachers of languages. This force, which is now almost wasted by the manner in which it is applied, may be concentrated in such a manner as to produce the most satisfactory results. Besides, the list of chaplains is so great that they can not all be employed at sea, and the range of selection of teachers may be enlarged by taking from their number some who would prefer giving instruction at the school to serving afloat. The object of the department being to make the simplest and most effective arrangement for a school; you will be the highest officer in the establishment, and will be intrusted with its government. It is my wish, if it be possible, to send no other naval officer to the school, except such as may be able and willing to give instruction. Among the officers junior to yourself, there are many whose acquisitions and tastes may lead them to desire such situation. For this end

the department would cheerfully detach three or four of the lieutenants and passed midshipmen, who, while they would give instruction, would be ready to aid you in affairs of discipline and government. Thus the means for a good naval school are abundant, though they have not yet been collected together and applied.

One great difficulty remains to be considered. At our colleges and at West Point, young men are trained in a series of consecutive years; the laws of the United States do not sanction a preliminary school for the navy; they only provide for the instruction of officers who already are in the navy. The pupils of the naval school being, therefore, officers in the public service, will be liable at all times to be called from their studies and sent on public duty. Midshipmen, too, on their return from the sea, at whatever season of the year, will be sent to the school. Under these circumstances, you will be obliged to arrange your classes in such a manner as will leave opportunity for those who arrive, to be attached to classes suited to the stage of their progress in their studies. It will be difficult to arrange a system of studies which will meet this emergency; but with the fixed resolve which you will bring to the work, and with perseverance, you will succeed.

Having thus expressed to you some general views, I leave you, with such assistance as you may require, to prepare and lay before this department for its approbation a plan for the organization of the naval school at Fort Severn, Annapolis.

The posts to which you and those associated with you will be called are intended to be posts of labor; but they will also be posts of the highest usefulness and consideration. To yourself, to whose diligence and care the organization of the school is intrusted, will belong, in a good degree, the responsibility of a wise arrangement. Do not be discouraged by the many inconveniences and difficulties which you will certainly encounter, and rely implicitly on this department as disposed to second and sustain you, under the law, in every effort to improve the character of the younger branch of the service.

I am, respectfully, your obedient servant,

GEORGE BANCROFT.

Com'r FRANKLIN BUCHANAN,
United States Navy, Washington.

Under these instructions the school was duly organized at Fort Severn, Annapolis, and formally opened, October 10, 1846, with 36 midshipmen, appointed in 1840, and who were, before resorting to Annapolis, preparing for examination at the Naval Asylum at Philadelphia; 13 of the date of 1841, who were to remain at their studies until drafted for sea, and 7 acting midshipmen, appointed in 1845. The first staff of instruction consisted, besides Commander Buchanan, of Lieutenant James H. Ward, in gunnery and steam; Surgeon J. L. Lockwood, in chemistry; Chaplain George Jones, in English studies; Prof. Henry H. Lockwood, in natural philosophy; and Prof. Girault, in French.

In 1846, Congress appropriated an amount not exceeding $28,000 for repairs, improvements, and instruction at Fort Severn, Annapolis, Md.; and a like amount in 1847 for the same objects, "including a purchase of land not exceeding 12 acres, for the use of the Naval School." In the same year (Dec. 1847), Secretary Mason recommended a practice ship.

Down to 1849, the regulations provided for two years' study at

the School, followed by three years' service at sea, and then two years' study at the School. This alternation of study and practice—of practice at sea associated with opportunities of study, and of study at school with many advantages of testing principles by experiments and the observations of professors and officers of experience, possessed advantages which still commend it to the minds of many officers over that of longer continuous study at school before practice in earnest is begun. The old system had its shortcomings, but it turned out good seamen and gallant officers, and its best features ought to be again engrafted on the new.

In 1849, a board of officers was directed by the Secretary of the Navy to consider the organization of the school at Annapolis, and report to the department. This was done, and new regulations were matured, and ordered to go into effect on the first of July, 1850. The teachers' staff was enlarged, and a practice ship, the Preble, a sloop-of-war of the third class, was attached for the purpose of a summer cruise, and the institution was henceforth styled in Acts of Congress and Reports of the Secretary, the Naval Academy. The course of instruction was arranged for four years, with an interval of two or three months in the summer devoted to a practice cruise for two of the classes. The President was authorized to appoint a Board of Visitors, whose functions were "to witness the examinations of the several classes, and examine into the police, discipline, and general management of the Academy."

The new system began in October, 1850, under Commander C. K. Stribling, as Superintendent, who was relieved in 1853 by Commander L. M. Goldsborough, who was in turn relieved by Captain George S. Blake, in 1857, who continued in the superintendence till 1867, when Admiral Porter was assigned to the position, which he held till 1870, when Commodore J. L. Worden succeeded him.

The first or lowest class in the four years' course, entered in October, 1851, and graduated in June, 1854, having had two summer cruises of practice, and a long period of continuous study.

The necessities of the War, which as early as April, 1861, had made Annapolis the seat of military operations, caused the removal of the Academy—its professors, students, library and apparatus—in the month of May, to Newport, first to Fort Adams, and afterwards to the Atlantic House in the town, and to the *Constitution* and other ships, which were not fit for active service, in the inner harbor. All the members of the three highest classes were ordered into active service, and with the fourth class, and 200 newly appointed, the system of instruction went on as in times of peace.

Course of Studies in 1864.

In the organization of the Naval School at Annapolis, in 1845, the ordering of the course of studies was left practically with Prof. William Chauvenet, a graduate of Yale College, who had been commissioned professor of mathematics in 1841, and had acted as such in the instruction of midshipmen in the Naval Asylum at Philadelphia. The following is substantially the arrangement proposed by him for the classes when fully organized—the main deviation in the course as followed in 1864 was in the assignment of text-books.

FIRST CLASS—FOURTH YEAR.

Department of Practical Seamanship, Naval Gunnery and Naval Tactics.—Seamanship, Naval Tactics. Naval Gunnery; Simpson's Ordnance and Gunnery. Simpson's Translation of Page's Theory of Pointing. Dahlgren's Boat Howitzer.

Department of Astronomy, Navigation and Surveying.—Theory of Navigation. Practical Astronomy. Marine Surveying.

Department of Natural and Experimental Philosophy.—Lardner on Heat. Wells' Chemistry. Main & Brown on the Steam-Engine.

Department of Ethics and English Studies.—Constitution U. S.; Kent on International Law, Vol. I.

Department of Spanish.—Ollendorff.

SECOND CLASS—THIRD YEAR.

Department of Practical Seamanship, Naval Gunnery and Naval Tactics.—Seamanship. Simpson's Naval Gunnery.

Department of Mathematics.—Smyth's Analytical Geometry. Smith's Differential and Integral Calculus.

Department of Astronomy, Navigation and Surveying.—Davies' Surveying. Herschel's Astronomy. Bowditch's Navigation.

Department of Natural and Experimental Philosophy.—Lardner's Optics, Acoustics, Electricity, and Magnetism. Smith's Mechanics.

Department of Field Artillery and Infantry Tactics.—Hardee's Light Infantry Drill. Instruction in Field Artillery.

Department of Ethics and English Studies.—Wayland's Moral Science.

Department of French.—Girault's French Student's Manual. Dumas' Vie de Napoleon. Manesca's Reader.

THIRD CLASS—SECOND YEAR.

Department of Practical Seamanship, Naval Gunnery and Naval Tactics.—Seamanship.

Department of Mathematics.—Davies' Legendre's Geometry. Chauvenet's Trigonometry. Davies' Mensuration.

Department of Ethics and English Studies.—Eliot's History U. S. Quackenbos' Rhetoric. Composition.

Department of French.—Girault's French Student's Manual. Girault's Vie de Washington.

Department of Drawing and Draughting.—Line Drawing.

FOURTH CLASS—FIRST YEAR.

Department of Mathematics.—Greenleaf's Arithmetic. Davies' Algebra. Davies' Legendre's Geometry.

Department of Ethics and English Studies.—Bullions' English Grammar. Cornell's Geography. Worcester's and Lord's History. Composition.

Department of Drawing and Draughting.—Sketching.

CONDITION IN 1864.

The following Report, drawn up by the author of this Treatise, after a residence of several weeks in the institution, as one of the Board of Visitors, exhibits its condition in 1864, and contains suggestions on the educational improvement of the military and commercial marine, which met the approbation of the Board.

Report of the Board of Visitors to the Secretary of the Navy.

SIR:—The Visitors, appointed "to witness the examination of the several classes and to examine into the state of the police, discipline, and general management of the Naval Academy," for 1864, report as follows:—

I. THEIR OWN PROCEEDINGS.

The regular session of the Board, although several members were in attendance earlier, commenced on Monday, the 20th of May, and continued from day to day until Friday, June 10th. Their investigations as a Board, embraced—

First.—A thorough inspection of the buildings, ships, and material equipment provided by the Department for the residence, subsistence, health, and instruction of the several classes.

Second.—An attendance of the whole or a portion of the Visitors, for a brief period at least, on the examination conducted by the Academic Board, of one or more sections of each class in each study professedly attended to during the year.

Third.—An exhibition of the professional knowledge and skill attained, including the parade, evolutions, tactics, and drill as a military corps—the uses of the rapier, cutlass, musket, and cannon, great and small—the handling of ropes, sails, spars, boats, and everything included in practical seamanship in harbor, afloat, and in action.

Fourth.—Inquiries into the mode of conducting the entrance examination, and the results—the classification and programme of studies for each class—scholarship and conduct rolls—causes of failure to graduate, and system of punishment—chapel exercises, morality, manners, and personal habits of the midshipmen—the accounts and vouchers for the expenditure of government appropriations, including payments made for the use of the cadets—in fine, into the police, discipline, and general management of the institution.

A committee of the Board was authorized and requested to attend the entrance examination of the new class, as well as the final

examination of the graduating class, in order that the report required of the Visitors might cover the operations of the Academy for the year 1864.

Every facility for prosecuting their investigations was extended to the Visitors by the Superintendent, Officers, Professors, and Students.

II. CONDITION OF THE NAVAL ACADEMY IN 1864.

In presenting some details of the condition of the Naval Academy as they found it, and in offering suggestions for its improvement, which the submitting of a report implies, the Visitors are not unmindful that the institution is not at present furnished with permanent buildings and equipments in all respects adapted to its purpose;—that even such as are furnished were selected with reference to a smaller than the present number of pupils;—that its staff of instructors and course of instruction have been disturbed by the pressing exigencies of a great war, calling off into actual service some of its most experienced teachers;—that the education which it aims to give is not general but special, not covering the whole ground of a generous culture, but particularly adapted to make accomplished seamen and midshipmen;—and, moreover, that in an educational field so wide and subjects of inquiry so numerous as attach themselves to the details of such a school, a brief visit, made while the institution is not following its usual daily routine, is not in all respects the most favorable to the formation of just and reliable opinions. They at the same time believe that the government and people expect that the liberal appropriations in its favor will be expended with a judicious economy, and that the knowledge imparted will be accurate, thorough, and professional, and that its graduates will be really fitted for that rank of the service for which they are professedly trained. They recognize the fact that the school is yet in the youth of its development, and also that its purpose is not only to perpetuate naval science as it has been taught, but to maintain a progressive course of instruction, engrafting thereon all necessary or possible improvements.

Organization for Administration and Instruction.

The Visitors find the Naval Academy, subordinate to the direct supervision of the Department, under the immediate government of a Superintendent, Commodore George S. Blake, who is held responsible for its discipline and management. He is assisted as chief executive officer by the Commandant of Midshipmen, Commander Donald M. Fairfax, who resides in the Academy building on shore, and is also head of the department of Seamanship, Naval

Gunnery, and Naval and Infantry Tactics. The Commandant is assisted in the different departments of his duty on ship and shore by three senior assistants and eleven assistants, nine of the latter being of the rank of lieutenant, and the remainder lieutenant-commanders. Two of the senior assistants have charge of the Practice-ships Marion and Macedonian, and also assist in instruction; six of the assistants are engaged in executive duty on board the School-ships Constitution and Santee, while the others, as well as these, are charged with certain branches of instruction in the department of which the Commandant is chief.

There are also attached to the Academic Staff one Professor of Astronomy, Navigation, and Surveying; two Professors of Mathematics, with six assistants in the same department; one Professor of Natural and Experimental Philosophy, with two assistants; one Professor of Ethics and English Studies, with nine assistants; one Professor of the French language, with an assistant; one Professor of the Spanish language; one Professor of Drawing and Draughting, with an assistant; one Sword-master, with an assistant; and one Librarian, who acts also as assistant in Mathematics, and Ethics and English studies. The officers not attached to the Academic Staff include a Paymaster, a Surgeon, with two assistants, a Chaplain, (with three, who are engaged as instructors,) a Commissary, Storekeeper, Secretary, Treasurer, and clerks to the Superintendent and Commandant.

The Academic Board is composed of the Superintendent, the officers in charge of the Practice and School-ships, and the professors, except that the professors of French, Spanish, and Drawing take part only upon matters pertaining to their own departments. The Board is required to conduct and regulate all examinations of candidates and students, preparing the necessary papers and reports in connection therewith, to prescribe the order and times of instruction, to recommend text-books for the approval of the Naval Department, and books, instruments, and other necessary material for instruction, to recommend at pleasure the restoration or farther trial of students that have been dismissed or found deficient in scholarship, to grant certificates of graduation, and to report from time to time, on the system of studies and instruction pursued, and propose such improvements as experience may suggest.

Buildings and Material Equipment.

The material arrangements for the accommodation of the Academy, for the lodging, subsistence, and comfort of the pupils in health and sickness, and for study and instruction, both scientific and profes-

sional, although made on a sudden emergency, for temporary occupancy, and for a smaller number, are far from being insufficient in extent, or particularly objectionable, when compared with similar arrangements for other great schools. The main building on shore is of wood, originally intended to lodge and board a large number of guests, and as adapted to the uses of the Academy, accommodates about half of the classes as well as most boarding schools provide for their pupils. The arrangements are not as convenient or as safe from fire as those at Annapolis; but they are too good to be complained of, even if they do require a strict observance of regulations, or special organization and diligence to protect from fire, which would carry mourning into many homes. Good discipline and good recitations, and a large amount of military and naval knowledge are secured under the difficulties such as they are, which the Department, be they great or small, will, doubtless, remove at the earliest possible moment. In any permanent or temporary arrangement, on ship or shore, while the privacy and comfort of separate lodgings for pupils should as far as practicable be secured, the Visitors recommend that convenient halls be provided, properly ventilated, warmed and lighted, and supplied with the best dictionaries, encyclopedias, and naval histories and biographies—to be occupied for study at certain hours by such pupils as have not acquired the power of concentrating attention, and the habit of solitary study—a power and habit of the highest importance, but very rarely attained. The same rooms might be open to the pupils at certain hours every day for the purpose of reading naval histories and biographies, and for consulting the encyclopedias and other books of reference. The formation of right habits of study and the habit and mode of reading such books to the best advantage should be made a matter of special and frequent inculcation by the head of each department of study.

The lack of suitable buildings for lodging, subsistence, and study, for a portion of the pupils, is supplied by an extension of the School-ship System, first inaugurated on board of the "Plymouth," at Annapolis, in 1849, in our system, although always the main feature in the French system of naval education. The old "Constitution" and the "Santee," properly moored in the harbor of Newport and adapted, are used for the residence and study of the younger classes, which are in this way brought more readily into the daily routine of the school and the service without the vulgar annoyances, to which the youngest classes are almost universally subjected, when lodged in the immediate neighborhood of the next older class. If School-

ships are to constitute a permanent, integral feature of the Academy, the details of arrangements for separate lodging and class study require additional attention. For the present, recitations are attended in suitable buildings on Goat Island, near which the ships are moored and reached by covered passages. On this island is sufficient room for all sorts of athletic sports, military drill, and target practice.

The "Macedonian" and "Marion" are used for practice in the evolution of guns and other naval tactics by the several classes. To these are added, at least for the purposes of the summer cruise, the screw steamer "Marblehead" and the yacht "America."

Number of Pupils—Entrance Examination.

The number of pupils belonging to the Naval Academy in the year closing June, 1864, was 458, distributed into four classes, generally according to the period of their connection with the institution, with a staff of 57 officers and instructors. This is an astonishing development of the Academy in respect to pupils, as well as in the number of the teaching staff, and equipment for professional training, since Oct. 10th, 1845, when the Academy found a location at Fort Severn in Annapolis, or since January 1st, 1846, when it was reported to have 36 midshipmen and six professors and instructors, including the Superintendent. To judge of the progressive development of the institution, and of the results of the annual examination which they were appointed to witness, the Visitors deemed it necessary to ascertain the average condition of each class as to age and attainments, at the time of becoming connected with the Academy, and with the general results of the entrance examination—this examination being the only check on the admission of unqualified candidates—no previous examination being held in the districts or States from which they come.

By law and regulations governing the admission of candidates into the Academy, the maximum number of pupils is limited to 526, viz., two for every Congressional district or territory, appointed on the nomination of the member or delegate, from actual residents of the district, if such nomination is made to fill a vacancy duly notified, prior to the first day of July in any year, and if not so made, by the Secretary of the Navy; and twenty-five more appointed by the President, two for and from the District of Columbia, ten from the country at large, ten from the sons of officers of the army and navy, and three from the enlisted boys of the navy. All candidates who receive notice of their provisional appointment must present themselves to the Superintendent for examination be-

tween the 20th and 31st of July, or September in case of second appointments. The examination is twofold; first, before a medical board, consisting of the surgeon resident and two other medical officers designated by the Department; and second, before the Academic Board. The candidate must be found, according to the law of 1864, to be between the ages of fourteen and eighteen years—of good moral character—physically sound, well formed, and of robust constitution—and pass a satisfactory examination in reading, writing, spelling, arithmetic, geography and English grammar.

The requisition as to age was advanced from 16 in 1861, to its present maximum in 1864, while the Board was in session, and conforms in that respect to the age which they had decided to recommend. The traveling expenses of the successful candidates are paid.

The Visitors were furnished on application with tables exhibiting the statistics of these entrance examinations from 1851 to 1863 inclusive. From these tables it appears that out of 1,522 candidates, nominated and appointed conditionally, but afterwards examined, 313 or one-fifth of the whole were rejected as unqualified, although the attainments required were such as any graduate of a common school should possess. Of the number (1,209) admitted, 466, more than one-third, failed on the first year's course. Out of the number who failed at the earlier examinations, three hundred and thirty-one were turned back for a second trial, and after floundering along in the lower sections, only a very small per cent. succeeded in graduating. Of the whole number admitted, (1,209,) only 269 graduated, including 93 who were received into the service from 1861 to 1864 before completing their studies.

From another table, covering the entrance examinations from 1860 to 1864 inclusive, it appears that out of 1,093 candidates who presented themselves for admission, 807 were admitted, while 53 were rejected by the Medical Board, 219 by the Academic Board, 11 withdrew, and 3 were found to be over the maximum age.

From another table, exhibiting the ages of the successful and unsuccessful candidates, it appears that out of 1,141 candidates examined, 201 (18 per cent.) were rejected, and of the number rejected, 177 were under 17 years of age. Of the 940 admitted, 313 (33 per cent.) failed the first year, and of the number that failed, 254 were under 17 years of age. The average age of the candidates admitted was 16 years and 2 months, and of those who failed, 15 years and 10 months.

The fact that one-fifth of the whole number nominated failed to

pass the examination in the most rudimentary branches of a common English education—and in only the most elementary portions of these branches—indicates unmistakably how little regard has been paid to school attendance and proficiency in the selection of candidates. To judge how far these failures might be attributed to a laudable strictness on the part of the Academic Board, the entrance examination papers, which are filed away from year to year, were called for, and from those it appears that the questions asked and exercises required were few and simple—far too few and simple—far below the requirements of any Public High School; and yet such wretched perversions of the orthography of the most common words, such mistakes in American geography, such bungling use of the English language in the composition of a simple letter, such numerous failures in arithmetical operations not going beyond the elementary rules and simple exercises in fractions and proportion, it would be difficult to gather from all the Public High School entrance examinations of the country. More strictness on the part of the Academic Board would have saved the government hundreds of thousands of dollars, for of the candidates allowed to pass, two-fifths fail on the studies of the first year, although these studies belong to a good English education, and are preliminary to a special scientific naval training—showing a want of suitable preparatory knowledge, of aptitude for study, or of will and desire to learn. A portion of those who fail the first year are put back for a second year's trial, and in some instances for a third, and the proportion of those thus put back who finally succeed in graduating is very small, thereby causing a total loss of the thousands of dollars expended upon each. From data gathered from the annual reports of the Department, it appears the annual expense of a pupil of the Naval school exceeds $1,500, and that each graduate who has been four years in the institution costs the government over $10,000. But the pecuniary loss is not the only consideration—the places filled by pupils, no matter what their courage or general ability, unable or unwilling to profit by the opportunities of scientific and professional instruction so lavishly provided, might be filled by competent, ambitious, diligent, and courageous young men, if they could have had their qualifications tested by a competitive examination.

Daily Routine.

The morning gun calls the cadets up at 6 o'clock. Inspection of the rooms follows, when the bedding must be found arranged, the rooms swept, and every thing in order. Ten minutes are given to chapel services, and half an hour to breakfast, which is over at 7.15.

Forty minutes recreation are then allowed, during which sick-roll is called and such as report themselves indisposed are marched to the hospital and reported to the surgeon. At 7.55 the sections are formed under the supervision of the Officer of the Day, assisted by the section leaders, and at 8 o'clock, on given signal, they are marched in close order to their recitation rooms, in perfect silence and with strict military decorum. All who are not engaged in the recitation rooms are expected to be preparing their lessons in their own rooms, and it is the duty of the superintendents of floors to see that they are there. The dismissal and re-formation of sections at the end of each hour are conducted with similar formality and regulated by special signals. Study and recitation continue until 1 o'clock, when the cadets are formed in order by the captains of crews, (the whole corps being organized in nine guns' crews, for the purposes of discipline and practical instruction,) all special orders and rules for the day are read, and they are then marched into the mess hall for dinner, which occupies forty minutes. From 1.40 to 1.55 recreation is allowed and the sections are then again formed as in the morning for recitation and study. At 4 o'clock ten minutes are given to preparation for drill, as may be the order of the day, and then follow instruction in fencing, infantry or artillery drill, and recreation until parade and roll-call at sunset. Supper immediately succeeds, to which half an hour is given, and recreation until study-call at 6.30 or 7.00, according to the season. Study hours continue until tattoo, at 9.30, during which time the cadets must all be in their rooms, and after inspection of rooms all lights are extinguished at 10 o'clock.

The routine on board ship is as far as possible the same. No control is exercised over the occupation of the time by the cadets during study hours, provided good order is preserved. No studies or exercises are required on Saturday afternoon and one-half of each class may then be allowed liberty beyond the limits of the Academy. A vacation is given at the close of the second year, the only one in the whole course. As means of recreation, chess, draughts, and all games of chance are strictly forbidden. On the other hand, every facility is afforded for games of ball, boxing, fencing, boating, &c.

Course of Instruction, Examinations, and Merit-Rolls.

The course of instruction at the Naval Academy is comprised in eight departments, with their special branches, as follows:—

First Department, in six branches—Practical Seamanship, Theory and Practice of Gunnery, Naval Tactics, Infantry Tactics, Howitzer Drill, and the Art of Defense.

Second Department, Mathematics, in seven branches—Arithmetic and Algebra, Geometry, plane and solid, Trigonometry, Mensuration, Descriptive Geometry, Analytical Geometry, and the Differential and Integral Calculus.

Third Department, in four branches—Astronomy, Practical Astronomy, Navigation, and Surveying.

Fourth Department, in eight branches—Mechanics of Solids, Mechanics of Liquids, Pneumatics, Acoustics, Electricity, Heat, Chemistry, and the Steam-Engine.

Fifth Department, in seven branches—English Grammar, Descriptive Geography, Physical Geography, Outlines of History, Rhetoric. Ethics, and Political Science.

Sixth Department—the French Language.

Seventh Department—the Spanish Language.

Eighth Department—Drawing and Draughting.

These studies are distributed into four annual courses for the four regular classes, each class being subdivided into convenient sections, usually according to the relative standing of the members. During the last year the first class, of 36 cadets, has been graded into three sections; the second class, of 59 cadets, into five sections; the third class into six sections; and the fourth class, during the first term, with 176 cadets, into fourteen sections, and in the second term, with 156 cadets, into twelve sections—each section receiving separate instruction.

The more difficult portions of the several branches may be reserved for the higher sections of the classes, and it is frequently the fact that in certain branches no instruction whatever is given to the lowest sections. Deviation from the general rule for the admission of cadets only in the month of September has made the formation of "Intermediate Classes" necessary, so that there are now two divisions of the second class and two divisions of the third class. By this means the number of sections is increased, the labors of instruction augmented, and much inconvenience in other respects created. The demands of the times have also introduced other irregularities into the course, hurrying the more forward sections through their studies and detailing them into active service at the close of the third year, with or without a graduating examination, while the lower sections are retained through the whole four years.

The Commandant of Midshipmen and the several professors are each at the head of a special department, with such assistants as may be necessary. The professors, instructors, and assistants are responsible for the regular and orderly conduct of their respective

classes and sections while under instruction, and must report all want of preparation, absence, or misconduct. Daily notes are taken of the progress and relative merit of each pupil in each of his studies. The assistants must make weekly reports of such notes to the heads of their departments, who in turn report to the Superintendent, recommending such transfers as should be made from one section to another. The scale of daily merit in each study embraces seven grades, with corresponding values designated by numbers, as follows:—Thorough, (4.0)—Very Good, (3.5)—Good, (3.0)—Tolerable, (2.5)—Indifferent, (2.0)—Bad, (1.0)—Complete Failure, (0.) The average standing for the week in each study accompanies the report. Monthly reports are drawn up by the Academic Board for each month in the academic year, showing the relative standing of the members of each class in their different studies, and also their conduct or demerits. These reports are based upon the weekly reports and upon the results of the examinations, when such are held within the month, and are posted for public inspection. The examination weeks are considered of equal weight with those of the month.

The examinations are held by the Academic Board in the months of February and June, and are sufficiently thorough to enable the Board to decide upon the proficiency and relative merits of the members of the several classes. After each June examination a "general merit-roll" is formed for each class, for which purpose a maximum number or value is assigned to each of the principal branches in the several departments. The total amount of these maxima throughout the course is 1,000, and they are distributed among the departments and branches, for the different classes, as follows:—In the first year, to mathematics, 20—grammar and rhetoric, 10—geography, 10—history and composition, 10—drawing, 10—conduct, 5—total, 65;—In the second year, to seamanship, 20—mathematics, 35—grammar and rhetoric, 15—history and composition, 10—French, 30—drawing, 25—conduct, 15—total, 150;—In the third year, to seamanship, 40—gunnery, 20—infantry tactics, 25—howitzer drill, 20—mathematics, 45—general astronomy, 25—practical astronomy, navigation, and surveying, 15—mechanics, 30—physics, 25—moral science and international law, 20—French, 40—conduct, 30—total, 335;—In the fourth year, to seamanship, 100—gunnery, 60—naval tactics, 30—practical astronomy, navigation, and surveying, 75—physics, 30—steam-engine, 35—moral science and international law, 20—Spanish, 50—conduct, 50—total, 450. The minima values are fixed at one-third of the corresponding maxima.

The "general merit-roll" includes only such as pass a satisfactory examination in all the principal branches of their class and have not exceeding 200 demerits recorded against them. In the formation of the roll, the individual having the highest standing in any branch for the year receives the corresponding maximum number, while the one who has the lowest standing receives the corresponding minimum. The intermediate members of the class receive numbers proceeding by equal differences from the maximum to the minimum, in the order of their relative merit as fixed by their "class merit-rolls." The gradation for conduct is determined by allowing the maximum number to such as have no demerits, and for others diminishing that maximum by $\frac{1}{300}$ part for every demerit recorded against them. All the numbers thus assigned to the several members for the different branches of study and for conduct are then added together, and the members are arranged in each class according to the aggregates thus obtained. For the graduating class a "graduating merit-roll" is formed by adding the aggregate numbers of each member upon the several "general merit-rolls" for the four years and arranging the order of the members according to these new aggregates. The highest number reached upon the "graduating merit-roll," by any one of the class just graduating, was 859.

If any student at any examination fails to pass a satisfactory examination in any principal branch, or has recorded against him more than 200 demerits since the commencement of the academic year, a report is made of the case to the Secretary of the Navy, showing the habits of study, aptitude for study and for sea duties, and his general habits and conduct, and upon his decision the student is dismissed, or upon recommendation of the Academic Board, allowed to continue at the Academy for further trial.

The final graduating examination is held by a special Board and occurs, by a recent regulation, not less than one year after the close of the course. This examination embraces seamanship and naval tactics, practical gunnery, navigation, and management of steam-engines, and the standing in these branches is combined to determine the relative merits of the candidates. In assigning numbers, 1,000 is considered the maximum and 333 the minimum for such as are considered qualified for promotion, and the Board assigns such numbers within these limits as will fairly express the relative qualifications of the members of the class. The numbers thus assigned, when added to the numbers already assigned on the "graduating merit-roll," determine the standing of the graduates as ensigns; the highest number taking precedence.

Text-Books. Studies of the past Year.

The method of teaching as at present pursued is almost wholly by means of text-books and recitations. A series of lectures is delivered in connection with the recitations in Natural Philosophy and Chemistry. Without underrating the office of the text-book, the success of the French Polytechnic method of teaching even the higher Mathematics by lectures, collateral study, and examination, and the experience of all schools, of the power of the human voice and of the human eye to win, hold, and harmonize attention, should not be lost to this institution, many of whose pupils need the influence of such a method to vitalize their powers of thinking and to bring within their grasp the general principle or doctrine of the subjects taught.

The division of the classes into small sections of 12–14 midshipmen each, of nearly equal standing, tends to secure the personal and thorough instruction of each and all. The attempt was made, by furnishing prepared blanks to the several departments, to ascertain the character and actual amount of the studies and exercises accomplished by the several sections during the eight months of study of the year 1863–4. The returns made are not complete, but it appears that the English studies of the lowest class (in 12–14 sections) have consisted of one lesson a week in Spelling and Derivation, four in Bullion's English Grammar, four during the first term in Cornell's Geography, and during the second term in General History, with daily exercises in Composition and the exercise of the Voice; in Mathematics, five lessons a week during the first term in Greenleaf's Common School Arithmetic, and during the second term in Davies' University Algebra. In the upper sections, the Algebra was commenced within the first term and more or less nearly finished at the close of the year. The highest section had also five lessons a week for three weeks in Davies' Elementary Geometry (5 books) and instruction twice a week in Drawing. The space in the several text-books actually gone over varied considerably in the different sections. It will be seen, therefore, that the studies of this class, with the exception of Algebra and Geometry, are simply those of every common school, and yet the lower section is reported as having succeeded but "imperfectly" in Grammar, and "very imperfectly" in Algebra. It is also to be stated that a part of the class had received eight weeks additional preparatory instruction during August and September, 1863.

In the third class, of six sections, there were three lessons per

week, during the first term, in American History, and during the second term in Rhetoric. The lower section prepared six English compositions each term—the highest section, weekly compositions through the second term. All the sections prepared three lessons weekly in French during the first term and four lessons during the second, but with very unequal progress. In Mathematics, (five lessons per week,) Algebra was completed by the lower sections and reviewed by the higher in the first four or five weeks, when Elementary Geometry was taken up by all, and completed in the first term by the highest section. In the second term, Elementary Geometry for three weeks by the lowest section, and Trigonometry for the rest of the term—in the highest section, Trigonometry for ten weeks, Mensuration two weeks, and Analytical Geometry commenced, for three weeks. The first section had also three lessons a week in Marine and Topographical Drawing, and during the first term one lesson a week in Seamanship.

In the second class, of five sections, during the first term, five lessons a week in Analytical Geometry, replaced in the highest section by the Differential and Integral Calculus for five weeks; four lessons a week in Statics, to which the first section added Dynamics, three weeks; five lessons a week in Surveying, three weeks in each term, with practical exercises. The lowest sections had also four lessons a week in French, and the first section weekly lessons in Seamanship and Infantry Tactics, and two lessons a week in Gunnery. In the second term, five lessons a week in Dynamics, Hydrostatics, Pneumatics and Acoustics, with twelve lectures, Surveying, three weeks, and Astronomy, ten weeks. Two lessons a week in Wayland's Moral Science. The first section had also two lessons a week in Gunnery.

The first class, consisting of the three more advanced sections of the second class, and in its third year of study, during the first term were pursuing chiefly second class studies, having five lessons a week in Physics, including Statics, Dynamics, Hydrostatics, Acoustics, Magnetism, and Electricity, with sixteen lectures; four lessons a week in Theory and Practice of Navigation (six weeks) and General Astronomy (eleven weeks;) two lessons a week in Seamanship, and two in Gunnery, Naval Light Artillery, and Field Fortifications. In the second term, four lessons a week in Heat and Chemistry, with nine lectures; three in Wayland's Ethics and Kent's Constitution of U. S., and International Law; three in the Theory and Practice of Navigation; two in Seamanship; and one in Gunnery, &c. Two lessons a week were given through the year in Spanish, by means of the French.

In addition to the daily lessons of each class are the general practical exercises by divisions, by the higher classes on shore embracing daily exercises in Fencing, three exercises weekly in Infantry Drill, Howitzer Drill once a week, the Great Gun Drill upon the Practice Ships twice weekly in favorable weather, and a certain amount of Target Practice by the first class. The younger classes on the school-ships have also their special drills. Special instruction is given them in boating, and the numerous cutters and launches belonging to the ships afford ample opportunity for recreation and practice of this kind at suitable times. The use of the "Rainbow," a schooner-rigged craft of 15–20 tons, is also not unfrequently allowed to pleasure parties made up from the cadets. Weekly bathing is enjoined and practiced throughout the year as a sanitary regulation, but the absence of the cadets from port during the summer months, while on the cruise, prevents the attainment of that knowledge and skill in the art of swimming, which seem to the Visitors so essential a requisite.

The general results of the examinations and exercises as observed by the Visitors, may be stated as in general very favorable. The examinations of the classes were made by sections and conducted by the individual professors of the departments, with great fairness and impartiality, without any purpose of embarrassing the pupils, and for the single object of eliciting the extent, accuracy, and vividness of the pupil's knowledge of the topic. Written lists of questions were furnished to the cadets on entering the examination rooms, which were usually answered in writing upon the blackboard, with opportunity for oral explanation. The difference in the proficiency shown by the higher and lower sections, in all except the first class, was very strongly marked. In the written answers, the writing was fair and legible, and the spelling and composition very creditable—revealing in these respects an immense improvement upon the entrance examination papers of the same cadets. The Visitors would suggest that in future examinations there should be more of paper, even if there should be less of blackboard work, and that a portion of the questions should be handed in on slips by the Visitors and answered in writing with ink, in presence of the Board, by every member of the section present.

The practical professional exercises of the cadets upon the parade ground and on board ship, embracing all the different branches of shore and ship duty, (including a harbor cruise on board the Practice Steamer,) and designed to exemplify the proficiency of the classes in seamanship, gunnery, and naval and infantry tactics, were

performed in the most satisfactory manner, justifying the professional pride manifestly felt by those taking part in them. Moreover, these exercises, instead of being executed under the direction, as heretofore, of the respective Academic officers in command, were conducted under the charge wholly of officers appointed from the midshipmen themselves.

Physical Training.

The unavoidable exposures and risks of the naval service require not only a sound mind—a mind well informed, quick, and accurate in its operations, but a sound body—a body supple, athletic, and tough to resist the rapid alternations and continuous exposures of wet and cold weather. Although careful and continuous training can do much to develope and strengthen the qualities referred to, the records of the Academy and of the service, as well as the present appearance of many of the cadets, show that sufficient regard has not been paid to vigor and elasticity of physical constitution, in the original appointment, or the entrance medical examination. The regular military drill and evolutions, the small arm and other exercises, in which the whole corps participates, the professional practice in gunnery and seamanship, all help to supply these deficiencies. There is still room for more careful scrutiny for inherited tendencies and hidden defects, in the entrance medical examination, as well as in the regular course of naval education, for a well arranged system of gymnastic exercises and athletic games, to give suppleness to the joints, steadiness to the nerves, hardness to the bones, and elasticity to the sinews. Such games and sports as the young universally accept with eagerness and pursue with unflagging interest, should be systematically introduced. Ample time, room, and encouragement by rank, prizes, and publicity, should be given to make a fondness and indulgence in such games as cricket, foot-ball, leaping, boating, &c., the habit of every member of the lower classes at least. An hour a day devoted to these healthful sports, even if taken from the study and class-room,—even more, if taken from the idle lounging, or the listless walk, or vulgar scuffling, will give at once health and strength, increased capacity for study, and valuable social qualities and manly virtues—all results of emphatically the highest professional value.

As part of the physical training of naval cadets, the expansion of the chest and the culture of the vocal organs should receive more special attention than the word of command on parade, and the questions and answers in the examination would indicate they had received. A clear, full, decisive voice is an element of influence on

the deck at all times, and of power in the hour of danger, as well as on the field or in the senate chamber.

The first beginning of habits, secret or open, which waste the vigor of the mind and body, should be watched with professional skill as well as parental interest, and those cadets in whom such indulgencies have grown into habits, should be cut off from the institution and service without hesitation and without reprieve.

Domestic and Sanitary Arrangements.

The institution is peculiarly fortunate in having had for years a Commissary who understands his business and gives universal satisfaction to all concerned. The neatness of the kitchen, the supply, preparation, and serving of the food, the geniality, good order, and enjoyment of the mess-hours, and the fact that no complaint reached the Visitors from any one of the 450 boys, blessed with good health and plenty of physical exercise, makes the record of this department an exception to similar departments in other large collegiate institutions. This comes from having the right man in the right place.

The hospital arrangements on shipboard and on shore, although not as large and quiet as would be desirable or as would be provided specially in permanent quarters, are sufficient for the demands on their accommodations. The location of the institution and the judicious arrangement and management of the Academy as to cleanliness, exercise, and diet, as well as the presence of a surgeon and two assistants on the Academic staff, and numerous attendants for hospital service, would seem to act as a preventive of accidents and disease, the mean daily percentage of sick on ship and shore from Oct. 1st to May 31st being returned at a little more than three per cent. out of an average attendance of 447 midshipmen. In calling for the annual reports to the Department of the medical condition of the institution, the Visitors were informed that a duplicate copy or abstract was not retained. Such copy or abstract would be highly convenient, and would seem to be even necessary, if it is deemed advisable to have a periodical inspection of the sanitary condition and requirements of the school.

Religious Observances and Instruction.

The regulations require that the students shall be assembled in the chapel for prayers daily, fifteen minutes before the breakfast hour, and that divine service shall be held on Sunday, which officers and students are expected to attend, unless excused on the ground of conscientious scruples, declared in writing by the former, and by the parents or guardians of the latter. These daily and Sunday ex-

ercises are conducted by the regular Chaplain of the institution. He is at the present time assisted in these and other such voluntary religious labors by three other chaplains of the Navy, who are now in residence as assistant professors. There are four Bible classes composed of cadets, and over one-eighth of the members are communicants in the different denominations of Newport. The student who brings, in his moral culture from home, religious convictions and habits, can easily preserve and strengthen them here, and no amount of instruction in the institution can compensate for the neglect of parental example and teaching in this respect. The absence of the religious element in the character and training of youth is a fundamental defect, and no institution of learning, special or general, can safely, for any length of time, dispense with appropriate and adequate means of religious instruction and a practical recognition of religious obligations, consistent with due regard to the religious convictions of individuals and the equal rights of all religious denominations. Such individual convictions and denominational rights can be best respected, not by ignoring the subjects themselves, but by selecting the chaplain from time to time so as to represent different religious denominations, and in all cases, in reference to his ability to be useful as chaplain in this institution.

The reading of the Sabbath, and one of the exercises of Monday morning might be so arranged as to harmonize with the religious observances and uses of Sunday, and the whole be made to unfold and enforce the great, definite, and unchanging obligations of every human being to his fellow-men, to his country, and to God.

As part of the religious and moral instruction of the Academy, more at least should be attempted to prevent, and if these unfortunately exist, to eradicate certain vulgar and vicious habits, whose beginnings are small, but which ultimately take complete possession of the individual. Although the Visitors can not, from their own knowledge, speak of its existence, they have had too many assurances from those who did know, to have any doubt of the prevalence of the vulgar and immoral practice of profanity, and that several of those addicted to it are among the youngest members of their classes, who came here entirely pure in this respect. The medical and police experience of the institution detects the occasional existence of other tastes and habits more directly affecting the health and morality of their victims, and which should and doubtless do receive the considerate and vigilant attention of the authorities, especially of the Chaplain, Surgeon and Superintendent.

Discipline.

The Superintendent is charged with and held responsible for the good order and discipline of the Academy, and it is made the duty of every officer, professor, and instructor, having knowledge of any violation of law or regulation, or of any crime, irregularity, neglect, or other improper conduct, of which any student or any other one has been guilty, to report the same without delay to the Superintendent. Offenses are defined with great minuteness and precision, and the circle of punishments embraces demerits on the roll of conduct, private and public reprimand, confinement to Academy grounds, to room, or to guard-room, and withdrawal on necessity, or dismission. In the administration of discipline, the Superintendent is clothed with much power, which is exercised by the present incumbent with great discretion and the happiest results. The private memorandum and letter book of this officer, respecting every case of discipline during the year, was placed before the Visitors, and they can bear willing testimony to the preventive admonition and parental regard with which he has exercised his authority.

Demerits, to be considered in making up the conduct-rolls, are assigned for all offenses. Such delinquencies as are not deemed deserving of severer punishment are grouped into four classes, which count ten, eight, six, four, and two demerits respectively, besides a miscellaneous class counting from one to ten demerits according to circumstances. The *total* demerits of each cadet is expressed by the sum of all demerits standing against him on record for the year, increased for the third class by one-sixth, for the second class by one third, and for the first class by one-half.

No punishment of any kind can be inflicted by other authority than that of the Superintendent. Report is read at evening parade of all demerits and other punishments that have been inflicted during the day, and opportunity is always given for excuse or explanation. Full record is made of every case of discipline, and a monthly conduct-roll is publicly posted showing the number of demerits against each cadet. It is evident that this conduct-roll does not fairly represent the character and conduct of the cadets, as a large number of demerits may be gained by numerous minor offenses, which involve neither immorality nor lawlessness, while a cadet who has been guilty of most flagrant acts of vice and disobedience may still be charged with but few demerits. Yet the conduct-roll has but a subordinate influence in determining the general merit-rolls, and in the question of dismissal the fuller record of punishments, as

well as the demerit-roll, has its weight in determining the action of the authorities.

Financial Affairs.

All money appropriated for the support of the Naval Academy is drawn for by the Paymaster and by him deposited with the Sub-Treasurer in Boston. The Paymaster draws upon him, from time to time, to make his disbursements.

The principal heads of expenditure for the fiscal year ending June 30th, 1864, are as follows:—

Pay of Commissioned and Warrant Officers, Midshipmen, Seamen, and others,	$241,771.71
Pay of Professors and Asssistants,	35,000.00
Expenses of the Academy, School and Practice Ships, Surgeon's necessaries, contingent expenses, and repairs of all kinds,	72,753.84

The total of all expenditures from 1st July, 1863, to May 31st, 1864, is reported at $383,419.41.

From the pay of the midshipmen, which is $500 per annum, $100 are reserved yearly to be paid upon graduation, though this sum is sometimes diminished by unavoidable circumstances. There is also deducted from their pay, the amount of board—at present $16.50 per month—and $3.00 per month for washing. The aggregate of these sums is paid monthly by the Paymaster to the Commissary. Articles of clothing for the midshipmen are provided under contract by the Storekeeper with the approval of the Commandant. All other articles for their use are purchased by the Storekeeper, from funds provided by the Paymaster, at prices sanctioned by the Commandant.

The midshipmen receive such articles as they desire upon requisition approved by the Commandant, and no other articles are permitted to be sold to them than those which the Storekeeper is authorized to have. Each midshipman has a pass-book in which his purchases are entered, and regular report is made by the Storekeeper to the Paymaster, who charges against each the aggregate amount of his purchases. On the 30th April, 1864, the amount of balances still due to the midshipmen was $44,579.93, the aggregate of indebtedness by them being only $111.90. The amounts to the credit of the members of the graduating class vary from $180 to $400.

The accounts of the Commissary are examined quarterly by a committee of three officers appointed by the Superintendent, to whom they make report. The Visitors deemed it their duty to go

behind the reports of this committee, and deputed one of their number to examine personally the original accounts of the Commissary and Storekeeper. As the result of this examination, which was conducted with the most rigid scrutiny, it is but justice to state that they found the accounts correct in all their details, and the prices of all articles as low as they can be purchased at wholesale in the city of New York, and the Visitors consider the financial affairs of the Academy as conducted with commendable skill and fidelity.

While the Visitors bear willing testimony to the fidelity with which the financial affairs of the Academy, as well as the departments of subsistence, discipline, and instruction, are and have been administered, they can not but express their disappointment at the very small number of officers of the lowest rank which the institution has contributed to the naval service. With an aggregate annual expenditure of several hundred thousand dollars, the aggregate number of graduates, since the opening of the four years' course, in 1851, including the three classes of 1858, '59 and '60, which were ordered into active service in 1862 and '63, before completing their studies, is but 269, or at the rate of less than 22 each year, at an expense to the country of over $12,000 for each graduate. If the 93 who entered the service with only two or three years' residence had completed their course, the aggregate expense for each graduate would have exceeded $15,000. This, as it appears to the Visitors, small result, is due mainly to the want of care in selecting candidates, and the very low standard of general scholarship required for entering the Academy. The experience of this institution is the same as that of others of the same character; any mode of selection which does not test in advance the natural aptitude and preparation for the special studies of the course, and exclude rigorously all who are found deficient, will burden the institution with a number of students which will have to be thrown off after months and sometimes years of struggling to incorporate them into the regular classes and to the manifest injury, in the meantime, of the scholarship and character of the institution. While a nomination by patronage, and a pass examination have a direct tendency to reduce the average ability of the selected candidates to the minimum required, a competitive examination raises the general average to the maximum ability of all who apply.

Graduating Class of 1864.

The present graduating class (consisting after the final examination of 31) at the close of its third year has completed the whole course

prescribed, excepting that the Calculus has been omitted and that Surveying has been limited to instruction in Harbor and Coast Surveying, from Bowditch. Steam and the Steam-engine have received fuller attention from this than any preceding class, embracing six weeks of theory and practice on board of the steamer Marblehead —altogether too little attention for a department so important. Two summer cruises have been made by this class—both coast cruises—the first on board the John Adams, from June 6th to Sept. 30th, 1862; the second from 16th June to 25th Sept., 1864, in which the following vessels were united, viz.: Flagship Macedonian, sloop of war Marion, screw steamer Marblehead, and the yacht America. Upon these cruises the midshipmen were practiced in all the regular duties attaching to the posts of lieutenant and master, taking by turns upon themselves the working of the ship, in the different vessels; making and calculating observations for determining the ship's position, going through all possible manœuvres and performing the duties incident to the management of ships in action, in heavy weather, or in the many emergencies which arise requiring superior skill in seamanship. They were engaged in instructing the crews in gunnery, in infantry and sword-drill, and in drill of the battery. They were also detailed for actual boat service, and for the transferring of howitzers and marines from ship to shore. During the last cruise Meyer's code of signals was used by the graduating class as signal officers, in communicating from vessel to vessel in the fleet, and instruction was also given in the Naval Code of signals, and in Navigation throughout the cruise to all cadets on board. In addition to these cruises the yacht America, in charge of cadets of this class, as commanding officers, has been engaged in the performance of despatch-boat duty, and also special "coast picket duty" in search for the Tallahassee.

The experience of this class—made up of three advanced sections of what is now the second class (the graduating class of 1865,) would seem to indicate, that under a system of appointment that should admit from the start only those who had maturity of mind and requisite scholarship, the professional studies of the Academy might be completed in three years. This is one year longer than the course of the French Naval School at Brest, the entrance examination of which would exclude most of the graduates of our Academy.

III. RECOMMENDATIONS.

The Visitors close their report with the following suggestions, as the results of their examinations and conferences, in reference to the

further development of the Naval Academy and the extension of nautical education generally, for the consideration of the Department.

I. Until the pupils of the Naval Academy have gone through the theoretical and practical course of instruction provided in this institution expressly to qualify them to act as Midshipmen, the Visitors recommend that they be designated as *Naval Cadets*—simply *candidates* for the lowest official rank in the Navy—and that no cadet be rated as midshipman, no matter how well up he may be in his studies, until he has had at least eighteen months of professional practice afloat, towards which time the actual time at sea of each experimental cruise shall be credited.

II. As the most direct blow to the hindrances which practically exclude a large portion of the youth of the country, no matter how strong may be their predilection or great their acquired fitness for the naval service, from even a chance of being admitted to this national school;—as the most effectual preventive of the disappointments now experienced by individuals and families in the failure of many appointees to pass the entrance examination, or to meet even the low requirements of the first year's course;—as the only effectual way of ridding the institution of the low average ability and attainments which characterize the lower sections of every class, and of bringing up the talent and scholarship and conduct of the whole corps to the average of the first two sections;—as a sure guaranty against the early resignation of officers educated at the public expense for a life service in the Navy, and of a progressive and honorable career as long as life and health last;—as a powerful attraction to draw to this department of the public service a fair share of the best talent and loftiest ambition of the youth of the country, and as a stimulus to their best efforts for self and school improvement for this purpose—the Visitors recommend the immediate abandonment of the custom of selecting candidates for admission by individual patronage, in consideration of neighborhood, relationship, or party connection, or the better motives of the poverty or the public service of parents, and that all appointments be hereafter made in consideration of the personal merit of the applicant, ascertained by a public competitive examination, conducted before an impartial tribunal, constituted as shall be prescribed by law. Admission, sought and obtained in this way, will be honorable to the successful candidates, a source of pride to the neighborhood and State from which they come, a reward to the teachers who have prepared them, and a stimulus to the industry and good conduct of their comrades at

home. The classes of the Academy, replenished every year by new recruits, all of whom have sought the service from personal choice and won their place by personal merit founded on natural aptitude and vigor of mind and acquired knowledge, and who regard the diligent improvement of these opportunities of professional study and practice as the true road to honorable promotion hereafter, to be gained by farther industry and devotion—will at once have an average ability and scholarship equal to that now attained by only five or six out of every one hundred, and a large proportion of the cases of discipline, the "dead weights," the reëxaminations, and the failures from inability, distaste, or want of preparatory knowledge, will forever disappear from the records of the Academy.

These suggestions have not the merit of originality nor the objections of novelty. The principle recommended has stood the test of seventy years' trial in France in naval and similar public schools, and is now in successful operation in England, as well as in most of the military schools of Europe. It has been again and again urged by thoughtful friends of this institution and of our other national school at West Point, as the most effectual remedy for the evils complained of. The Academic Board of this Academy, in answer to a request from a committee in 1858 for its opinion on this point, replied:—"The Academic Board has long been of the opinion that the present system of appointing midshipmen without care in their selection, was undermining the very existence of the institution. The records of the Academy show that scarcely more than one-fourth of those admitted graduate. The fault lies with the appointing power, which has not kept the institution supplied with the proper material, and the Board has been powerless in applying a remedy. It has done all in its power by recommending a higher standard of proficiency." The Visitors for 1862, in the Report of their examinations, remark:—"After a careful examination of the subject, the Board has been forced to the conclusion that the selection of candidates has not been made with sufficient reference to the wants of the public service, but has been and continues to be regarded as a portion of the patronage of the members of Congress making the nominations. The evil does not stop here; for in many cases, after they have been appointed without regard to talents or fitness, and have obtained admission to the institution, and subsequently have been found incapable to pursue the studies of the class to which they belong, the influence of the same member of Congress originally nominating them is successfully used to continue them at the institution, in obtaining authority for them to recommence their studies by joining a lower class; thus retaining

those wanting in talents and fitness, to the exclusion of others of suitable qualifications that might be presented. An institution like this, in which the students are educated and supported by the government, ought to have them selected from the highest and most promising youths of the country."*

The same general principle, selection by merit, ascertained by the same general method, competitive examination, conducted on such conditions as Congress shall authorize or prescribe, has been recommended for appointments to the kindred national institution—the Military Academy at West Point—with the view of removing the same hindrances and remedying the same defects in the practical working of that school. That eminent military teacher and administrator, General Thayer, under whom the Academy, notwithstanding many hindrances and defects, attained its highest development, recommended the adoption of this principle at the outset of his administration, after having seen its successful operation in the military schools of France; and he has recently, after the lapse of nearly fifty years, all of them spent in actual experience or observation of the practical results of a different principle, renewed the recommendation in a communication to the Secretary of War. He has, within the present year, declared his belief that the adoption at the start, and the continuous recognition of this principle, the selection of candidates for admission on the ground of personal merit and aptitude for the special purposes of the institution, in appointments to the Military Academy, would have more than doubled its usefulness, would have avoided most of the difficulties of administration which it has encountered, would have prevented the popular prejudices which demagogues and disappointed parents and Congressmen have fostered, and would have gained for it a larger measure of the popular favor.

The Visitors of the Military Academy for 1863, in their Report

* An early friend of this institution, on learning the fact stated in the same Report of 1862, from which the above extract is taken, "that in the course of six years one hundred and twenty-four students were turned back to pursue a second time portions of the academic course," and of this number only six passed the final examination, (thereby costing the country over $300,000 in pay, salaries, and equipment, for absolutely nothing, and at the same time depriving the naval service of an equal number of competent young officers,) writes to a member of this Board as follows:—"I have had the curiosity to question fifty middies, as I happened to meet with them, without selection, and representing different classes in the institution and different States, as to the circumstances of their appointment—and of these fifty, forty were the near relations or sons of political friends of the parties making the nominations, and five were the sons of persons in official stations at Washington, although appointed 'at large,' leaving but five for selection from other sources. In several cases the answers were significant—'My father had to bleed freely for my appointment.' 'My brother worked hard for his election.' 'I had the promise of a cadetship at West Point, but as there was no vacancy that year, I got an appointment here.' 'I am an exchange. Senator ——— got an appointment for Mr. C.'s nephew, and Mr. C. nominated Senator ——— friend's son for the place.' "—[*Ed. of Amer. Journal of Education.*]

to the Secretary of War, go into an extended discussion of the advantages and objections to this principle and mode of making appointments. To this document reference is made as embodying the convictions of this Board as to the probable working of the same principle in admissions to the Naval Academy.

III. In connection with a change in the mode of appointment, the Visitors would commend to the consideration of the Department a revision of the conditions as to the age, bodily vigor, and general knowledge of candidates. The old sytem of training naval officers, by placing boys at the early age of twelve or fourteen years on shipboard in the daily and constant practice of the routine of the ship, when accompanied with the parental oversight of the captain as to conduct, and with regular and progressive instruction in the science and art of his profession, on ship and shore, by the teacher of mathematics and navigation—has produced many capable commanders, out of the larger number who have been ruined for the want of proper supervision and instruction, or grown up into men of mere routine. Some of the brightest names in the records of our own and of the English naval service had no other education or training than this. But these are the exceptions, and their success was as much due to opportunity and original genius, as to their early and continuous ship experience. That system of training officers is, however, everywhere abandoned, and the present aim of every naval power in the world is to seek out young men having a fondness for sea-life, with a generous ambition for naval distinction, with an aptitude for the sciences which qualify and adorn the naval officer, with vigor of body to bear the inevitable exposures of the service, and with a large amount of general knowledge, and then subject them to a special course of professional study and practice in a naval school. For every stage of promotion, additional knowledge as well as professional experience, tested by successive rigid examinations, are required. The experience of this class of schools indicates that those original qualities and acquired qualifications deemed indispensable in candidates for the proper mastery of a thorough course of naval instruction, can not often be found in young men under eighteen years of age.

IV. With an advance in the average age, maturity of mind, and preparatory attainments of the cadets on admission, the Visitors believe a revision and readjustment of the subjects and course of instruction can be advantageously made, which in connection with the new schools of naval construction, and of marine engineering, would greatly extend the range, depth, and practical value of the education of the naval officer, without prolonging the time now

devoted to its acquisition. If the Academy can be relieved of the large amount of merely elementary general education which every graduate of the common schools of the country ought to have received, and which in a few years every aspirant to the privileges of this school would contrive to get, if the law made its acquisition necessary as a preliminary to a competitive examination—then the whole general scientific course could be mastered in two years, with a large amount of military and naval tactics, as well as of practical seamanship in the two summer cruises. At this point the Visitors recommend to the consideration of the Department the establishment of the following departments, or schools, in each of which the course of instruction shall be far more comprehensive and thorough than is now practicable where the branches constitute parts of a single course:—

First.—Of Navigation and Seamanship.

Second.—Of Naval Ordnance and Practical Gunnery.

Third.—Of Hydrography, Marine Surveying, Astronomical Observations, Construction of Charts, &c.

Fourth.—Of Drawing, Naval Designs, Construction of Ships, Naval Machinery, Docks, &c.

Fifth.—Of Steam and Marine Engineering.

Sixth.—Of Naval History and Strategy, International Law—especially of belligerents and neutrals—and the Law of the Sea, Consular Duties, &c.

Seventh.—Of Modern Languages.

Into each of these schools let the cadets be drafted, the choice to be determined by their own predilection or comparative fitness, at the close of the second year, and after completing such number of these courses, not less than four, as may be prescribed, let them have the privilege of an examination.

Each of these departments or schools might be opened to a certain number of candidates, on competitive examination, from each State—no matter where they may have received their education—and permission might be given to officers of any rank to review and extend their knowledge of either of these departments with the more advanced text-books and means of instruction. By this arrangement the service will secure the highest development of any special aptitude, preparation, or experience—and will more frequently get "the right man in the right place."

The importance of these great departments of the naval service, and of special preparation for them, is fully appreciated by the Academic Board, but any attempt to give this preparation to all the members of the present classes, with such unequal and deficient preparatory

knowledge and with such diverse aptitudes for particular branches, would be futile. The attempt to teach as much as is now done, under the circumstances, only produces confused and unsatisfactory results with a large portion of the class. The remedy for this state of things seems to the Visitors to be in:—

1. More thorough preparation, higher average ability, and greater maturity of mind on the part of the cadets.

2. A thorough scientific course up to a certain point, for all the cadets, to occupy two years.

3. The requiring of linguistic training (in one or more modern languages,) only of those who show some aptitude or previous preparation for the same.

4. An option of two or three of the above courses, and a thorough proficiency in those selected before being permitted to pass as midshipman.

5. And finally continuation of study as well as of practice after graduation in the directions for which there is a demonstrated fitness and ability.

V. The Visitors deem it desirable to concentrate in and around the Naval Academy the largest amount and the highest quality of teaching ability, naval experience, and the apparatus and opportunities of practice of every kind connected with the naval service. But they would also commend to the consideration of the Department the encouragement of Naval Institutes, or temporary courses of instruction, at suitable seasons of the year, in some of the great departments of naval education specified in the foregoing classification—for the benefit of officers on furlough, or connected with the National Dockyards and Depositories, especially those in the neighborhood of large collegiate institutions, on the request of a certain number of such officers. Private naval architects and shipmasters might also be invited to attend these Institutes. Something of this kind should be provided, especially if continued study and examination is required by law and regulation at every stage of promotion in the naval service.

VI. The absence of elementary naval schools and of any regular instruction in navigation, the want of nationality and the low condition of the seaman-class generally, prevents any considerable demonstration or recognition of that nautical taste and aptitude for sea-life in the great mass of the population, which ought to be the basis of all special nautical training. To remedy this state of things, to develope and cultivate, where it exists, a desire for a maritime career, to provide at once a supply of intelligent, hardy, and well-trained seamen, mates, and masters, for the national as

well as for the commercial marine, in time of peace as well as in the emergencies of a sudden or a great war, the Visitors recommend the inauguration, under the auspices of the Naval Department, of a system of navigation schools and naval instruction, in addition to and in connection with our present system of naval apprenticeship, commensurate with the demands of the service, the country, and the age. As the basis of this system, they recommend the immediate offer of pecuniary aid to encourage the establishment of a class of navigation schools in all the large seaports of the country, subject to thorough national inspection in order to secure uniformity and efficiency. They do not deem it necessary to consider here the organization, management, and instruction of this class of schools, farther than to present the outline of a system.

1. The schools which they contemplate, are not to be government schools—although they will be aided and inspected by the Naval Department. Their original establishment, buildings, material, equipment, and immediate management will belong to the local Board of Trade or Commerce representing the shipping and commercial interests of the communities in which they are located. Through such Board, the State or municipal authorities, or individuals, can extend pecuniary aid for the original outfit or annual support.

2. The objects aimed at in the internal constitution of the schools and classes, will be thorough instruction in navigation, seamanship, and kindred branches through:—*First*—Evening classes for adults, (seamen, mates, or masters,) who can not attend regularly on account of absence from port or engagements by day, in which the instruction will necessarily be elementary and fragmentary; *Second*—A junior department or division, in which instruction in arithmetic, drawing, commercial geography, and statistics, will be given, as well as in navigation, the use of instruments, calculation of observations, keeping a log-book, journal, &c; *Third*—A senior department, in which a thorough course of mathematics, navigation, nautical astronomy, steam and steam navigation, &c., will be given, with facilities for acquiring one or more of the languages of the nations with which we have large commercial dealings.

3. The extension of any government aid should be based on the condition that suitable buildings and material equipment are furnished and kept in repair and working order by the local Board, or committee of the same, charged with the immediate management of the school; and such aid shall be subject to reduction and withdrawal for the succeeding year on the recommendation of the Department inspectors. For the first year the only condition should be the actual payment, from other sources, of an equal amount for

the annual expense of the school, subject to the disposal of the local Board. For the second and subsequent years, the sum paid by the government shall be appropriated in portions; *First*—a specific sum to the principal teacher and assistants according to the grade of certificated qualification each may hold; *Second*—a specific sum to the managers of each school for the annual expense of the same, according the average daily or evening attendance of the whole number enrolled in each class or division for a specified period of time in each year; *Third*—a specific sum to the managers of each school according to the number of pupils who shall complete certain specified courses of study to the satisfaction of the inspectors upon examination by them; *Fourth*—a specified sum in prizes, in the form of chronometers, sextants, text-books in navigation, &c., to be competed for by all the pupils of each division of a school; *Fifth*—a specified sum in aid of such professional experience as can be secured for the younger members of the school, as is now given to naval apprentices. All payments by the government should be so made as to secure and reward the services of able and faithful teachers, the regular, punctual, and prolonged attendance of pupils to the completion of each course which they enter, and the liberal coöperation of the local municipal authorities and the commercial and shipping portions of the community in which the school is located. Without such coöperation the whole plan will fail. The school need not be free—but let the instruction be good, practical, and cheap, and its possessor be sure of a lucrative employment, and then there will be a demand for it.

And why should not the national government enter upon this or a better devised system of training its own seamen, and advancing its naval and commercial interests? All maritime nations, either directly and exclusively by the central government, or through local boards of trade and commerce, have aimed to protect the lives and property of citizens engaged in commerce and navigation, by providing not only for the erection of light houses, buoys, and other material safeguards, but also by an adequate supply of competent pilots and mariners, duly trained and commissioned. Our own government has recognized its duty in all these respects, and in the recent enormous expansion and peculiar risks of the steam-marine, has established a system of inspection which is intended to reach every engine used for the propulsion of every vessel of any class in all waters subject to national law. Surely the same policy which permits and justifies this interference of the national arm and the application of the national resources to build light-houses, erect buoys, register the names, tonnage, and ownership of vessels;

which commissions pilots, inspects steam-boilers, surveys harbors, makes observations of the stars, the currents of the ocean and the prevalent directions of the winds in different seasons and latitudes; constructs and circulates maps and charts, and does all these things for the protection of commerce and for the use of the navy, will, in behalf of the same great interests, when satisfied that they are jeopardized by present neglect, see and be assured that the masters, mates, and seamen, who have all the precious lives and enormous properties embarked in commerce in their keeping, are properly trained in the science and art of navigation.

The liberal educational policy of the national government which has set apart over one hundred millions of acres of the national domain for educational purposes, which if the right of inspection into its application had been asserted and exercised, would have amounted ere this time to a permanent fund of over five hundred millions of dollars—and which has more recently appropriated over six hundred thousand acres of public land for the establishment of agricultural and scientific schools;—the similar policy of the State governments, that holds all property subject to taxation for the support of schools, and that authorizes the most munificent appropriations for free public schools in all of the large cities, which are also the great seaports of the country—all justify the belief that a system of education for this large class of the community, once fairly entered upon by the national government, will be cheerfully and liberally responded to and sustained.

In England the same necessity which exists in this country—the reluctance of young people in good circumstances, to enter the maritime service—the low state of the professional as well as general education of her seaman-class—the enormous amount of property and the large number of lives directly interested in commerce and navigation—the reliance for properly manning the national vessels in the sudden emergency of war, on the commercial marine—the representative character which mariners bear, of the religion, manners, and civilization generally of the country, to all nations which they visit—the desire for the elevation of this large class of the population in intelligence, morality, and physical well-being, for its own sake as well as for the happiness, safety, and glory of the whole country—has prompted the government to organize a system of nautical education, not only for officers, gunners, architects, shipwrights, engineers, seamen, and boys employed directly in the national service, but for the masters, mates, sailors, and boys in her large commercial marine. Prior to 1853, the whole reliance of that country for the professional education of masters and mates was their reg-

istration after an examination in the mere mechanical knowledge of navigation and seamanship. To obtain this knowledge, reliance was placed on the economic law of supply and demand, and in this case as in others of an intellectual and moral nature, the least demand was made by those in the greatest want. Only here and there, in the great seaport towns, individuals poorly qualified in most instances, opened schools and classes of navigation, in which instruction of the most elementary and mechanical character was given without system, to a very small number, and without supervision or responsibility. In 1853, after the great International Exhibition had demonstrated the superiority of France and other continental nations, in the scientific as well as artistic training of their industrial classes, the English Government constituted a Department of Art and Science to administer a large appropriation (amounting annually to nearly a half-million of dollars) so as to extend encouragement to local institutions of practical science scattered in all the principal centers of population, and acting in every department of industry, all subject to the visits of government inspectors. To this Department of Science and Art was assigned the extension of pecuniary encouragement to, and the inspection of a class of schools which had been instituted by the Mercantile Marine Department of the (governmental) Board of Trade, in connection with local boards of commerce and trade, for the benefit of the navigation interests of the country. These schools in 1863 had increased to eighteen—each in an important seaport—each under the management of a local committee—each having a fair attendance of boys, seamen, mates, and masters, who all paid small fees. The system is still in its infancy, but continues to enjoy the confidence of the government and of the large commercial houses.

Nor is this system of governmental aid and inspection of marine and navigation schools, confined to England. In all the continental states in which the commerce is large enough to require the aid of government in any form for its protection, as well as for the indirect advantage of the navy, this class of schools exists—and in some the national policy in this respect is most comprehensive and thorough. In France, the government in its gigantic efforts within the last twenty-five years to establish a navy which in the number, design, construction, and armament of its vessels, in the scientific and professional knowledge of the officers, and the practical intelligence of her seaman, should be equal to that of any other nation—has included the whole commercial marine in its operations. Encouragement is given to private shipyards, architects, and founderies; and the system of maritime "inscription" or enrollment is

so thorough that there is not a master nor an engineer in the commercial service who has not served at least two years in the national dockyards, founderies, or ships, and enjoyed opportunities of professional study, as well as practice, of the most scientific character.

VII. To give unity, stability, thoroughness, and general efficiency to the inspection and operations of the large system of naval education contemplated in the foregoing suggestions, the Visitors recommend the appointment of a Council or Board of Naval Education, in the constitution of which the great features of such a system should be represented, viz.:—(1.) Experience and success in naval command. (2.) Experience in large commercial and maritime affairs. (3.) Success in naval construction. (4.) Success in the instruction and discipline of educational institutions. (5.) A new infusion every year of the popular element, by the appointment from year to year of one or more public-spirited citizens from different sections of the country to attend the local examinations of applicants for admission, and the annual examinations of the several institutions.

To this Board should be assigned the duty of (1.) Frequent personal inspection and examination at other than stated periods. (2.) The thorough examination by themselves, and in connection with the professors, of the several classes in their daily recitations. (3.) The examination by themselves, or by competent experts, of all candidates for admission, of which as far as practicable, the written answers of the candidates should be preserved, and a written report in detail should be filed away for reference.

The language used in the law under which the present Board of Visitors are appointed—"for the purpose of *witnessing* the examination of the several classes"—if taken literally, would certainly justify the practice adopted by this, and as far as they can learn, by previous Boards. At all events, the constitution of this and previous Boards, composed as it is of members a majority of whom have had no experience in school examinations—who have had no acquaintance with this institution before their present appointment—and who are together for but a short period of time, is very inadequate for any purpose of thorough personal examination. They must be satisfied in the main to receive statements on trust, and to receive and communicate only general impressions. All the duties devolving upon the Board of Visitors as at present organized, could be far more efficiently and successfully performed in connection with the other duties of the Council of Naval Education, here suggested.

VIII. With a programme of studies so extensive as that now laid

down or as herein proposed, in which each study is, or should be arranged with reference to what has gone before, as well as to what is to follow, the professor of each department and the teacher of each branch and section, should be kept closely to his portion, each cadet should master thoroughly every step in the succession, no professor should encroach upon the time of another, no teacher should be allowed to pass his pupils indifferently prepared into the succeeding section or branch. Even if no change be made in the present programme this course is essential to the success of the school, and to secure this an Inspector of Studies should be appointed, who should report frequently to the Academic Board all and every infraction of the programme, so that it may be ascertained whether the cause of failure be in the programme, or the class, or the teacher; and the remedy at once applied. Both the special and general duties of the Commandant preclude the constant and minute inspection referred to, and to the professor of no one department can these duties be properly assigned. While there is a superior executive officer who has in charge the external administration of the affairs of the Academy, there is no corresponding officer, as in the opinion of the Visitors there should be, to preside over the vital matters of instruction and training.

IX. The appointment of professors and assistants is a subject from its importance at all times, and from its immediate bearing upon the welfare of the school, deserving of mature consideration. The efficiency and thoroughness of instruction, the spirit of diligent study and the enthusiastic love of it among the midshipmen, depend to a great degree, upon the fitness of the instructor for his post and the method and manner of teaching which he employs. Though there may be some reason for limiting their appointment to the graduates of the Academy, yet the present course of instruction has by no means in view the training of future teachers, nor has it yet reached its full development. The success and advancement of the institution would seem to require the employment of the best educational talent, and none other, to be obtained wherever it can be found. Whenever any vacancy is to be filled, or new appointments to be made, the Visitors recommend that due notice of the same be given, and that the credentials of all applicants be referred to a competent board, and the applicants themselves whose credentials are satisfactory, be subjected to an open, competitive examination.

X. In conclusion, the Visitors recommend that greater publicity be given to all the documents which set forth the object

and operations of the Naval Academy, the mode and conditions of nominating midshipmen, the name of the person responsible for a nomination, the requisitions and results of each entrance as well as of all annual examinations, with specimens of the questions asked and answers given, so far as the same were written or printed. They would respectfully urge that the Official Register of the Academy, with the above and other information deemed necessary by the Department, be sent not only to every member of Congress, but to the libraries of all principal High Schools, public and private, and all institutions where candidates are prepared, that both teachers and pupils may know what the Department requires as preliminary to the special professional training provided in this Academy for any branch of the naval service of the country, and especially how deplorably deficient a large proportion of the candidates are found to be, on only a moderately strict but impartial examination. To this Register might be appended the official report of the Bureau charged with its supervision, or of any Board of Visitors, or Special Examiners, appointed by the Department.

With the best permanent accommodations and equipment of the Academy that can be made at Annapolis or elsewhere—with schools or courses of scientific and practical instruction for every branch of the service, and for every stage of promotion—with a teaching staff so numerous and so diversified as to secure the advantage of special attainment and qualifications to each branch of study—with entire control of the pupil's time—with hospital accommodations and medical services for the sick—with chaplains for religious observances and the moral culture of all—with regular alternations of physical exercise and intellectual labor, and the stimulus of an honorable distinction before and after graduation—the Visitors think it not unreasonable to expect from an institution so provided for, the highest results, especially as the government has it in its power to select for admission, without regard to the social or political status of parents, from among the entire youth of the country, those who are best fitted by their physical and mental endowment and preliminary education, as well as by their aptitude for special studies and predilection for the naval service, for which those studies are a preparation.

All which is respectfully submitted.

JOHN MARSTON, *Commodore U. S. Navy, President.*

JAMES A. HAMILTON, *New York.* G. D. A. PARKS, *Illinois.*

JOHN RODGERS, *Commodore U. S. Navy.* C. W. PICKERING, *Capt. U. S. Navy.*

CHARLES D. ROBINSON, *Wisconsin.* JOHN W. HARRIS, *Missouri.*

HENRY BARNARD, *Connecticut.*

The aggregate expense of the Military Academy at West Point, and the Naval Academy at Annapolis, to the country, is not represented by the specific sums which appear in the annual appropriation for the military and naval service, but is increased by the large sums paid to officers and men who are detailed to these posts for police, instructional, and other purposes of these institutions. The cost to the government of each cadet from his admission to his graduation in either Academy, exceeds $10,000.

NAVAL CONSTRUCTION AND ENGINEERING.

Under authority of an Act of Congress (July 4, 1864), the Secretary of the Navy, in 1865, made provision at Annapolis for a course course of instruction for a class of Assistant-Engineers, composed of persons admitted on competitive examination, many of whom had secured a preliminary scientific training, and all of whom gave evidence of aptitude for such occupation and of having had experience in the fabrication of steam machinery. There was every indication of a special school for this department of the naval service, when the enterprise was suspended; but to be revived under the following Regulations, issued by Secretary Robeson, April 4, 1871:

REGULATIONS FOR THE APPOINTMENT OF CADET ENGINEERS.

I. In pursuance of the third and fourth sections of an act passed at the first session of the 38th Congress, approved July 4, 1864, "*To authorize the Secretary of the Navy to provide for the education of Naval Constructors and Engineers, and for other purposes,*" and of the second section of an act passed at the first session of the 39th Congress, approved March 2, 1867, entitled, "*An Act to amend certain acts in relation to the Navy,*" applications will be received by the Navy Department for the appointment of Cadet Engineers.

II. The application is to be addressed to the Secretary of the Navy, and can be made by the candidate, or by any person for him, and his name will be placed on the register. The registry of a name gives no assurance of an appointment, and no preference will be given in the selection to priority of application.

III. The number of Cadet Engineers is limited by law to fifty. The candidate must be not less than eighteen nor more than twenty-two years of age; he will be required to certify *on honor* to his precise age, to the Academic Board, previous to his examination, and no one will be examined who is over or under the prescribed age. His application must be accompanied by satisfactory evidence of moral character and health, with information regarding date of birth and educational advantages hitherto enjoyed. Candidates who receive permission will present themselves to the Superintendent of the Naval Academy between the 15th and 25th of September for examination as to their qualifications.

IV. The course of study will comprise two academic years. All Cadets who graduate will be warranted as Assistant Engineers in the Navy. The pay of a Cadet Engineer is the same as that of a Cadet Midshipman.

V. The academic examination previous to appointment will be on the following subjects, namely: *Arithmetic:* the candidate will be examined in numeration and the addition, subtraction, multiplication, and division of whole numbers, and of vulgar and decimal fractions; in reduction; in proportion or rule of three, direct and inverse; extraction of square and cube roots. In *Algebra,* (Bourdon's,) through equations of the first degree. In *Geometry,* (Davies' Legendre,) through the plane figures. *Rudimentary Natural Philosophy. Reading:* he must read clearly and intelligibly from any English narrative work, as, for example, Bancroft's History of the United States. In *Writing* and *Spelling:* he must write from dictation, in a legible hand, and spell with correctness, both orally and in writing. In English *Grammar* and English *Composition* he will be examined as to the parts of speech, the rules connected therewith, and the elementary construction of sentences, and will be required to write such original paragraphs as will show that he has a proper knowledge of the subject. The candidate will also be required to exhibit a fair degree of proficiency in pencil-sketching, and to produce satisfactory evidence of mechanical aptitude. Can-

didates who possess greatest skill and experience in the practical knowledge of machinery, other qualifications being equal, shall have precedence for admission.

VI. Any of the following conditions will be sufficient to reject a candidate.

Feeble constitution, permanently impaired general health, decided cachexia, all chronic diseases or injuries that permanently impair efficiency, viz:

1. Infectious disorders.
2. Weak or disordered intellect.
3. Unnatural curvature of spine.
4. Epilepsy, or other convulsion, within five years.
5. Chronic impaired vision, or chronic disease of the organs of vision.
6. Great permanent hardness of hearing, or chronic disease of the ears.
7. Loss or decay of teeth to such an extent as to interfere with digestion and impair health.
8. Impediment of speech to such an extent as to impair efficiency in the performance of duty.
9. Decided indications of liability to pulmonary disease.
10. Permanent inefficiency of either of the extremities.
11. Hernia.
12. Incurable sarcocele, hydrocele, fistula, stricture, or hæmorrhoids.
13. Large varicose veins of lower limbs. Chronic ulcers.
14. Attention will also be paid to the stature of the candidate, and no one *manifestly* undersized for his age will be received into the Academy. In case of doubt about the physical condition of the candidate any marked deviation from the usual standard of height will add materially to the consideration for rejection.
15. The Board will exercise a proper discretion in the application of the above conditions to each case, rejecting no candidate who is likely to be efficient in the service, and admitting no one who is likely to prove physically inefficient.

VII. If both these examinations result favorably, the candidate will receive an appointment as a Cadet Engineer, become an inmate of the Academy, and will be allowed his actual and necessary traveling expenses from his residence to the Naval Academy, and be required to sign articles by which he will bind himself to serve in the United States Navy six years, (including his term of probation at the Naval Academy,) unless sooner discharged. If, on the contrary, he shall not pass both of these examinations, he will receive neither an appointment nor his traveling expenses, nor can he have the privilege of another examination for admission *to the same class* unless recommended by the Board.

VIII. When candidates shall have passed the required examinations, and been admitted as members of the Academy, they must immediately furnish themselves with the following articles, viz:

One navy-blue uniform suit,
One fatigue suit,
One navy-blue uniform cap,
One uniform overcoat,
Ten pairs of white pants,
Four white vests,
Six white shirts,
Six pairs of socks,
Four pairs of drawers,
Six pocket handkerchiefs,
One black silk handk'f or stock,
One mattress,
One pillow,
One pair of blankets,
One bed cover or spread,
Two pairs of sheets,
Four pillow cases,
Six towels,
Two pairs of shoes or boots,
One hair-brush,
One tooth-brush,
One clothes-brush,
One coarse comb for the hair,
One fine comb for the hair,
One tumbler or mug, and
One thread and needle case.

Room-mates will jointly procure, for their common use, one looking-glass, one wash-basin, one water-pail, one slop-bucket, and one broom. These articles may be obtained from the store-keeper of good quality and at fair prices.

IX. Each Cadet Engineer must, on admission, deposit with the paymaster the sum of seventy-five dollars, for which he will be credited on the books of that officer, to be expended by direction of the Superintendent for the purchase of text-books and other authorized articles besides those above enumerated.

X. While at the Academy the Cadets will be examined, from time to time, according to the regulations prescribed by the Navy Department; and if found deficient at any examination, or dismissed for misconduct, they cannot, by law, be continued in the Academy or Naval service, except upon recommendation of the Academic Board.

XI. A Cadet Engineer who voluntarily resigns his appointment will be required to refund the amount paid him for traveling expenses.

INSTRUCTION, TRAINING AND PROMOTION OF SEAMEN.

INTRODUCTION.

UNDER the constitutional powers "to regulate commerce with foreign nations and among the several States," and "to provide and maintain a navy," Congress, it is believed, can do more than is now done to provide both the military and commercial marine with intelligent, hardy and skillful sailors, as well as mates and captains, and to elevate the position of the whole seamen class.

The frightful accidents from explosions caused by badly constructed, or worn out steam-boilers, led to a system of national inspection which has done something to diminish the loss of life and property from this source, in vessels engaged in commerce on the ocean or our inland waters—but a system of instruction, examination, and promotion, under national authority, with national aid and the cöoperation of the mercantile community, of all persons intrusted with the command and navigation of all vessels, registered as national shipping, would put an end to all that class of disasters to life and property which is now attributable *to ignorance and want of experience*—and which is regarded by underwriters as much the largest portion of all marine disasters.

The necessity of doing something led to the establishment of the naval apprentice system, under the Act of March 2, 1837.

The original trial was not inaugurated under favorable conditions, and was prematurely abandoned, under the economical action of Congress which compelled the department to elect between men and boys for its arduous service. In 1864 the system was revived by Secretary Welles, a vessel was placed under the command of a competent officer, and a promising class of boys, after a preliminary examination were enlisted, and the work of their instruction was begun by training them in all the details of a sailor's duty at sea. The Secretary in his Report for 1866, expressed himself hopeful of the results—but urged Congress to further legislation, to make the system attractive, by holding out to the most deserving members of the class, appointments to the Naval Academy, and a retiring pension after twenty years' service. His suggestions were not heeded, and under the limitations of the Act of 1866 the trial failed.

Commodore Jenkins, Chief of the Bureau of Navigation, having cognizance of Naval Apprentices, in his Report for 1866, remarks:

A judicious naval apprentice system will secure to the navy every year, after the first enlisted boys are thoroughly trained and educated, a sufficient number of well-disciplined and better instructed seamen to give tone and character to the crews of our vessels of war than heretofore, and if the enlistments were unlimited it would require only a few years to provide all the seamen necessary for a formidable naval peace establishment.

But it is not the navy alone that is or ought to be greatly interested in the success of the naval apprentice system. Every ship-owner and shipper in the country will be directly or indirectly benefited as well as the navy. Many of the apprentices will, at the expiration of their apprenticeship, seek service on board of merchant vessels, where the advantages of their previous training and education will be felt.

If there were training-ships in every port of the United States for apprentices to the sea service, and the apprentices, after being taught the rudiments of an English education and all the seamanship that could be taught on board of a vessel in port, were sent on long sea voyages, the seamen of the country would soon become more elevated in character than they are at present, and ship-owners would realize the importance of cherishing and protecting a valuable class of our countrymen who are now left to the tender mercies of hard-hearted landlords, crimps, and runners.

It is a great mistake to suppose that steam vessels can be managed well by landsmen at sea. The terrible shipwrecks, loss of numbers of individuals, and of millions of dollars' worth of property annually on the ocean, is in the main attributable to bad management, ignorance, and want of experience of those in charge of the vessels. It is as necessary that sea steamers should be officered and manned by expert seamen as it was in former times for clipper and other sailing vessels. A good knowledge of seamanship is only to be acquired by a long apprenticeship; nor does the ability to navigate a vessel from one port to another make a man a seaman. There is no vocation, profession, or calling which requires a more varied knowledge and a greater experience than that of an expert seaman. It is not sufficient that he should know how to knot and splice a rope, to reef and furl a sail, to take his trick at the helm, or to give correct soundings in heaving the lead. He must be a good judge of the appearances of the weather, know how to lay his vessel to and under what canvas for safety, on what tack to put his vessel to avoid the strength of the approaching gale or hurricane, when to run and when to lie to, and he must be fertile in resources to save his vessel in case of danger or disaster at sea. The expert seaman is a man full of resources, and ever ready to turn his knowledge and experience to good account; but such is not the estimate of him by those who only know him as an outcast of society, without friends and without influence.

As education and careful training elevate those who are engaged in the different pursuits on shore, the same means, if judiciously employed, will elevate and make useful and respectable in their sphere that much neglected and greatly oppressed class of our fellow-citizens—the American sailor.

Navigation Schools for the Mercantile Marine.

Whatever may be the success of still another trial of the apprentice system to secure a supply of trained seamen for the Navy, the experience of all other countries is decidedly in favor of a liberal system of Navigation Schools, as well as an efficient system of registration, examination, and certificates of competency and of service, administered under national inspection and with pecuniary aid, and under the local management of merchants, ship-owners, and underwriters, for the commercial marine.

GENERAL REVIEW OF MILITARY EDUCATION.

I. NAVAL SCHOOLS AND EDUCATION.

We can not better introduce the conclusions to which this study of the subject has brought us, than by giving a few extracts from the many communications, which the recent agitation of naval education in England has elicited.

Proposed Improvements in Naval Education in England.

In 1869, the alternative was offered, on their own petition, to the 2,710 disabled seamen, who resided in the truly magnificent Hospital at Greenwich, on the Thames, which the national gratitude had set apart for their accommodation, when no longer able from wounds, age, or other infirmities to serve under "the meteor flag" of England—to continue there at the expense of the government, or draw their pensions and spend it in their own way, among their friends in their old homes, or wherever they fancied; only 31 elected to remain—and these were too feeble to leave, or had outlived their friends. The old Hospital infirmary, a large detached building, was granted by the Admiralty to the Seamen's Hospital Society for the benefit of the mercantile marine; but the bulk of that immense pile—which is covered in by seven acres of roof, and whose domes and colonnades were designed by Sir Christopher Wren, and erected at a cost, from first to last, of not less than a million sterling—full of historic associations as the birthplace of Queen Elizabeth, and the residence of two dynasties of English kings, and the greater Lord Protector Oliver Cromwell, and for two centuries the home of the British Navy—for nearly two years has stood vacant. The Times, in an editorial of September 13, 1871, renews a suggestion made at the time the system of out pensions was under discussion, to continue its use for the Navy.

It is almost two years since we hazarded the suggestion that it should be converted into a Naval University. We used the term "University" in the sense of a collective institution, embracing several separate Colleges adapted to a similar purpose. We pointed out how inadequate in extent and in range of education is the present Royal Naval College at Portsmouth, the only institution we possess for supplying to Naval Officers what is termed a "higher education." We also reminded our readers that the education of our Naval Cadets between the ages of 12 and 14 is now carried on in a School-ship, which, from the nature of things, must have many disadvantages in comparison with a building of ample space on the brink of a great river and on the border of a

Royal Park. We showed that there was already a great Charity-School in the rear of the Hospital, and supported by its funds, for the gratuitous education of 800 children of poor sailors; and we reckoned that the Hospital would still supply ample accommodation for a scheme, suggested to us on high authority, for furnishing at cost price to the children of seamen of all grades in the Navy and Commercial Marine, an education in English, French, the elements of science, and the ordinary rudiments of instruction.

In the year 1870 the Admiralty appointed a committee on "the Higher Education of Naval Officers," and directed them to consider whether it was desirable to limit the place of study to the College at Portsmouth, or whether the vacant buildings at Greenwich could be utilized for the purposes of education. The reported evidence of the Committee revealed a lamentable want of scientific knowledge in the naval profession. The witnesses were agreed in stating that few half-pay Officers had knowledge enough to study with advantage after the age of 30, and that few could, with advantage to the service and themselves, be spared to study before the age of 30. It was stated by the Mathematical Master that Commanders and Captains come to the College very badly prepared, and that "some come who are unable to work a decimal fraction." They come, as the College is now organized, exclusively for scientific study, in which Mathematics are a necessity, and yet are destitute of the most elementary preparation. Of course there are a few brilliant exceptions, but the scientific attainments of the profession as a body appear to be deplorably low.

In preparing a scheme for the improvement of what is so modestly termed "the higher education" of Naval Officers, the Committee proposed to add to the voluntary subjects of study a considerable number of practical pursuits. They proposed, under the advice of the late Chief Constructor of the Navy, to add both a short and a long course in Naval Architecture, in which there is at present absolutely no instruction given to Naval Officers. Such an education was supplied between the years 1806 and 1821, but since the latter year it has been altogether ignored and discouraged. It would require considerable space for the exhibition of models, and no sufficient room exists for it in the present College in Portsmouth Dockyard. The Committee proposed to furnish instruction, as now, in Steam, Mathematics, Nautical Astronomy, and Field Fortification, but to add facilities for the study of Languages, Chemistry, including Metallurgy, Geology, Mineralogy, and Naval Tactics. The want of a knowledge of languages in the British Navy was signally illustrated on a somewhat recent occasion, when the French iron-clad fleet visited Spithead, and upon our Admiral signalling for all officers who could speak French to come on board the Flagship, only one officer in the Channel Fleet was able to respond to the summons. The want of a scientific knowledge of the principles of naval architecture has prevented of late many skilled seamen of the Royal Navy from contributing useful and practicable suggestions to the discussions on our iron-clad ship-building. The Committee seem to have thought that it would not be practicable to make a year's study in the Naval College in peace time compulsory for every sub-lieutenant, though distinguished officers, like Admiral Sir Alexander Milne, gave evidence in favor of it. But, apart from this abundant source for supplying students, it was anticipated that an extension of the education would attract a large increase of scholars; and on general grounds, quite distinct from the accommodation, one-half of the Committee, including the Director of Naval Education, were strongly in favor of establishing the College at Greenwich. Fortified by this concurrence of authority, we recommend again to the consideration of the Government the scheme of a Naval University as the best mode of repeopling that ancient and now vacant Hospital.

This "leader" of the Times was followed in the issue for Sept. 20, by a communication from the eminent ship-builder E. J. Reed, who was for several years at the head of the Department of Naval Construction—with reasons for immediately widening and raising the education of naval officers of all classes.

The absence of everything like a comprehensive organization for imparting

to them the knowledge necessary in these days is truly deplorable, and is made the more so by the very fact that our officers are themselves well aware of the extreme defectiveness of their training in many branches of knowledge which would be most valuable to them, and exhibit the strongest desire to supplement that training by every available means. I have had many occasions of observing this during the last few years; not the least striking of them being the publication of my book on *Shipbuilding in Iron and Steel*, which, although a purely technical and professional book, was eagerly procured and studied by a very large number of naval officers, who, as you justly state, are now left absolutely without any official instruction in naval architecture. When in Russia this year I found elaborate means and appliances for instructing young officers in all the great features of practical shipbuilding, as well as in the general principles of naval design, and I had the opportunity of examining a large model of an iron-clad ship which was being constructed by these young naval officers; while the shipbuilding and engineering officers of the Russian service have one entire side of the vast building which accommodates the Admiralty branches, wholly devoted to their instruction. I have not yet seen the naval training schools of Germany, but I have had several opportunities of conferring on shipbuilding questions with the naval officers of that country, and I can state with perfect confidence that they possess a most intimate acquaintance with even the latest methods of naval design and construction, and obviously have had a careful training in the principles of naval architecture and the details of shipbuilding. How much this training contributes to the efficiency of naval commanders and other officers I need not say.

Mr. Reed dwells on the total absence of even an attempt to instruct naval officers of all ranks in the department of construction.

Even our warrant officers, the "carpenters" of the Navy, whose duty it is to keep our Navy in repair at sea, and to take instant measures for saving our ships from the effects of injuries sustained by collisions, groundings, or during action—even these officers are subjected to no special and organized training whatever, and are often put on board ship, in responsible charge of the repairing staff, without any knowledge whatever of the construction of their vessel.

I knew so well that the whole class of naval "carpenters" have for years been anxious to obtain a better training for their very responsible duty, that I made a vigorous effort to be allowed to organize a system by which every carpenter of the service should be carefully instructed in iron shipbuilding, and as carefully selected for particular ships on account of his fitness for the duty; but some tradition about warrant officers being "executive officers," and therefore not under the Chief Constructor of the Navy, and also, I fear, some jealousy of the patronage of such appointments passing into new hands, effectually barred my progress, and imposed conditions under which it was not possible to give effect to my wishes.

I do not think I shall go beyond the truth if I say that other warrant officers are as deficient of suitable training as carpenters. I have certainly known of more than one instance in which the machinery by which our great modern guns are worked at sea has been so imperfectly understood that the "breaks" which are intended to control them have been "greased;" and no doubt a war would develope sad consequences of the enforced ignorance of our gunners.

But let it not be supposed that I advocate the instruction of warrant officers alone in the principles and practice of shipbuilding; it is in my judgment pressingly desirable that the whole class of executive officers should be afforded a certain amount of training in these subjects, and a far ampler training than they now receive in many other subjects also. The Navy suffers very much, even in peace times, from the want of a more liberal training on the part of its officers, as they themselves well know; and I am thoroughly persuaded that in a time of war we shall have to make great sacrifices on account of our neglect in this respect. Many unwise things are done, and many unwise reports are written, because of the want of fuller scientific and technical information on the part of naval officers; and I do not hesitate to say that during my tenure of the Chief Constructorship serious evils arose in my own department from the outside pressure of the uninformed.

Mr. Reed would locate the Naval University at Greenwich.

Such a University must almost of a necessity be metropolitan. All the provincial Government Schools of Naval Architecture in this country have failed, and always must fail, because the metropolis alone can supply the necessary professors for class education chiefly of a scientific character; and the same is even more true of the present case. All the civil members of the late Admiralty Committee on the higher education of naval officers concurred in this view, none more strongly, I believe, than the present Director of Admiralty Education, Dr. Joseph Woolley, who is undoubtedly at once the most experienced and most enlightened authority alive as regards all questions of naval training. And there is this very strong further reason for making this University metropolitan—viz., that one of the most fruitful and valuable results to be anticipated from a more liberal and enlarged education of our naval officers is the release of the service from those thousand and one Old World prejudices which cramp the action and spirit of the service in these modern days, when other nations are bringing their most free and cultivated minds to bear upon naval warfare; and to found a University in a port where the present traditions and habits of thought of the service have the greatest force, would be to place a fatal stumbling block at the very threshold of the work; and if the metropolis is to be the home of the University there can not be a doubt about the superior eligibility of Greenwich. There the magnificent college already stands, with its empty halls, inviting the Government to devote them to some great national and naval object. It is within easy reach of London, professors and teachers; it is in the neighborhood of great shipbuilding and marine engine-making establishments, and also of Chatham Dockyard. It is on the banks of our noblest river, and on the verge of the open country, so that every form of healthful recreation would be available for the students. It also affords ample internal space for all those laboratories, model rooms, lecture rooms, and other apartments, which could only be secured on a sufficient scale at a seaport by a large outlay of money. And, above all, it affords the readiest, as well as the best, means of entering upon a much too long-neglected undertaking.

In the same issue (Sept. 20), the Times had a leader on the subject, from which we take a few paragraphs.

It is certainly discouraging for a nation which has hitherto held, and which means to keep, the first place in the world as a naval Power to find that in systematic training Russia and Germany are dangerously surpassing us. No doubt in the raw material of a navy we can compete fearlessly with any country on the face of the earth; our sailors can not be matched for enterprise, resolution, and discipline, nor can our captains, in spite of some late disasters, be out-sailed or out-manœuvred by any who sail under foreign flags. But we must not forget that war on the seas, like war on land, is year by year becoming more and more a scientific pursuit. Our magnificent iron-clad fleet, in which Mr. Reed feels justly a parental interest, is too precious a possession to be intrusted to men who do not know how to use so two-edged an instrument. But how should our naval officers know how to manage an iron-clad ship? They are taught nothing about the construction of these triumphs of modern science; they do not, as a rule, possess even the elementary knowledge which would enable them to commence the study of the subject.

Whether the unequaled advantages offered by Greenwich Hospital be turned to account or some more expensive method be adopted by a Government which pins its credit on economy, the necessity of providing for the education of naval officers can no longer be ignored. Not to speak of the absolute absurdity of sending iron-clads to sea in charge of officers who know no more of the construction of an iron-clad than they know of the latest improvements in cotton-spinning machinery, it is obvious that a system under which men whose business is to navigate costly vessels of war, are sent to their work without knowing even the elements of mathematics, must sooner or later result in a disastrous collapse. It may be a question whether such has not been the case already,—whether the recent mischances in the conduct at sea of some of our finest vessels may not be traceable to the imperfect education of the officers.

When other nations are giving their sailors scientific teaching, and when we are expending gigantic sums on the construction of a Navy which must be handled in accordance with scientific principles, it appears absurd, or worse, to allow the commanders and the officers of our iron-clads to go to sea without the slightest guarantee for their knowledge of the peculiar conditions under which one of our modern monster ships is to be managed. If an iron-clad happens, as we may presume, considering what has lately happened, is not impossible, to strike upon a rock or otherwise seriously to damage herself at a distance from home dockyards, the chances are that no one on board, from the captain down to the carpenter, will know how to repair the damage.

To the urgent demand for more scientific knowledge of naval construction, Admiral Henry J. Rouse interposes a plea for more seamanship, discipline, and education afloat. In the Times for Sept. 28, the bluff Admiral says, rather bluntly:

I was alive to the want of seamanship and to the neglect of a naval education from the moment a midshipman left his school and was appointed to a steamer: but I always flattered myself there was one redeeming point—namely—gunnery—in which the officers of the present day had a wonderful preëminence over the old school. How is the proposed college to ameliorate this state of things? Will it make the young officers engineers when on board ship? They are not allowed to interfere with the engineer, who is, in fact, the commanding officer. Will warrant officers, carpenters, and gunners, be educated there? And in answer to Mr. Reed relying upon the carpenter in the event of a ship grounding (not an uncommon occurrence), we look to the captain to lay out his anchors, lighten his ship and heave her off by purchase over purchase; we do not consult the carpenter. Mr. Reed says,—"The men who will have to design for our Navy will never be free to design the best ships which can be provided until an improved education of the whole naval service unbinds the hands of the *scientific servants* of the Admiralty."

Who are the scientific servants? Are the men who designed the iron-bound monsters at the expense of half a million each; which have every bad quality, which can neither sail, wear, nor stay better than a coal barge, and which roll and pitch like maniacs owing to the weight of their armor, and which are certain to founder if called upon to face a very heavy gale? Are the servants scientific who stow their ballast on empty cells, thereby preventing a ship righting herself if she heels over 33 deg. under canvas, and which makes her capsize keel uppermost, according to the simple law of gravitation which impels the vacuum to the surface? Was the servant scientific who reduced a ship's ballast 300 tons, and put a corresponding weight of iron on the upper works, boasting he had retained the same line of immersion without calculating the loss af stability, and did not the Admiralty listen to him like countrymen to a mountebank, and reward him with a grant of money?

If a Greenwich College could diminish the frightful excesses and expenditure in the last eight years in the building department, for which the House of Commons demanded an investigation, which was checkmated by sending a distinguished admiral to the Cape of Good Hope; if it could instruct the scientific servants in the mysteries of their vocation, and convert the simple landsmen in Charing-cross into naval oracles: if it could make young officers seamen by inspiration, then I should agree with Mr. Reed that a Greenwich College would be most desirable.

As for the junior officers nothing but a sailing ship can educate a seaman. If a midshipman loses the precious years from 14 to 17 in a steamer he will be too old and proud to learn his profession, and when later in life he is sent to take command of a prize ship under canvas in war time he will look very foolish in half a gale of wind.

If any man will take the trouble to think, he must be convinced that no ship of any size, no armor *clypei septemplicis*, no guns of 25 tons can compete with an iron-cased steam ram of about 1,200 tons, invulnerable, bomb-proof, which would put five feet of cold steel under a ship's water line going 14 miles per hour. We are now building gunboats to protect the coast. One of Mr. Drake's steam rams of about 300 tons, without a gun mounted, would destroy a dozen

of them. In the next naval action history will be repeated. Romans, Carthagenians, and again the *naves rostratæ, alias* the Steam Ram, will carry the day. It is wonderful that the Admiralty for the last twenty years have been building their hogs in armor to defy shot and shell, ignoring the terrible attack of this superior power. It is never too late to mend. To save enormous sums of money and a waste of coal we ought to pay off all our useless monsters, and during peace to commission small ships with auxiliary screws, never to burn a coal except in a case of necessity; and then, by keeping squadrons at sea, we might improve our discipline, our seamanship, and *esprit de corps.*

The letter of Admiral Rouse was accompanied by a leader in the Times of the same date from which we take a few paragraphs.

The spirit of an English sailor of the old school, with his bluff, outspoken, uncompromising detestation of change, and his unfaltering belief that all that has been was right, is something to wonder at and even admire, if we should not care to imitate it, in these days of perpetual motion. He has observed, as we all have, with shame and misgiving, that while the cost of our vast iron-clad vessels of war is growing yearly greater, the officers of the new generation who are to be intrusted with the handling of these expensive monsters are not comparable for practical skill and shiftiness with those of Admiral Rouse's contemporaries who dominated the seas in sailing frigates in the days before either steam or ship-armor was devised. In his perception of the defects of our present system the Admiral does not stand alone; it is condemned by the ablest officers who are now in command of our fleets, by the eminent engineers who construct them—unfortunately, with still more eloquent urgency by the voice of our recent naval annals. The misadventures of the Captain, the Psyche, and the Agincourt, not to mention less serious mishaps, have startled us all, and the seamanship of the British Navy has come to be gravely questioned.

Let us compare Admiral Rouse's remedy with Mr. Reed's.

The latter is dwelling on the custom of sending young boys to sea with necessarily imperfect training, and of promoting them to the higher grades, though in the meantime they have had no opportunities of scientific instruction. He asserts the consequence is that very few of the officers who command our costly iron-clads at the present day know any thing of the construction or the qualities of those gigantic boating masses. Admiral Rouse admits this fully, but he superadds a charge at least as serious; he alleges that few or none of our modern naval officers who spend the years of their apprenticeship to the sea on board a steamer, and who "worship the boiler whenever they are in a scrape," do know or can know any thing of real seamanship. Mr. Reed says that the study of the principles of shipbuilding is unknown among the officers of our Navy, and that accordingly, few of them can handle an iron-clad. Admiral Rouse says that the study of the winds and waves is neglected by them, and that not many of them can sail a frigate. Mr. Reed demands a Naval University to teach officers the theory of navigation as applied to the vast masses of iron now afloat under our flag. Admiral Rouse would get rid of these "useless monsters" altogether, would, during peace, commission small "ships with auxiliary screws," and "never burn a coal except in case of necessity." Here we have the ancient and the modern spirit in contrast and juxtaposition. The former, obstinate and often illogical, but with a certain rude and not unjustified faith in practice, deserves our respect, for it was this spirit which won us, in old times, our naval supremacy. The latter may be over-bold and presumptuously contemptuous of the past and all its belongings; but it is the spirit of progress, and on its guidance we have to depend for the maintenance of the renown we achieved in the earlier and darker time.

On the 20th of March, 1871, Capt. James G. Goodenough, R. N., read a paper before the Royal United Service Institute, on the Preliminary Education of Naval Officers, from which we make extracts.

I should be guilty of an absurd and forced indifference to what is passing around me if I were not to say that an impression now exists very generally in the service, that the views which finds most favor with regard to the train-

ing of the officers of Her Majesty's Navy is, that the naval officer should be taught young; that he should be made to devote himself to the details, and nothing but details of his profession from boyhood to youth, and from youth to middle age, and that somewhere behind middle age and old age, he should be deemed to be warrant, and be thrown away a pensioner on the country's gratitude, unfit even to have a voice in the guidance of the affairs of the service to which he may have been an ornament. This impression is doing much harm in all directions.

It is weakening the desire for knowledge and self-improvement in naval officers; it is tending to narrow and circumscribe the idea of responsibility of a naval commander for all things coming within his ken, and to lower his conception of his own position from that of a representative of his country in all parts of the world, an agent of her policy, and a guardian of her commerce, to that of being a mere executing tool, whose only argument is force.

The warning which I should give, and it contains the whole case, is this,—that while all other circumstances of life at sea have changed considerably in the last thirty years, the preliminary training of our officers has not changed in its main features. It is not merely that our material, whether in ships or guns, steamships or canvas, has changed. It is not only that our material has become far more complicated than of yore. If that alone were the case, the system of a former age might supplant the wants of the day. No! the change whose bearing we have failed to acknowledge, even though we may have perceived it, is this, that while formerly the conduct of ships at sea, their discipline, and the handling of their material generally, was based on the experience obtained in the practical individual lives from early years, and on an acquaintance with external phenomena and internal details, which were not reduced to laws or elevated into systems; now, we do possess rules and laws, which greatly reduce the value, if they do not quite supersede, the practical experience of a single life. In every one of the varied practical duties of a sea officer, this is the case, whether in navigation or in discipline, in artillery or in manœuvring; and I say that this constitutes the great change in a sea life to which we have made no corresponding advance. I say that although those laws and systems exist, we still continue to let the details which they include be painfully and only practically acquired by experience, instead of methodically teaching the principles on which they are based.

The principles on which I consider that that education should rest are these: *First*, that a distinction should be made between the period of education and that of special training. *Second*, that special training should be the business of the Government, while education should be left to the care of the parents, at the ordinary schools of the country. *Third*, that the handling of ships' sails and boats, and the principles of command should be methodically taught, instead of, as at present, being left to chance observations and the accidents of service. *Fourth*, that the young officers under training in schoolships should have no command, except over each other, and should count no sea time; and that on entering the service afloat in sea-going ships, they should become at once, in some measure, responsible officers, though liable to future examinations, and to produce evidence of having done work after leaving the training-ships. *Fifth*, that in order to discourage cramming, all entrance examinations should be confined, as far as possible, to the subject of study at advanced public schools, and that every candidate should be required to bring with him certificates of a year's good conduct from his last school.

I wish to see a distinction made between the education and the special training of naval officers. I do not pretend to give the precise age at which this distinction should be made. It will necessarily differ with different boys, and I would therefore have a two years' limit to the age of entry instead of one. My opinion is, that special training should begin at from 14 to 16, and that it should be continued from that age for three years; that is, from an average of 15 to an average of 18 in the college and sea-going training ships.

I should wish young officers to proceed thence to the ordinary service afloat, and after two years' service in a sea-going ship to be admitted to pass an examination for lieutenants.

The examination for entry, which under the system I propose, would be at the average age of 15, should take place in November of each year, and should

be arranged, as far as possible, so as to comprise subjects which do not require special cramming, but are taught generally in our public schools, omitting some, such as Greek, of which no further use or notice would be made in their future career, and substituting French, or another modern language in lieu.

The college would then open for the cadets on the 1st of February, and and while indoor studies of navigation, nautical astronomy and modern languages occupied the mornings, the afternoons should be devoted to practical seamanship until the first of May, when they should embark in a corvette, especially set apart for their instruction, until August.

During these four months they should perform every practical duty of their profession with their own hands, under instruction, with plenty of time, and with patient, steady instructors, and at the end of their cruise, after an inspection by the governor of the college, they should strip and clear their vessel before proceeding on a summer holiday.

During the cruise they should not only learn to take and work their own observations for the position of the ship by the ordinary known methods, but should also study the pilotage of the coast of England, whenever visited.

After the vacation they should again rig their vessel, and until the end of October should have instruction in rigging, masting, and so on, while the weather permitted, as well as continuing to exercise in boats. November and December being devoted to indoor studies and examination. This would complete the first year of training.

The second year would begin as the first, with indoor studies in the morning, the advanced seamanship class of the afternoon, alternating with gunnery instruction classes until May, when the second class would embark in a steam corvette, and in addition to the study of seamanship, as in the first year, would join that of steam machinery. While the cruise of the first year would have been on board a sailing corvette, and on the south coast of England generally, that of the second year should have been extended to the coasts of the United Kingdom and western coast of Europe; and while the sailing corvette should be manned by steady old seamen, and no attempt should be made at quickness of manœuvre, the steam corvette for the second year should be manned by active young trained able seamen, and all manœuvres should be performed together, as in actual practice in man-of-war, the young cadets under training working a mast.

At the end of this cruise, they would not only strip their vessel, but would also take to pieces the principal parts of the machinery, before the summer holidays and after inspection.

On recommencement of term in October, indoor studies should again be taken up, and the final examination for the rank of midshipmen should take place in December, the average age of the young officers being now 17 years.

I should now reassemble the midshipmen on February 1st, either on board the gunnery ships or in a special ship attached to the college, for a three months' course in practical gunnery, after being examined in which, they should be discharged into a full-rigged, full-manned frigate for final instruction in the duties of an officer, under selected captains, commanders, and lieutenants. They should here alternately take the duties of officers of tops, officers of boats, officers in charge of a particular mast, and in rotation as officers of the watch, under the care and guidance of a lieutenant of each watch, while lectures and exercise in manœuvres of ships and boats, of heavy and field guns, of small-arm drills and landing parties, should be systematically taught them. At the end of this cruise, which should extend to the Mediterranean, an examination in seamanship should take place, and the midshipmen would be discharged into the service afloat, at an average age of 18 years, where they would serve as midshipmen for one year before examination (as now) for sub-lieutenants.

Thus, the whole course of training would be two years at college, and in training corvettes as cadets, and one year's training in practical gunnery, and instruction as an officer in various duties, with the rank of midshipman, performing all the duties of a subordinate officer, at the conclusion of which an examination should take place in all the subjects of the profession, whether at home or abroad. This preliminary education should be followed by the modification of the navigating class, the creation of an examination for the rank of lieutenant, and other changes in rank.

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