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THE

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On Teaching Natural Science in Schools.

By J. M. Wilson, M.A., F.G.S., F.R.A S.

(*Concluded.*)

The next training subject is unquestionably Experimental Physics. This term is used commonly to denote the sciences which can be studied experimentally, without an extensive knowledge of mathematics, and excludes Chemistry. Mechanics and Mechanism, Heat and Light, Electricity and Magnetism, Hydrostatics, Hydrodynamics, Pneumatics, and Acoustics are the principal branches of the subject. In selecting from them the subjects most fit for use at schools, and in choosing the order in which they should be taught, we must be guided by the principles already enunciated. We must proceed from the concrete to the abstract, from the familiar to the strange, from the science of masses to the science of molecules. Hence, Mechanics and Mechanism must come first. In a year most boys are able to learn the great principles of Statics and Dynamics, and the elements of Mechanism, such as the ordinary methods of converting one kind of motion into another. They become tolerably familiar with the ideas of motion, and space, and time, and form, in their exact numerical relations. Ignorance of arithmetic and the want of ideas in practical geometry are the main hindrances in their way; but even they are improved by the many illustrations of arithmetic and geometry that are afforded by Mechanics, and by the growth of exactness in all ideas of quantity and form as expressed by numbers. Arithmetic is too often the science of pounds, shillings, and pence alone; and by being so limited it loses in dignity, and in interest, and in clearness. In Mechanics, also, the motion of force is constantly present in its commonest and simplest forms; and in this respect also this branch of science serves as the best introduction to the later branches.

Hydrostatics and pneumatics, I do not doubt, are the best subjects to take next: the range of these subjects that could be taught at school is not great; and they may be learnt very thoroughly and exactly, and provide very good illustrations of the principles of the subjects that precede them. Hydrodynamics, Acoustics, and Geometrical optics will be only studied profitably beyond the bare elements by those who have special talent for mathematical or experimental investigation, and should, I think, be in general reserved for university teaching. Physical Optics unquestionably should be excluded from school teaching.

The next year's course should be Heat and the elements of Electricity. By the time boys have reached this stage they are far more able to acquire new subjects than in the previous stages, and are fit to enter on these branches of physics, if they have studied the earlier subjects intelligently. And of all subjects of experimental investigation, Heat (1) seems to me the best for work at schools. Three times I have taken classes in Heat, and with more satisfactory results than in any other subject. The phenomena of Heat are so universal and so familiar; it has so central a position among the physical sciences; its experimental methods are so perfect; it affords such a variety of illustrations of logical processes; that it seems unrivalled as a subject for training in science. And allowing for seventy lectures in the year it is clear that this year's course will allow of some time being given to Electricity. This may be made an enormous subject, but I apprehend that it will not be worth while to attempt its more difficult branches, but to reserve them for the University and for private study.

I will repeat, that a boy can learn, when he knows how to learn, far more than a master can teach; and it is at increasing the boy's power that the master must aim unweariedly. And by combining a voluntary and a compulsory system, giving opportunities for learning something of the higher branches, and insisting on a sound knowledge of the more elementary parts of Physics in which the teaching can be most stimulative and suggestive, all requirements will be met.

The methods of teaching Physics will be different in different hands; they will vary with the knowledge, the enthusiasm, the good sense, the good temper, the practical skill, and the object, of

(1) On this subject there is a very good text-book by Balfour Stewart.

the teacher. If the thing to be aimed at is to make them pass a good examination as soon as the subject is read, the best means will be to put a text-book into the hands of every one, and require certain parts of it to be learnt, and to illustrate them in an experimental lecture with explanations. The lecture may be made very clear and good; and this will be an attractive and not difficult method of teaching, and will meet most of the requirements. It fails, however, in one. The boy is helped over all the difficulties; he is never brought face to face with nature and her problems; what cost the world centuries of thought is told him in a minute; his attention, clearness of understanding, and memory are all exercised; but the one power which the study of physical science ought pre-eminently to exercise, and almost to create, the power of bringing the mind into contact with facts, of seizing their relations, of eliminating the irrelevant by experiment and comparison, of groping after ideas and testing them by their adequacy —in a word, of exercising all the active faculties which are required for an investigation in any matter—these may lie dormant in the class while the most learned lecturer experiments with facility and explains with clearness.

Theory and experience alike convince me that the master who is teaching a class quite unfamiliar with scientific method, ought to make his class teach themselves, by thinking out the subject of the lecture with them, taking up their suggestions and illustrations, criticizing them, hunting them down, and proving a suggestion barren or an illustration inapt; starting them on a fresh scent when they are at fault, reminding them of some familiar fact they had overlooked, and so eliciting out of the chaos of vague notions that are afloat on the matter in hand, be it the laws of motion, the evaporation of water, or the origin of the drift, something of order, and concatenation, and interest, before the key to the mystery is given, even if after all it has to be given. Training to think, not to be a mechanic or surveyor, must be first and foremost as his object. So valuable are the subjects intrinsically, and such excellent models do they provide, that the most stupid and didactic teaching will not be useless; but it will not be the same source of power that "the method of investigation" will be in the hands of a good master. Some few will work out a logic of proof, and a logic of discovery, when the facts and laws that are discovered and proved have had time to lie and crystallize in their minds. But imbued with scientific method they scarcely will be, unless it springs up spontaneously in them.

For all classes, except those which are beginning, the union of the two methods is best. If they have once thoroughly learnt that the truths of science are to be got from what they see, and not from the assertions of a master or a text-book, they can never quite forget it, and allow their science to exist in a cloud-world apart from the earth. And undoubtedly the rigid and exact teaching from a book, insuring a complete and formularised and producible knowledge, is very valuable, especially with older classes.

The work out of school for a natural science lecture consists chiefly at first in writing notes on the previous lecture. When the lecture has been discursive, and the method hard to follow, some help may be given by a recapitulation; but in general it may be left to the boys. It is an admirable exercise in composition. To reduce to order the preliminary facts, to bring out the unity in them, to illustrate, to describe, to argue, and that about things in which they are interested, and for which they feel a match, are the very best exercises that can be put before boys. They begin with a helplessness and inanity almost incredible, improve constantly, and end generally by writing these notes very well. And in the higher classes the working of examples and problems may well be thrown in part on the out-of-school hours.

There are three other subjects on which a few words should be said. These are Chemistry, and Geology, and Physiology.

I am fully convinced, and could support my conviction by that of others, that Chemistry is not a good subject for lecture instruction to beginners in science. Laboratory work must precede, in order that a certain degree of familiarity with facts may be acquired before they are analysed and methodized scientifically. It can be taught, even to young boys, and so can anything else; and it has the advantage of being rather amusing; but as an exercise in reasoning it is very deficient. The notions of force, cause, composition of causes, are too abstruse in this subject for boys to get any hold of. Hence it is, as a matter of fact, accepted as a mass of authoritative dogmas. It is not the conclusiveness but the ingenuity of the proofs that is appreciated. It is of all subjects the most liable to cram, and the most useless, as a branch of training, when crammed. Most of it requires memory, and memory alone. The manufacture of alum, the sources of borax, and the properties of the oxides of nitrogen, are the kinds of knowledge that is got by chemecal lectures, and demanded in most examinations in Chemistry. Now this is a part of the necessary knowledge of a chemist; and to one who has, by laboratory work and leisurely thought, arranged his knowledge, and digested it into science, it is valuable; but the acquisition of it is not a valuable process when it is got by lectures alone. And as laboratory work is not likely to form an integral part of school education, Chemistry ought not, I think, to take an early place in the scientific course. It is most desirable however that schools should possess laboratories, into which boys of some talent may be drafted, and there prepared for the profitable attendance on good chemical lectures in the higher part of the school.

Geology is a popular and attractive subject with boys, but it lies outside the subjects which best illustrate scientific method. The largeness of the ideas in it; the great inferences from little facts, as they seem to boys; the wide experience of scenery, and rocks, and fossils, and natural history, which it seems to require; the very unfinished condition of it; are all reasons which make its advocates enthusiastic, but unfit it for the staple of school teaching. Nevertheless, the value of it on other grounds, such as its interest, its bearing on all kinds of thought, its position as typical of Palætiological science, and the opportunities it offers for original investigations in most places, seems to me so high, that I think it ought to be introduced parenthetically into the course of instruction in whatever way or place may seem most convenient.

Physiology cannot be taught to classes at school. Nor ought it be learnt before Physics and Chemistry. A most enthusiastic advocate of Physiology at school talked over the subject with me at Rugby. Practical work, he admitted, was necessary; and that it was impossible. I could not give my class forty rats on Tuesday, at 9.15, to dissect for an hour, and then put them away till Saturday at the same hour. And the other subjects, if well taught, will have given boys a method and a knowledge which will fit them for acquiring, by reading alone, even if they cannot have practical work, some intelligent acquaintance with the doctrines and facts of Physiology.

Is education in natural science a panacea for stupid boys? Will it herald in the golden age to schoolmasters when all boys are to be industrious and intelligent? It will be found that first-rate ability is as rare in this as in anything else. All the different subjects have their stars at school, as in the great world. And great inability is rare also. The great majority display intelligent interest and power of learning which does not amount to original genius, of course, but is genuine intellectual work. The active thought of the master is contagious, for he is visibly thinking as he teaches. And science admits of having excellent questions asked about it. The Germans have a proverb, "Mit fragen wird man weise." And it is true in a double sense. To put a question well is no mean attainment. Many will be asked simply from muddleheadedness, and will answer themselves when a distinct statement is insisted on. I am sure that more is gained by insisting on good questions than by giving good answers. So therefore the effect on the whole is to make boys more intelligent, to widen their range of ideas, to make them more active-minded, more logical, less one-sided. But while it succeeds with the great majority in accomplishing this at least, still it is not a panacea. There are some whom science, like everything else, fails to educate. The author of "Daydreams of a Schoolmaster" has, indeed, said, that a physically healthy booby is as rare as a live Dodo. I do not agree with him. Boobies are not extinct: in the interests of science—say for preservation in the British Museum, or for dissection at the College of Surgeons—two or three very fine specimens might be procured in a certain great school. In young specimens, however, the species is almost as difficult to determine as it is in young ammonites; and the old ones have a singular imitative instinct (apparently with a view to concealment from their natural foes), and externally resemble persons of intelligence.

The truth is, that there is no place like school for having notions of equality driven, by dire experience, out of one's head. There are scores and scores of boys whom you may educate how you will, and they will know very little when you have done, and know that little ill. There are boys of slipshod, unretentive, inactive minds, whom neither Greek grammar nor natural science, neither schoolmasters nor angels, could convert into active and cultivated men.

There is no great mass of opinion unfavourable to making natural science a regular part of school instruction; and there is a large, and not very inactive mass of opinion favourable to it. But progress in this direction is not likely to be very rapid, as both the men and the machinery that are to work the subjects have to be created. At present a Natural Science master is very hard to get. When the demand begins, doubtless more will qualify themselves. And most schools are unprovided with buildings and apparatus necessary for teaching science properly. These essentials cannot be supplied without considerable expense; that is, in general, without increasing the cost-price of education. And schools naturally hesitate before raising their terms with this object. They wait till they are sure that the opinion of their clientela will sanction both their object and their method of attaining it.

But more than all, the influence of the universities and colleges is on the whole unfavourable. The universities, by their Triposes and prizes, affect generally the studies in the colleges. But the colleges, by their scholarships, exhibitions, entrance examinations, prizes, and lectures, direct the studies of the schools throughout the kingdom. They do this to an extent of which they are, in general, unconscious. If the colleges, for example, ceased to demand Latin verses for their scholarships, Latin verse would almost die before the breath of their disfavour. If the colleges offered scholarships and exhibitions, to acknowledge and encourage the study of science at schools, then the teaching of science would at once be naturalized in most of the schools which contribute many men to the Universities. Up to the present time Oxford has taken the lead in this: Christchurch, Balliol, Merton, Magdalen, and New College all encourage natural science more or less. And their recognition of it, though very small, has been most useful. But at Cambridge, very little is done by the colleges; and the two great colleges, Trinity and St. John's, have hitherto out of their large revenues, liberally expended for the encouragement of some other branches of learning, devoted literally nothing to reward the successful prosecution of natural science. Hence all the abler boys at school are in fact heavily bribed to study either classics or mathematics, even though their genius is for natural science. And from this want of recognition of science by the colleges generally, and from a belief that it is founded on a well-grounded disapproval of science as a part of early liberal education, and from some distrust of it as a possible disturber of classical tradition, schools naturally hang back from taking the step of incorporating natural science into their course of study. (1)

Cambridge, moreover, must undergo a great change of disposition, and therefore of its institutions, before science will flourish there. For science requires above all things the ardent and devoted love of knowledge: it requires enthusiasm for study: it cannot live where teaching has taken the place of learning; and where a nearly stationary unprogressive condition of learning is tolerated, and is supposed to be even favourable to the education of students. Whatever change is made for the revival of learning at Cambridge will be favourable to the cultivation of science there. Nothing, I believe, is of greater importance as affecting the progress of education in England than the reforms, now whispered, which must soon be made at Cambridge.

Besides the immediate results of the recognition of science as a part of the higher liberal education in improving the working of schools, there are other remoter effects of much greater importance. To them, in the concluding paragraphs of an essay already too long, it is not possible to do more than briefly allude. It is impossible not to feel that with the spread of scientific modes of thought are bound up all the highest interests of philosophy and religion. Much of modern logic, and philosophy, and thought is incomprehensible except to men trained in science. To any one tolerably conversant with the distressful state of mind of thoughtful men on some religious questions, most welcome will be any progress which may help to free our successors from the same partition of soul, the same divided allegianee, from which the present generation suffers. It cannot long be possible for us to consent to turn out men into the world totally unprepared to meet the problems which will necessarily force themselves on their notice; to turn out men, professedly of the highest education, totally unfurnished with true scientific method and knowledge, totally unable to meet the shallowest arguments from a false philosophy of nature brought on the side of materialism or atheism; who will talk glibly of the supernatural, and yet be ignorant of natural. Does it seem strange to hail as a friend to religion that scientific spirit so often denounced as hostile? Yet how can it be otherwise? "Are God and nature then at strife" indeed? At present there is secret, if not avowed, hostility between religion and science, or at any rate a distrusful toleration; nothing but active co-operation will permanently reconcile them. To endeavour not to see the results and tendencies of modern science is folly in the higest degree. The study and knowledge of the seen is sure to react on the study of the unseen; and he will entertain these studies in perfect harmony, and he only in whom the scientific and religious ideas are allowed to grow up, not in antagonism, but fearlessly and freely, side by side, co-operating in the formation of a reverent, active, and independent mind, and well-balanced judgment. To think otherwise is to think that half the world is God's and the other half the devil's.

We inherit a noble inheritance, the achievements of the intellectual giants of past ages carried foward by the intelligent sympathy of thousands of their fellows. It confers on its inheritors a calmness, and dignity, and confidence which will ever increase. For them no fear of to-morrow's discoveries breaks the night's rest: they utter no little shrieking cries of alarm: they are confident in the power and in the ultimate unity of truth. Not to any generation is it given to outstep its place in the history of philosophy; and the work of our generation is clear: it is to ascertain what is and what is not true, by patient and trusful investigation, and to have unbounded faith in truth.

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(1) This was written in April. Since that time Trinity College has appointed a Lecturer in Science, and St. John's College has made it known that an exhibition of 50*l*. a year, tenable for three years, will in future be offered in the spring for competition in natural and physical science. This is a great and important first step, and will doubtless soon be followed by further movement in the same direction. When some attainments in physical science are looked on as a necessary part of higher culture, as a means of forming a superior mind, the great colleges will not fail to encourage these attainments by a much more extensive recognition. The great colleges will remember that they have not only to train common minds for common professions, but to keep alive and advance all kinds of human culture, and knowledge, and philosophy. And in the present century physical science is perhaps the greatest school of philosophy.

To later generations it is reserved to bridge the chasm that may now seem to separate truths from truths; and to find a higher and profounder unity than we can yet imagine.

> "This fine old world of ours is but a child
> Yet in the go-cart. Patience! Give it time
> To learn its limbs. There is a Hand that guides."

The Primary Schools of Germany.

We will endeavour to indicate the career of an intelligent village lad who, having, at the age of fourteen, completed his school course, resolves to become a school-master. If in Saxony or Silesia, he enters a training-school called *Proseminar*, because preparatory to the seminary or normal school; if in Prussia, he enters the house of a private tutor, probably the local schoolmaster or clergyman. At the age of eighteen he proceeds to the seminary, where he has to spend three years; the first and second to be devoted, according to an elaborate scheme, to all the subjects he will hereafter have to teach; the third to be spent in teaching, under the supervision of the director of the seminary, in the "practising school," which is simply the nearest primary school. While in the seminary, he is subjected to stringent discipline. He makes his own bed, and cleans his own room; he pays for his board and lodging--the former being of a very homely description, and valued at eight-pence or ninepence a day—and provides his own bread. At the end of the third year he presents himself for his examination, which is conducted by the authorities of the college, under the superintendence of the school councillor. This examination embraces religion, language, arithmetic, writing, drawing, and singing, and is partly oral and partly on paper. The performances of the candidates are estimated with great precision, and a certificate is given to all who acquit themselves satisfactorily. The teacher is now taken charge of by the department councillor, who appoints him to a vacancy in his district. He holds, however, only the position and title of provisional teacher, the full status and rank of schoolmaster being withheld until he has passed a second examination, held three years after the first. This examination is rather an investigation into character and conduct than into attainments. When this last ordeal has been passed, the teacher takes the oaths of allegiance, and receives a definite appointment as master of a school. It is evident, then, that in Prussia, no pains are spared to fit the schoolmaster for his duties, and to drill him into perfect sympathy with the system with which he has to deal. He has, however, two grievances—the inadequacy of his salary, and his relations with the pastor. His renumeration is, theoretically, fixed by the commune, which, as we have seen, has to bear the expense of the primary school, and which, therefore, has a strong motive to reduce the salary of the masters as much as possible. But in 1848 the complaints of the masters attracted the intervention of the central Government, and by a Cabinet rescript of 1852, the various departmental authorities were directed to inquire into the salaries of all schoolmasters within their jurisdiction, and raise them, where necessary, to such an amount as they should consider sufficient. Subsequent legislation resulted in the fixing of a minimum of salary by the central power, the Bill of 1867 providing that teachers in towns of ten thousand inhabitants are to have a house rent free, and salaries of not less than from £30 to £37. 10s. a year; in villages no maximum is mentioned, but the master must be supplied with fuel, provisions, and conveyances. But notwithstanding the improvement in his condition, the schoolmaster's position lacks independence. Inside the school he is, as the State has laboured hard to teach him, the subordinate of the pastor, who frequently renders his inspection vexatious, with the view of magnifying his own office. Outside the school any concerted effort for the redress of grievances is prevented by the accustomed machinery of rescripts, minutes, and regulations. He may not—in Prussia, at least—become a member of any union or society, except the parochial and district conferences, and these he is directed to attend, but on the understanding that no criticism antagonistic to the management of the central or departmental governments will be allowed. He belongs to a book society, but all the books in it are selected by the authorities, and the only periodicals allowed are feeble and one-sided local prints, in the columns of which all discussion is prohibited. The Prussian schoolmaster is, in fact, an incarnation of discipline, a revised code endowed with vitality. "He is," says Dr. Pattison, "hopelessly isolated in a kind of official world, and has no means of knowing what is really being thought or done without."—*St. Paul's.*

What John Knox did for Scotch Education.

Scotch education, like most things of much worth in Scotland that has come down to us from the past, owes a great deal to John Knox. Knox, indeed, is commonly called the founder of the parish school system, and the man who has given to Scotland what educational celebrity it has since had; but this is only vaguely true. In the seething times of the Reformation, almost all that was good and lasting in the nation, whether the gathered fruit of the past or the seeds of the future, was found with Knox, and got its living power from him; and so it was with education. Knox did not create the education system of his country, he reorganized it and put new life into it. He found even the parish-school system already made, and only adapted it to the wants of the time, and made it rest on the people instead of being supported by the ecclesiastics of the country. This is only what we should have expected, for a good system of education is not made, but grows. A reformer may mould it, or train it to his mind, or read just it and free it from the obstacles with which time has clogged it, but he cannot create to much purpose. Nor did Knox need to attempt any such creation; for it is a curious fact that, as Mr. Hill Burton says, "in almost all the periods of the history of Scotland, whatever documents deal with the social condition of the country reveal a machinery of education always abundant, when compared with any traces of art, or the other elements of civilization;" and in the beginning of the sixteenth century, few countries possessed such a complete educational system as Scotland did. It is true that during the twenty or thirty years which preceded the declaration of the Reformed religion, scholastic organization in Scotland had become so mismanaged, that able and conscientious prelates made arrangements to send theological students from their dioceses to French colleges for their education; but, on the other hand, all throughout this time of decline there were ever and again strong efforts made by well-meaning Churchmen to stem and turn back the tide of degeneracy, and such efforts commonly took shape in a revival of learning, or the re-establishment of able teachers in some of the monasteries or cathedral towns Knox, therefore, I repeat, did not create the Scotch educational system. He found one existing which had been the growth of some centuries; but, for all that, the educational reputation of his country is due more to him than to any other man. John Knox did these three things for Scotch education:—(1) He put a moral earnestness into it. Before his day young Scotchmen took to learning because it paid well, because it suited their inquisitive and ambitious natures, and because the roving life of the mediæval student gave full swing to their wandering adventurous habits. But Knox taught Scotchmen to make education a religious duty which they owed to God and to themselves. He taught them to forego any comfort rather than allow their children to grow up ignorant and untaught—and Scotchmen have not yet forgotten the lesson. (2) He set up a high educational ideal to be aimed after, and made the people see it. The Books of Discipline contain the rudiments of one of the most enlightened and far-reaching educational systems ever presented to a nation. This scheme for causes to be mentioned was not realized, but did a great work as the ideal to be looked to. (3) By an appeal to the people he managed to realize in no small measure what the scheming Lords of the Congregation, intent only on securing the property they had pilfered from the Church, scouted as a devout imagination. Since Knox's day education in Scotland has been mainly self-supporting, and has found its strength in the nation's desire to be educated.—*Macmillan's Magazine.*

Canadian History.

JACQUES CA[R]TIER AND ROBERVAL.

After a delay of four years, the affairs of France allowed King Francis to think again of Canada. Now, it was proposed to send out people to settle there, and to found another empire for France in the West.

A French noble, named Roberval, was appointed by the king to the head of the new colony. He had the title of "the king's Lieutenant-General over the countries of Canada, Hochelaga, Saguenay, and neighbouring parts."

To command the fleet, Jacques-Cartier was appointed, with the title of "Captain-General."

On May 23rd 1541, Cartier sailed from St. Malo with five ships. Roberval was not ready to start, but was to follow soon, with more ships and supplies.

Cartier had a long passage of three months. On August 23rd, he reached the mouth of the St. Croix, when the Indians of Stadacona immediately flocked to his vessels asking for Donnacona and the other captives. Cartier told them their chief was dead. Of the others, he allowed them to believe that they were doing well in France, not desiring to return to Canada. He soon saw that the Indians were not, in their hearts, friendly towards himself and followers. Instead, therefore, of mooring his ships again at the St. Croix, he went higher up the St. Lawrence, to *Cap-Rouge*, so as to be farther away from the people of Stadacona. There, at the mouth of a small stream running into the St. Lawrence, three of the ships were made secure. The other two were sent back to France. On the high land a fort was begun, all necessary out-buildings were made, and the people were set at work clearing ground.

While these works were going on, Cartier paid a visit to Hochelaga. The Indians there were as friendly as before. They tried to help him to pass up the rapids above their town, and to procure more knowledge of the country westwards.

On returning to Cap Rouge he found his people and the neighbouring Indians on bad terms. Quarrels had taken place. The French were defied by the savages and scarcely dared to go unarmed outside their premises. Roberval had not arrived, which displeased Cartier, for there was not enough of gunpowder and arms.

There was ill-feeling between the French and the savages during the ensuing winter. Cartier's people were not content. They suffered from cold and scurvy. Long before spring, all wished to leave the country as soon as possible. But we do not know much concerning the events of that winter.

As soon as the river was clear of ice, in the spring of 1542. Cartier and all his people went on board ship, and set sail for France. At Newfoundland, Cartier met Roberval, who was now on his way out, with three large and two small ships, carrying 200 men and women. Cartier told his superior officer that he had not been able to remain longer at Cap-Rouge because of the trouble which the Indians constantly gave. Roberval ordered him to return to the St. Lawrence. But Cartier did not obey him. On the contrary, he weighed anchor in the night time and continued his voyage homewards. He arrived safe at St. Malo and gave the best account he could, to the king, concerning his conduct.

Roberval, with his five ships, reached Cap-Rouge in July. At that place, he passed two wretched winters. Many of his people were *convicts*, who had been taken out of the public prisons in order to go out as *colonists* to the banks of the St. Lawrence. To keep such persons in order, Roberval made use of severe punishments, such as *flogging, imprisonment*, and even *hanging*.

In course of time, provisions and other necessary things ran short. Roberval sent home to the king for succour. But Francis either could not or would not send it.

Roverval's undertaking was, in fact, a failure.

In the Spring of 1544, Roberval was anxiously looking for the arrival of succour from France. He had made some poor attempts at cultivating the ground. He had also visited Hochelaga and the country of the Saguenay. But his journeys were of little or no benefit, and caused the loss of many lives.

In the end, the king of France sent ships to bring home Roberval and all who remained with him alive. Some say that Jacques Cartier was employed in thus saving his former chief. At any rate we may be sure that Roberval and his people were very glad to return to their native land.

From what has been said, we learn that Jacques Cartier made three if not four voyages to Canada. He was about 50 years of age when he went out on his last trip, in 1544, to bring home Roberval. We are not told what afterwards befell him. It is thought, however, that he lived, in quiet, a few years, at St. Malo, his native place. The remains of his habitation were to be seen there as late as the year 1865.

He was a brave and skilful sailor, a wise commander, and a pious man. It was not his fault if but little was done, in his own times, to render his services useful to France and to the world. He will always be famous in history as the great sea-captain who first made Canada known.

Roberval's attempt was the first ever made to found a colony in Canada. Five years after his failure, namely in 1549, he perished at sea, along with his brother. He was, at the time, trying to take out to the St. Lawrence another fleet, and another set of colonists.

CANADA FORGOTTEN.—FUR TRADE.—THE MARQUIS DE LA ROCHE.—SABLE ISLAND.

From the days of Jacques Cartier and Roberval, the history of Canada leaps over a period of more than 60 years. King Francis, and four kings of France after him died in that time. They were all so taken up with their affairs at home that they forgot Canada. (1) The St. Lawrence, and the vast forests of New-France, were, in fact, left to the savages and the wild animals.

Although Canada was thus forgotten by the kings, yet the French traders did not cease to visit the St. Lawrence. They went to buy the skins of wild animals from the Indian hunters. These used to meet the traders, to traffic with them, at Tadoussac, and other places on the river. Furs were, in those days, sold for high prices in Europe. The French traders gave the Indians, in exchange for the skins of wild animals, hatchets, knives, cloth, and various iron and brass vessels. It is also thought that in this way the Indians first came to know of what the French called "eau de vie," of which the poor savages learned to be very fond.

So it happened that nothing more was done towards settling Canada for a long time after the last attempt of Roberval.

In the year 1589, the throne of France was filled by Henry IV., called in French history, *the Great*. During his reign, which lasted until 1610, men's thoughts were once more turned to Canada, or New-France.

The Marquis de la Roche had been made Viceroy of New-France by king Henry III. His appointment was little better than an empty title. But he did make some attempt to turn it to account. It would scarcely be worth while to speak of it here but for a curious story about a number of men, left by him on a desert island.

De la Roche had leave to take with him about fifty convicts out of the French prisons. He then sailed westwards and happened to come upon *Sable Island*, a miserable spot, nearly covered with sand and stones, and without any trees growing. Still, there must have been some herbage. because there were goats and cattle running about, wild. Many years before de la Roche's time, animals, of the sorts named, had been let loose on the island. De la Roche wished to see something of New-France before choosing a place of settlement. Perhaps the convicts were found too troublesome to be kept on board while search was being made for a suitable spot. At any rate the whole fifty were landed and left on Sable Island, while de la Roche went to observe the neighbouring coasts. He intended, of course, to come again and remove them, but storms prevented his return, and

(1) *Note for the Teacher.*—We here use the name Canada to denote only a part of the region through which the St. Lawrence flows from the great Lakes in the west to Gaspé. But this was not the name commonly used in France when they spoke of the king's American territories, for they called these "*New-France.*" This name was first given by *Verrazzani* in the time of Francis I, about 1523. Verrazzani had been sent out to explore the American coast. To it, from the shores of New England to Labrador, and to the unknown regions beyond, he gave that title, New-France. So Canada was a part of this New-France, and came to be so called about the latter part of the reign of Francis. Of course New-France had no known boundaries. The French claimed that it included much of what the English called New-England. It also included Nova-Scotia (or Acadia) also those vast regions in the interior of North America which extend south of the great lakes and now form the more inland parts of the United States. In short New-France although used chiefly to denote Canada, was a great part of North America claimed to belong to the French kings and proudly spoken of as the territory of a future great French empire in the west.

drove his ship across the sea to France. There, de la Roche was seized by another noble, his enemy, and shut up in prison several years. At last he was freed, and the case of the convicts on Sable Island was made known to king Henry IV. The king ordered a sea-captain, named Chédotel, to go out, and learn what had become of them.

Chétodel visited the island, and brought off twelve of the poor wretches, who were all that remained alive. They were hideous in appearance, and scarcely like human beings. They had very long beards, and were clad in sea wolf skins. For shelter, they had made caves in the sand, and for food they depended upon fish and the flesh of such animals as they could catch. Sometimes they had been so fortunate as to find on the coast pieces of wood, and metal, cast ashore from ship-wrecked vessels. None but the strongest had been able to survive a condition so horrible as theirs was. Most likely they had quarrelled and fought with each other, so that the weakest may have died by the hands of the others.

Chédotel carried the twelve to France, and presented them before the king, with their long beards and clothing, just as they were on Sable Island. Henry IV listened to their tale and kindly pardoned them for their former crimes. Each received a present of 50 crowns. Doubtless they became, after that, useful citizens; but when they were on Sable Island they had wished themselves back in their former condition of convicts *in the French prisons.*

After *de la Roche*, other persons received *commissions*, from Henry IV, to trade with New-France and to found colonies. Amongst them we read of *Captain Chauvin, M. de Monts,* and especially, *Samuel de Champlain.*

We need say but little about Chauvin, for he only carried on a little traffic in furs with the Indians, chiefly at the station named *Tadoussac*, at the mouth of the river Saguenay. De Monts and others founded Port Royal (*Annapolis*) in Acadia, now called Nova Scotia. Afterwards, the same DeMonts, with Champlain, and another, named *Pontegravé,* turned their attention to the St. Lawrence, in a way which led to the settling of Canada.

English History.

THE SOVEREIGNS OF ENGLAND.

HENRY II.

(Born at Mons, in Maine, 1133. Died at Chinon, July 6, 1189. Reigned 35 years.)

Prince Henry, son of Matilda, as soon as he heard of Stephen's death, came over to England, and was, with his queen, Eleanor of Guienne and Poitou, crowned at London on the 19th of December, 1154. He was afterwards crowned at Lincoln, and again at Worcester. In 1157 he subdued the Welsh; and in 1158 a war broke out with France, but peace was made, and King Henry promised that his eldest son should marry the French king's little daughter Margaret. In 1162, Thomas à Becket, a very able and zealous man, was made Archbishop of Canterbury; but the king having attempted to reduce the power of the clergy, Becket took part with the Pope against the king, who fined him. Becket, in consequence, quitted England and placed himself under the protection of the Pope and king of France, and a war with France was the consequence. In 1170 the king caused his second son, Prince Henry—the eldest, William, having died young—then sixteen years of age, to be crowned King of England. This offended France, and caused a war. Shortly afterwards the king made up his quarrel with Becket, and as a mark of respect held his stirrup while he was mounting on horseback. He never, however, completely forgave him, and some of his friends, wishing to please him, murdered Becket before the altar in Canterbury Cathedral, on the 30th of December, 1172. In 1173 the queen, with three of his sons, conspired against the king, who ordered her to be kept a close prisoner during the remainder of his reign. He was not a good man, and his wife and children had no love for him. On the 11th of June, 1183, Henry, the king's eldest son, died, having been styled king for thirteen years. Richard and John, two of his brothers, rebelled against their father, who, everywhere defeated, was obliged to submit to hard terms. He died of grief, in Normandy, on the 6th of July, 1189; and his last words expressed his anger at his sons' conduct. He had two other sons, Geoffrey and Philip, and three daughters, Matilda, Eleanor, and Joan.

RICHARD I.

(Born at Oxford, September 13, 1157. Died at Chalons, April 6, 1199. Reigned 10 years.)

This king was called Cœur de Lion, or "the lion hearted," because of his great courage. He was a very renowned warrior, and remarkable for his immense strength. He was crowned at Westminster on the 3rd of December, 1186. Several rich Jews came to offer presents; but the mob, which hated Jews, attacked them, robbed their houses, and killed many. The example was followed in other towns, especially Norwich, Stamford, Lincoln, and York, and many terrible murders were committed. One of the first things Richard did after he became king was to release his mother, Eleanor; and he left her to govern the kingdom while he went to the Holy Land to take part with King Philip of France in the great Crusade. He was afraid his brother John would seize on the kingdom during his absence, so he gave him six earldoms, and a rich heiress, Isabel, daughter of the Earl of Gloucester, for his wife. On the 11th of December, 1190, *King Richard* embarked at Dover for Calais; and on the 7th of August sailed from Marseilles for Messina, in Sicily. Early in the next year he conquered Cyprus; and married in that island, on the 12th of May, Berengaria, daughter of the King of Navarre. In September, having reached the Holy Land, he defeated Saladin, and repaired Ascalon, Jaffa, and other cities; and, with the King of France, took the city of Acre. In June, 1192, Richard and Philip quarrelled, and the French king went back to France. Richard, therefore, made a peace with Saladin, and also returned; but, being shipwrecked, was taken prisoner by the Emperor of Austria, and kept in captivity for more than a year. It is said that a favourite minstrel, Blondel, discovered his prison by playing a tune which the king knew and answered. Richard was released, early in 1194, on payment of a great ransom; and returned to England, where his brother John had seized the government. Soon afterwards a war broke out between England and France; and in 1198 Richard was wounded with a poisoned arrow while besieging Chalons, and died on the 6th of April, 1198. His body was buried at Fonteveraud, his head at Rouen, and his heart at Charron, all in France. He was the first king who took "*Dieu et mon Droit*" for his motto.

JOHN.

(Born at Oxford, December 24, 1166. Died at Newark, October 19, 1216. Reigned 17 years.)

Although John had acted so treacherously in his brother's absence, yet Richard wished him to be his successor, although Prince Arthur, the son of Henry II.'s fourth son, Geoffrey, was still living. King John was crowned at Westminster on the 27th of May, 1199; and in the following year, having been divorced from his first wife, married Isabella, daughter of the Earl of Angouleme, and was again crowned, with her, on the 8th of October, 1200. He was afterwards twice crowned at Canterbury. The King of France supported the claims of young Prince Arthur; and John undertook a war against France, in which, however, many of the barons refused to support him. In August, 1202, he besieged the castle of Mirable, and took Arthur prisoner. The little prince soon afterwards died in prison, and it was generally thought that John stabbed him with his own hand. Philip of France denounced him as guilty of murder, and declared that he had forfeited all his possessions in Normandy; and in 1204 Rouen and the whole of the duchy were taken by the French. John heavily taxed his barons for refusing to help him in the French war, and thereby caused the powerful nobles to be very dissatisfied. The Archbishop of Canterbury having died in 1205, the king named his successor; but the Pope did not approve of him, and made the monks choose Stephen Langton; at which the king was so angry that he turned the monks out of their homes, and afterwards banished the bishops and a great number of the clergy, for preferring to obey the Pope rather than himself. The Pope, in consequence, excommunicated the king, ordered the English not to obey him, declared that he was deposed, and gave the crown to the King of France. John was not strong enough to resist, and therefore asked the Pope for pardon, consented to be heavily fined, and to hold his kingdom as a tributary to Rome. In 1215 the barons, tired of his tyrannic rule, made war against the king, and compelled him to sign Magna Charta, which established freedom in this country. John persuaded the Pope to declare the Charter void; and the barons asked the King of France to help them, and Lewis, the Dauphin, came with an army to this country, and the barons swore to obey him as their king. King John died at Newark, it is supposed of poison, which, say some writers, was given him by a monk of Swinstead, in Lincolnshire.

HENRY III,

(Born at Winchester, October 1, 1207. Died at Westminster, November 16, 1272. Reigned 56 years.)

Prince Henry, the eldest son of John, was only nine years old when his father died. The Earl of Pembroke was appointed his guardian. The Dauphin of France continued to make war against him, but was defeated at Lincoln, and afterwards besieged in London; so that he was glad to make a treaty of peace, and to quit the kingdom. The young king was three times crowned—first at Gloucester, on the 28th of October, 1216; then at Westminster, in 1219; and again at Gloucester, in the same year. In 1227 he declared himself of age, and cancelled Magna Charta, but it was subsequently confirmed, and remained the law of the land. On the 14th of January, 1236, the king married Eleanor, daughter of Raymond, Earl of Provence. There were several conspiracies against the king, which he subdued; and in 1242 he embarked for France, and carried on an unsuccessful war, which was ended in the following year by an agreement for a five years' truce. Wars broke out with the Welsh, and again with France, and the king taxed the barons so heavily, to find money for himself and the Pope, that the nobles rebelled and compelled him, at a parliament in Oxford, in 1258, to give up his royal power to twenty-four persons, of whom he might himself choose one-half. In 1259 the king sold his rights in Normandy and Anjou to the French king for £3,000. The next year the king declared that he would not keep the promise he had made at Oxford, and levied war against his barons. This war lasted for three years, Simon de Montfort, Earl of Leicester, being the leader of the popular army; and during a part of that time the king and Prince Edward, his eldest son, were prisoners. At length the prince escaped, and defeated De Monfort, who was killed, at Evesham, in Worcestershire, on the 4th of August, 1265. The estates of the rebellious barons were forfeited, and they were obliged to pay a large sum of money. Another rebellion broke out, but was suppressed after some hard fighting; and in 1267 a peace was concluded with the Welsh. The king died in 1272, and was buried at Westminster Abbey. The first regular Parliament assembled in his reign.

EDWARD I.

(Born at Westminster, June 18, 1239. Died at Burgh, in Cumberland, July 7, 1307. Reigned 35 years.)

It was not very polite to call young Prince Edward Longshanks; but it was the fashion of the time to give surnames; and as Edward was very tall, he obtained that strange name. He took part, as we have seen, with his father in the wars against the barons, and when peace was ensured, he being then thirty-one years of age, embarked, in 1270, for the Crusades, taking with him his wife, Eleanor, Princess of Castile, to whom he was married when only fourteen years old. He greatly distinguished himself in the Holy War; but was unfortunately wounded by a poisoned dagger, and would have died had not Eleanor sucked the poison from the wound. Hearing of the death of his father, he returned to England, but travelling was so slow in those days that he did not arrive till the late king had been dead about eighteen months. Edward and his queen, Eleanor, were crowned at Westminster on the 19th of August, 1274. He had not been long on the throne when he resolved on subduing the Welsh, who were very warlike, and were continually fighting with the English. There was very great slaughter; but at Llewellyn, the Welsh prince, was defeated, and did homage to the king. Soon afterwards, however, the war was renewed, and in December, 1282, Llewellyn was killed in battle; and since then Wales has been attached to the English crown. Two years afterwards the king's fourth son, Edward, was born, and he was at once named the Prince of Wales, being the first who bore that title. The king was very cruel and unjust to the Jews, forcing them to give him large sums of money, and at last banishing 15,000 of them from the country. On the 28th of November, 1291, Queen Eleanor died at Grantham, and her body was brought to London: a beautiful cross being erected on every spot where it was rested on the journey. Only two of these crosses are now left—one near Northampton and the other at Waltham; but there was a very fine one in Cheapside and another at Charing Cross. During the latter years of his life King Edward was engaged in wars with Scotland. Sir William Wallace, one of the Scottish leaders, a very brave man, was taken prisoner, brought to London, and there executed as a traitor. In 1307 the king, with the finest army ever collected in England, marched towards Scotland, determined to completely subdue that kingdom; but was taken ill on the way, and died near Carlisle. He was buried in Westminster Abbey.

EDWARD II.

(Born at Caernarvon, April 25, 1184. Died at Berkeley Castle, September 21, 1327. Reigned 20 years.)

This king was the fourth son of Edward I., the three before him having died when children. His first act after ascending the throne was to recall Piers Gaveston, an old companion whom his father had banished for bad conduct, and make him Earl of Cornwall and Treasurer of England. On the 23rd of January, 1308, the king married, at Boulogne, Isabel, daughter of King Philip of France, and they were crowned together at Westminster, on the 24th of February, 1308. The nobles were very much displeased at the favour shown to Gaveston, and in 1309 compelled the king to invest the government in twenty-one persons, and banish Gaveston, who, however, was soon recalled. The barons then united in a conspiracy against the king, took Gaveston prisoner at Scarborough, and beheaded him. The king and the barons being then reconciled, the war against Scotland was renewed; but on the 25th of June, 1314, the English were completely defeated at Bannockburn by the Scotch, commanded by Robert Bruce, whose brother, Edward, was proclaimed King of Scotland. He only reigned for three years, when he was defeated and killed by the English. In 1321 a war broke out between the king and the barons, and the latter being conquered, the Earl of Lancaster and several others were beheaded. In 1324 the queen headed a conspiracy against the king, and went to France to raise an army, with which she returned in September, 1326, and landing in Essex, drove the king into Wales. He was taken prisoner at Caerphilly, in Glamorganshire, and confined first in Kenilworth Castle, and then in Berkeley Castle, Gloucestershire. On the 13th of January, 1327, he was declared to be no longer king, and his eldest son, Edward, then only fifteen years of age, was proclaimed king. The old king was murdered, with terrible tortures, in Berkeley Castle. He was buried in Gloucester Cathedral, where his fine tomb may yet be seen.—*Kings and Queens of England.*

OFFICIAL NOTICES.

Ministry of Public Instruction.

APPOINTMENTS.

BOARDS OF EXAMINERS.

The Lieutenant-Governor, by an Order in Council, dated the 17th ult., was pleased to appoint the following gentlemen members of the hereinafter mentioned Boards of Examiners:—

Sherbrooke.—The Revd. Mr Augustus Tanner, M. A., and the Revd. Mr. Charles Tombs, M. A., in the room and stead, respectively, of Frederick William Terrill, Esq., resigned, and of the Revd. Mr. William Richmond, removed from the Municipality.

Rimouski.—The Revd. Mr. Pierre Charles Alphonse Winter in the room and stead of the Revd. Mr. J. B. Blouin, resigned.

Quebec (Catholic).—The Revd. Mr. Pierre Lagacé, in the room and stead of the Revd Mr. Thomas A. Chandonnet, resigned.

REGULATIONS CONCERNING THE EXAMINATIONS FOR THE CIVIL SERVICE, P. Q.

I

APPLICATIONS FOR ADMISSION TO THE EXAMINATIONS.

1. The Candidate for the Civil Service is required to produce at the Office of the Board, an application for admission to the examination, in his own handwriting, mentioning his age, his place of birth and his present place of residence, the length of time he has been resident in the Province, and the nature of his previous occupation, declaring his desire to enter the Civil Service and indicating, if he thinks proper, the Branch of the Service for which he considers himself best adapted.
2. The application of the Candidate must be accompanied by satisfactory Certificates as to age, health and character.
3. No Candidate under seventeen years of age shall be admitted to the examination.
4. Every Candidate, in order to show that he is of the required age, shall produce an extract from the Register of the Parish in which he was baptized and if, for reasons which he must explain to the satisfaction of the Board, it should be impossible for him to do so, he shall furnish the best proof possible by Certificates from credible persons, to the satisfaction of the Board.
5. The Certificate on health must be in the subjoined form (A) signed by a practising Physician, and bearing date within one month of the date of the application for admission to examination.
6. Notwithstanding the production of a Certificate of good character, the Board may require such additional evidence as to moral character of the Candidate as it may deem expedient, and may take action in accordance therewith.
7. Candidates previously employed in the Public Service must state the Department in which they were so employed and the length of time they served.
8. The Candidate must be recommended by at least two persons who must be householders, each of whom shall answer in writing and over his own signature, the questions submitted in form B, which answers shall be produced with application for admission. When the Candidate has been previously in the employment of private individuals, commercial

houses or companies or in any office or Department, such private individual, or some person on behalf of such House, Company, Office or Department, must be one of those who sign the recommendation, and when this condition is not complied with, the Candidate must explain the reason.

9. In the case of a Candidate who has left school or college or other educational establishment in the year preceding his application for admission, the principal or one of the professors or teachers of the school or institution he attended last, must sign the answers to the questions in form B, and if this condition is not complied with satisfactory reasons must be given by the Candidate.

10. The five preceding articles do not apply to the actual employes

11. Forms may be obtained by application to the Secretary of the Board.

12. The Candidate must produce his application and Certificates before the third Wednesday of the month when they will be examined, and the Secretary will notify him of any objection that may be made to them

II.

EXAMINATIONS AND CERTIFICATES

13 The examination shall be conducted partly orally and partly in writing.

14. The time allowed for the answer to every written question shall be indicated underneath the same

15. The Certificates shall be divided into two classes; those of the First class will render the holder eligible for any employement in the Civil Service with the exception of that of Book-keeper, if the Candidate has not passed a satisfactory examination on that subject; the Certificates of the Second class only render the holder eligible for employment as Copying-Clerk and also as Book-keeper, if the Candidate has undergone a satisfactory examination on this subject.

11. In order to obtain a second class Certificate, the Candidate must:
1. Give proof of good handwriting;
2. Write correctly from dictation in French or English;
3 Copy correctly in both languages;
4. Pass an examination in Arithmetic as far as the Rule of Three, inclusive. He may also if he desires it undergo an examination in Book-keeping.

17. For a first class Certificate the Candidate must in addition to what is required for a Second class Certificate.
1. Translate in writing from English into French, and From French into English;
2. Write from dictation in both languages;
3 Transcribe and make abstracts of documents in both languages.
4. Pass an examination on the following subjects; 1. Arithmetic in all its branches: 2. Geography; 3 History of England, History of Canada and the Elements of General History; he may also if he desires it undergo an examination in Book-keeping.

18. The actual employés shall be exempt from examination in No. *one* of the preceding articles and in Nos. *two* and *three* shall only be required to pass an examination in one or other language.

19. A Candidate for a First class diploma may, if he desires it, undergo a more extended examination: but in this case, he must in his application for admission mention the other subjects upon which he wishes to be interrogated and the Board shall decide whether or not he may conveniently be examined upon such subjects, and he shall at the same time be notified of the decision of the Board on Certificates

20. There shall be endorsed upon the Certificate of examination a list of all the subjects upon which the examination has been held, with number 1 or number 2 opposite each of them, the number 1 indicating that the result of the examination on that subject was excellent, number 2 indicating merely a satisfactory result. If number *one* has been obtained on two-thirds of the subjects of examination it shall be stated in the body of the Certificate that the examination has been passed "*with distinction*," and in the First class Certificates if in addition to this, the Candidate has passed in a satisfactory manner an examination on one or more of the optional subjects, it shall be stated that the examination, has been passed "*with great distinction*."

21 There shall be published every three months under the signature of the Secretary of the Province, in the *Official Gazette*, the *Journal de l'Instruction Publique* and *The Journal of Education*, a list of the Candidates who have obtained Certificates at the three meetings, indicating exactly the classes and the nature of the Certificates.

(FORM A)

I certify by these presents that I have this day examined Mr ——— ——————— and that I find him free from defects and physical or mental maladies which would prevent him from efficiently discharging the functions of an employé in the Civil Service.

(Signature.)
(Address.)
(Date.)

(FORM B)

Statement concerning Mr. ———————————— a Candidate for employment in the Civil Service of the Province of Quebec:
1 Are you related to the Candidate and if so in what degree?
2 Are you acquainted with the Candidate?
3 Under what circumstances did you become acquainted with him?
4. How long have you been acquainted with him?
5. Is he strictly honest, sober and laborious?
6 What do you know concerning his education and his mental capacity?
7 In so far as you are able to judge of his character, is it such as to render him fit for the public employment?

(Signature.)
(Address.)
(Date.)

THE JOURNAL OF EDUCATION.

QUEBEC. (PROVINCE OF QUEBEC) JANUARY, 1871.

Science Education Abroad.

(A lecture by J. W. Dawson, LL. D., F. R. S., etc, Principal and Vice-Chancellor of McGill University, Montreal.)

Every one who reads must know that in our time no subject is more extensively agitated and debated than that of the present lecture. In every civilized country it has become a question of first-rate importance, not only for educators but for business men and statesmen, how the largest amount of success can be attained in the practical application of science to the arts of life. Everywhere, as a means to this end, it is felt to be necessary to provide the widest extent of science education for the mass of the people, and the highest perfection of such education for those who are to take leading places as original investigators or as directors of business undertakings.

From the time when I first had the honour of addressing a Canadian audience, until this day, I have not ceased, in season and out of season, to urge this subject on the attention of the friends of education here, as one of the pressing wants of this country; and within the past few years, feeling that we were falling farther and farther behind other countries, I have made some special efforts to collect additional information as to the state of science education abroad, and to bring this to bear on the public mind here, as opportunity offered.

In my recent visit to Great Britain I had this object specially in view; and found it to be one much before the minds of all educated men, and prominent in conversation and discussion whenever education was referred to. The results of recent industrial exhibitions had painfully impressed the minds of Englishmen with their actual and growing inferiority, in important arts and manufactures, to better educated nations. Great efforts were being made to erect new schools of science and to introduce science teaching more effectually into other institutions. The usual expedient in England in all doubtful and urgent matters of national importance, the appointment of a Royal Commission of Inquiry, had been resorted to; while the Commission already engaged in the improvement of the endowed schools had taken high ground on the question of science education. All this was very interesting to me, and I availed myself fully of the many opportunities which offered to visit schools of practical science, and to learn the views of those most concerned in their management; and who, in the true spirit of the brotherhood of Science, were ready to place all means of information at my disposal. What I learned I would now desire in some measure to lay before this audience, with practical deductions bearing on our own condition. While however, most desirous to convey to your minds the impressions made upon my own, I feel that the subject is too vast to be discussed in an hour, and that I can present but a mere skeleton, unless I confine myself to notices of a few of those institutions which appear to be most instructive with reference to ourselves. I shall, therefore, first, shortly define what I understand in this paper by science education, shall then notice a few science schools in England and elsewhere, and shall conclude with some practical applications of the subject.

WHAT IS SCIENCE EDUCATION?

In speaking of science then, I would restrict your attention to the physical sciences, or those which relate to what we call material things. In this great group of sciences we may recognize three subdivisions, distinguished by the modes in which they are pursued, though shading into each other. (1) Mathematical sciences, or those in which the methods chiefly pursued are those of mathematical reasoning and calculations, as, for instance, astronomy; (2) Experimental sciences, of which chemistry and several departments of natural philosophy may be taken as examples; (3) Observational sciences, such as zoology, botany, and geology. Each of these classes of subjects must be treated according to its own methods; and unless so treated is useless whether as a means of training or for practical application. The learning, for example, of any of the natural sciences by "getting up" a text book, without actual examples and work, is not of the nature of science education; and much of the undervaluing of science studies as a means of education, on the part of practical teachers, is due to their want of acquaintance with this first truth. Natural history or experimental science taught merely from books, is only an indifferent form of verbal training, and it is no wonder that those who know it only in this way should form a very low estimate of its educational value. To be usefully taught, the pupil must be familiar with the actual objects of study, and must understand experimentally the modes of attaining to results with regard to them. He will then receive a real and valuable kind of education, the benefits of which may be summed up as follows:—(1) The student is taught to observe, compare, and reason for himself, and this in a practical manner, not so easily attainable in other subjects, and tending to give an accuracy of method and quickness of perception and of forming conclusions most valuable in actual life. (2) Much knowledge of a useful and interesting character is acquired; and the student, while learning the uses and properties of common things, may rise to large and enlightened conceptions of the works of God, and the natural laws under which man exists. (3) Men are trained to pursue original investigations, and thus to enlarge the boundaries of science. (4) The means are afforded to utilize natural resources and improve arts and manufactures. With regard to the extent and nature of such science education, it appears to be the result of experience in all the more advanced countries; (1) That there should be special practical schools to train investigators and practical science workers in the departments most important to the welfare of the community. (2) That science study should form some part of a liberal education. (3) That the elements of some of the natural or physical sciences should be taught in all the common schools. (4) That means should be employed to train competent teachers of science. This being what I understand by science education, with reference to its nature, results and methods, let us glance at some of the efforts put forth on its behalf, more especially in the mother country.

THE ROYAL SCHOOL OF MINES.

In London the principal institution for science education, supported directly by the Government, is the Royal School of Mines, Jermyn street, with which is associated the Royal College of Chemistry in Oxford street.

The Royal School of Mines is an outgrowth of the Geological Survey of Great Britain, whose building it shares and whose officers are its chief directors and instructors. This association gives it great advantages, in securing the influence and management of the distinguished head of the Survey, Sir R. I. Murchison, and the services of such eminent practical geologists and naturalists as Ramsay, Huxley, Etheridge and Smyth, as professors, in giving the students access to large and admirable collections in Geology and an extensive scientific library, and in placing the young men under the immediate superintendence of those who have the best opportunities for opening up to them the paths of usefulness and success. The very atmosphere of such an institution savours of practical science, its appliances for work and study are of the most inviting description, and it has several prizes and scholarships for its more deserving students, and gives the title of "associate" to those who pass its final examinations. Notwithstanding these advantages, though it has many occasional or partial students, the number of regular students has been much smaller than could be desired. This may in part be accounted for by its situation in a city not directly interested in mining, and remote from the great manufacturing districts: in part, perhaps, by the want of appreciation of the advantages of science training on the part of the English public. It is certain, however, that the School of Mines, though its instructing officers are second to none in the world, is inferior to the great science schools of America and the continent of Europe in its academical organization, in the completeness of its course, more especially in the direction of literary and mathematical culture, and in the standard of attainment required for entrance. Were it improved in these respects, and enabled to offer a larger number of direct prizes to students, its usefulness might be greatly increased.

Still, with these limitations, the success of the school has been great. It has trained a succession of competent men for geological surveys in the United Kingdom and the colonies. Among others, the present head of the Geological Survey of Canada is one of its graduates. It has also sent forth a number of trained men into mines and manufactures, who have been very successful, not only in introducing new inventions and improvements, but in realizing fortunes for themselves; and it is stated that the demand for these men is much greater than the supply. The course of study in the school of mines extends over three years, and in the senior year the students are allowed options, by virtue of which they may devote themselves specially to chemistry, mining or geology.

The Royal College of Chemistry is a distinct institution, situated in a different part of the town, which is a cause of some inconvenience to the students of the School of Mines, who have to attend its lectures and classes in practical chemistry. It was established originally by private subscription, but has been adopted by Government. Under the able management of Prof. Frankland, it is a useful institution, and always crowded with pupils. It has, however, accommodation for only 42 practical students, and this by no means of the airy and sumptuous character to be found in the laboratories of the continent of Europe and the United States. Crowded among the shops of a noisy business street, it has no room for extension, and its teachers and students have to submit to many inconveniences which might readily be obviated were it removed to a more suitable locality, and provided with a laboratory fitted up with modern improvements. It must, however, be admitted that the utmost possible use has been made of its too limited accommodation.

THE DEPARTMENT OF SCIENCE AND ART.

The Royal School of Mines, as well as the Royal College of Science, Dublin, and the Edinburgh Museum of Science and Art, are under the direction of the Government Department of Science and Art; but its largest sphere of operations is in the great South Kensington Museum, and the schools connected with it throughout the country. In its last report these schools and classes are stated at 525 in all, with an aggregate of 24,865 pupils. This represents much science teaching; all, however, of an elementary character, and of small amount relatively to the great population of Britain and Ireland. Much of the teaching is necessarily done by teachers of a very humble grade of scientific attainment; but the most effectual means are taken to ascertain that it is faithfully done, and to give it opportunities for improvement. The principle adopted is that of giving money aids to teachers, building grants, grants for apparatus, &c., scholarships and exhibitions, medals and prizes to pupils. All of these are awarded on the results of rigid examination, conducted by papers sent from London and reported on by examiners, among whom are some of the first scientific men in the country. The aids to teachers are at the rate of £2 per annum for each first-class pupil, and £1 for each second-class pupil; and the teacher, in order to receive aid, if not a University graduate, must have obtained at least a second class in the advanced grade of these examinations. Of the aids given to pupils a number are in the form of exhibitions in aid of attendance on higher science schools, and in the case of the higher Government schools the fees are remitted in favor of students taking these exhibitions. It would be difficult to imagine a system likely to do more good, and all that is wanted is that it should be further extended and that more thorough means should be adopted for training the teachers.

SOUTH KENSINGTON MUSEUM.

The most conspicuous part of the establishment at South Kensington is its museum, embracing a vast collection of objects illustrative of industrial products, art and manufactures, and one of the most popular and useful places of instruction by the eye in London. It is proposed to remove to the extensive buildings at South Kensington the vast Natural History collections of the British Museum, and also the collections of the Geological Survey, so as to promote science study as well as that of art. Art education on an extensive scale is conducted at South Kensington itself, as well as in a multitude of affiliated art schools. More especially, young persons are trained as teachers, and with reference to practical applications to decorative art of every description. As illustrations of these, I was shown large collections of patterns for wall papers, table cloths, pottery, and coloured and engraved glass, prepared by the pupils for competition for prizes offered by manufacturers; while in a gallery of the museum, assistants were busy in arranging a vast collection of drawings and paintings sent in from affiliated schools for competition. In the Art training school I saw hundreds of pupils engaged in all kinds of work from the elements of drawing to studies in painting and modelling from life. In addition to the study in the schools, the students, of whom there are between eight and nine hundred, have access to the *Galleries of Art in the Museum*, and to an Art Library of 25,000 volumes and a collection of 55,000 engravings and photographs. Last year 107 schools were conducted under the "Department" with 20,000 pupils; and in addition to these, elementary drawing was taught in 1,094 schools to 120,928 children. Though art is distinct from science, I think it proper, when speaking of South Kensington, to refer to its work in art as well as in science. Not only is science the handmaid of art, but art is also the handmaid of science, and both must flourish or decay together. More especially the study of art in its application to the wants of ordinary life, cannot fail to be auxiliary to the advancement of science. It is a matter of profound regret that the Boards of Art organized in this country more than ten years ago, have been permitted to languish, and have not been enabled to establish here institutes on the plan of those of the Department of Science and Art in England.

THE LONDON UNIVERSITY.

University College, London, has no organized science school, but it trains men for the Bachelor of Science examination of the London University. This is a general science examination, implying the training necessary for matriculation, and subsequent studies in Physics, Chemistry, Animal Physiology, Geology, Logic, and Moral *Philosophy. Bachelors of Science of two years standing* can go up for an examination for the degree of Doctor of Science. These science degrees of the University of London do not lead directly to practical work, and this is an important defect in the system, but they are, no doubt, very important as stimuli to the general preparatory training required by every man of science. The Bachelor of Science degree as offered by the University of London, has also undoubtedly tended to raise science to its proper status in connection with the higher education, but it is not as yet largely taken. At the graduation in May last, at which I was present, there were only eleven Bachelors in Science and seventy Bachelors in Arts. This arises in part from the want of prestige and antiquity in the degree itself, and in part from its having to compete with the honours in science which may be taken in courses in arts, and with the special science schools.

The Birkbeck laboratory of University College accommodates 24 practical students; and I was pleased with the ingenious arrangement of its theatre, by means of which 98 students can be employed simultaneously in making experiments with tests, under the direction of Professor Williamson and his assistants. This is only one among many indications which I observed of the tendency to give to examinations and instructions in science a practical character, an evidence that its true nature is being more and more appreciated.

THE ROYAL INSTITUTION.

It would be wrong to leave London without referring to the remarkable and unique establishment known as the Royal Institution, founded in 1799, at the suggestion of Count Rumford, and celebrated throughout the world as the theatre of the labours of Davy, Faraday and Tyndall, while in London itself it is known and valued as an agreeable and popular exponent of science by means of its lectures and discourses. The Royal Institution has a good building in Albemarle street, containing its theatre, laboratories, library, and reading room. Its function is twofold. First, it sustains as its professors eminent scientific men, and provides them with the means for prosecuting original research; secondly, it provides, by its afternoon and evening lectures, the means of presenting to the more refined and educated classes, information as to the latest result of scientific discovery, from the lips of the actual discoverers themselves. Its lecture-room is always filled with a cultivated and attentive audience, who have the advantage of learning orally and at first hand what others must gather from reading or from secondary sources.

The Royal Institution thus occupies a middle place between the general public and those Scientific Societies, like the Royal, Geological and Linnean, whose objects are strictly scientific or special, and whose meetings are consequently almost entirely composed of scientific men. At the same time it promotes original research in a manner peculiar to itself, and in the highest degree successful. It *undoubtedly exerts a most important influence in keeping those who* move in the higher strata of society in London abreast of the science of the day, and thus procuring moral as well as material support for scientific researches; more especially for those which, not being of direct educational or practical utility, are liable to be neglected even by the more intelligent portion of a community, engrossed in the accumulation of wealth or in the still more laborious pursuit of spending it.

OWEN'S COLLEGE, MANCHESTER.

In the great manufacturing community of Manchester, academical education rears its head in an institution of no mean repute in the matter of science education. Owen's College is, like our own McGill, based on the liberality of a wealthy merchant, whose name it bears, supplemented by numerous additional benefactions. Among these I find a sum of £10,000, subscribed by 118 merchants and others, for a chemical laboratory and a library; a sum of £9,472 subscribed by the principal engineers of Manchester and neighboring towns, for the foundation of a chair of civil and mechanical engineering, and a fund of £200 per annum to augment the endowment of the professorship of chemistry. These noble benefactions remind us of the liberality of some of our Montreal merchants and professional men, and should act as a stimulus to others.

I am indebted to Principal Greenwood and Professor Williamson for enabling me to learn the nature and results of the science teaching at Owen's College, which in many essential respects more nearly resembles one of our Canadian colleges than any other institution which I saw in England. The department of general literature and science, or, as we should say, the course in arts, extends over three years, and, like our own, includes a certain amount of modern languages, and physical, natural, and mental science. The department of theoretical and applied science, or science course proper, also extends over three years. The first is identical with the first in arts. The second and third are occupied entirely with science subjects, along *with the French or German language. The students in* this department are prepared for the bachelor of science examination at London. This course is said to be suited to prepare "for the higher departments of manufacturing art, and for pursuits and professions purely scientific." It is also said to be "adapted for such as are hereafter to be engaged in commercial pursuits"—a remarkable testimony to the ideas of education on the part of business men at Manchester, who in this respect come up more nearly than any others in England and her colonies to the standard of the New England cities. The Principal informed me that there were last session 100 students taking this science course. The third department in Owen's College is that of civil and mechanical engineering, in which students are prepared for the examinations in engineering in the Indian Public Works Department, and also for entering on the higher branches of the engineering profession. The course extends over three years. It had only twenty students last year.

Another and most interesting feature of Owen's College, suited to its position in a great manufacturing town, is the provision made for evening classes These include the subjects of the general course, and also a pharmaceutical course intended to prepare chemists and druggists for the examinations under the Pharmacy Act. Most of the students in these classes are what we would call partial students; but some study for the Degree of B.A. of London University. The intention of the college is to accomodate those whose business engagements prevent them from attending lectures in the day time; and the number of students last year was no less than 400. This is a remarkable indication of the avidity for learning on the part of the young business men of Manchester, who enter on this somewhat severe course of study as an employment for their evenings, and after the toils of the day. It is further to be considered that many of these young men have to walk or drive considerable distances in order to attend these classes; but in all the cities of England distance is much less regarded than it is in this country. Prof. Roscoe delivers a separate course of lectures on chemistry to women, which, I was informed, had been successful, though I did not note the number of students. The authorities of the college have under consideration the establishment of a regular academical course for women, which will be largely of a scientific character.

Owen's College has its class rooms at present in an old building adapted to its use; but an elegant new building is now in process of erection at a cost of £90,000, and a sum of £130,000 is said to have been raised as a building fund. The foundation stone of this building was publicly laid in September last. It is to be observed that Mr. Owens wisely prohibited any portion of his endowment fund being expended in buildings, and that the Government of Great Britain has given no aid to Owen's College, so that this large sum is a product of private munificence, chiefly in the town of Manchester.

SCIENCE TEACHING AT CAMBRIDGE

The two great English Universities of Oxford and Cambridge are obviously not content to lie under the aspersion some time ago cast on them by an eminent scientist that their "atmosphere" is unfavourable to scientific study. Both are are making rapid strides in this direction.

At Cambridge, under the kind guidance of Prof. Stokes, himself one of the most eminent of living physicists, and of the patriarchal Sedgwick, and his able assistant Seele, I saw the improvements which in late years have been made in the means of study in natural and physical science, and which tend, with other changes, to give greater effect to the regulations in favour of the natural science tripos. Still more recent movements in this direction are the appointment of a university professor of pure physiology, and the movement in aid of a university professorship and demonstratorship of experimental physics, towards the buildings and apparatus necessary for which, the Chancellor, the Duke of Devonshire, has offered a contribution of £6,300.

WHAT OXFORD IS DOING.

Oxford has, however, taken the lead of its sister University in this matter, and I shall therefore notice more in detail what I had the pleasure of seeing there in the way of provision for practical science teaching.

The new museum, now of world-wide reputation, is not merely a museum in the more modern sense of the term, but a series of scientific laboratories and class rooms, attached to a magnificent library and museum. The museum proper had been largely increased and improved in its collections since my last visit in 1865, and its great central glass-roofed court, more than 100 feet square, with its surrounding galleries, is now well filled with specimens in Geology and Zoology. On the south and west sides, the museum is encompassed with class rooms and laboratories in geology, chemistry, and physical science. On the north side are the laboratories and class rooms in physiology. Prof. Phillips was absent, owing to an attack of illness, and in his department I saw only assistants engaged in laboriously piecing together the huge bones of the Cetiosaurus, a gigantic reptile with thigh bones more than five feet in length, of which a magnificent skeleton has recently been discovered in a quarry not far from Oxford. I had, however, the pleasure of seeing the students at work in the laboratory of practical chemistry, under Prof. Brodie, and of examining the admirable arrangements of Prof. Rollestone for practical work in physiology. Among other things which I saw in the physiological laboratory, were excellent dissections of mollusks and worms made by students as a part of their examinations in the honour course of Natural science.

Though the museum contains rooms for experimental physics, the University has greatly enlarged its means of instruction in this department, by the erection in the vicinity of the museum of a physical laboratory, which I believe will cost about £10,000, and which, in the perfection and completeness of its arrangements, will surpass all similar workshops of science, not only in England, but in the world. Prof. Clifton, who himself showed me the building, and explained its plan, has endeavoured to make this laboratory in itself a model of practical science, considered as the art of doing everything in the best way, by applying in the most perfect manner every known improvement and many original inventions of his own, to secure convenience and accuracy of working. The building has a central hall for apparatus, and for certain experiments requiring large space; a class room, which is a model of acoustic perfection and mechanical arrangement; and a number of work-rooms, in which all the most delicate kinds of operations in weighing and measuring can be carried on with the best apparatus and with every precaution against error. This laboratory was to be opened in the present autumn, and I was informed by Prof. Clifton that he expected to begin with about 30 practical students. The object of the laboratory is two-fold—(1) to train observers and experimenters more thoroughly than heretofore; (2) to undertake original physical researches with more perfect appliances than those now available.

The Oxford new Museum, with the neighboring Physical Laboratory, thus constitutes in itself a great educational institution in physical science, managed by some of the ablest instructors and original investigators of the day, and providing for studies in experimental physics, chemistry, mineralogy, geology, physiology, and zoology: botany being otherwise provided for in connection with the Botanic Garden. It has seven large class rooms and a multitude of working rooms and laboratories, with the scientific department of the Radcliffe Library. These appliances are as yet large in comparison with the number of students who use them; but the number of students is increasing, and this apparently not at the expense of the literary courses of study. It is to be observed, moreover, that the aim of the Oxford Science school is high. Its object is not so much to train practical workers in science as applied to the arts, as to give the education necessary to enable those who receive it to take their places as original investigators in the advancement of theoretical science, and in connection with this to bring out the true value of physical science as a means of securing the highest mental culture. Viewed with reference to these ends, Oxford is undoubtedly an excellent Science school; and a University which offers its highest honours, in courses, in which practical chemistry and physics, and dissections of invertebrate animals, constitute important parts, cannot be regarded as unfavourable to the cultivation of science. It must be admitted however that these improvements have been effected only after severe contests between the advocates of modern science and the conservative element in the University, contests in which my valued friend, Dr. Acland, well known to many of us here, has borne an influential part.

MOVEMENT IN EDINBURGH.

Edinburgh has as yet no organized Science school, and has undoubtedly been falling behind the English schools in its reputation for training in natural science. This is, however, a relative rather than an actual decadence, and there is a very strong desire on the part of many of the friends of the University to restore its ancient reputation in this respect. In evidence of this we have the recent endowment of the Baxter Chair of Engineering, and the still more recent of Sir Roderic I. Murchison to give £1,000 as the endowment of a Chair of Geology, which I am informed the Government is likely to supplement with a like sum. The Department of Science and Art has also attached to the University a museum on the plan of that of South Kensington, under Prof. Archer; but no lectures are delivered in connection with it. No Institution in Great Britain has a better field for science education than Edinburgh, and it possesses many excellent teachers, but their action is to some extent paralyzed by want of facility for mutual cooperation, and by the want of some professorships necessary to complete the course of study. In the meantime, there are excellent practical classes in chemistry, experimental physics and botany, and there is an academical course for a science Degree. In this course, the candidate is required to have the degree of B.A., M.A., M.B., or M.D., or to hold certificates of having passed the examinations in two of the departments of the University course, or to have matriculated in the University of London. Otherwise he must pass a preliminary examination in mathematics, physics, chemistry, zoology, and botany; but may omit this examination if an M.A. who has taken honours in natural science, or an M.B. or M.D. who has taken honours in natural history, and has pased the examinations in physics, higher mathematics, and logic. There is then a final examination in which the student may select one of three branches in which to pass, viz.: (1) Mathematical science; (2) physical and experimental science; (3) natural science. On passing this examination he is entitled to the degree of Bachelor of Science; and at the end of twelve months may come up for the degree of Doctor of Science, in the examination for which he must show profound knowledge of a special scientific subject. The number of candidates for these degrees is not as yet large, but is increasing. They might obviously be rendered much more valuable and attractive by connection with special science courses, leading to application to the arts or to the definite branches of original research.

It may be well to mention here that the Principal of Edinburgh University, in his inaugural address, has suggested the omission of Greek from the University course for M.A., to make room for science culture, and that the chairman of the Endowed Schools Commission has, as already mentioned, put this idea in a practical shape before the English Universities, in an official letter to the Vice-Chancellors, in which he intimates the design of the Commissioners to establish schools in which Latin alone shall be taught, in addition to science and modern languages and literature, and invites them to open their examinations for degrees and honours to the pupils of such schools. While it is to be doubted whether any such change is required here, where classics have not been so exclusively insisted on in the schools as in England, the arguments adduced by Lord Littleton in his circular are well deserving of study, as indicating the strong feeling among parents and educated persons in England that science education for their children is a matter of absolute necessity, and that if it cannot otherwise be obtained, some portion even of their cherished literary culture must be sacrificed to a want, on the supply of which even national existence may depend.

SCIENCE TEACHING IN THE UNITED STATES.

We might now turn to the efforts which have been made in the United States, where, owing to the more general diffusion of elementary education, the value attached to the applications of science to the arts of life, and the liberality of private benefactors and of the State and general Governments, much more has been done than in England, and where such schools as the Lawrence and Sheffield Schools, the Boston Institute of Technology, and the Cornell University, challenge comparison with any in the world. I shall, however, refer to only one of these, which I had the pleasure of visiting rather more than a year ago, and which, in my judgment, has been one of the most successful.

SHEFFIELD SCIENTIFIC SCHOOL.

The Sheffield Scientific School is a modern outgrowth of the old University of Yale College; and originated in 1847 in the organization of the "Department of Philosophy and Arts," under Professors Silliman and Norton, representing respectively the subjects of applied Chemistry and Agriculture. The scheme seems to have been devised by the elder Silliman, and to have had its birth in his private efforts in previous years to give practical instruction to special students. This department was maintained with moderate success for several years; but at length in 1860 E. Sheffield, a wealthy citizen of New Haven, came forword to its aid with a handsome gift of a building and apparatus valued at over $50,000 and a fund of $50,000 more to endow Professorships of Engineering, Metallurgy, and Chemistry. This enligthened benefaction at once placed the school on a respectable footing, and in 1863 it was further enlarged by the application to its use of the share of the State of Connecticut in the large grants of land made by Congress in that year for purposes of scientific education, grants which have borne similar good fruit in many other States. The Sheffield School will also be a large sharer in the benefits which the University will derive from the great Museum founded by Mr. Peabody, and endowed by him with the sum of $150,000. The present extremely valuable collections of Yale College are stored in rooms of quite inadequate dimensions, and are being rapidly augmented and improved. Prof. Marsh and Prof. Verrill alone have vast stores of fossils, corals and other specimens in basements and cellars; and when the whole shall be arranged in Mr. Peabody's Museum, Yale College will be inferior to few Academic institutions in the world in regard to its facilities for teaching the science of nature through the eye. A special collection in Sheffield School, very valuable and well worthy of study, is that of economic geology. It is admirably arranged, and gives at one view an idea of nearly all the mineral resources of the United States from the Atlantic border to the Pacific.

The building of the Sheffield School is well suited to its purpose, though it is an old medical school adapted to its present use; and the scope of the institution is wide, including six distinct courses, any of which may be followed by the student. These are: 1st, Chemistry and Mineralogy: 2nd, Engineering and Mechanics; 3rd Mining and Metallurgy; 4th Agriculture; 5th, Natural History and Geology; 6th, A Select Scientific and Literary Course. The class rooms and laboratories struck me as remarkably ingenious and neat in all their arrangements, and combining in a great degree all possible conveniences, while the uncomfortable arrangements too often seen in academic rooms had evidently here been replaced by the exercise of some engineering and mechanical skill and contrivance; and by a combination of lecture room and cabinet, the means of illustration had been rendered extremely accessible. In token that the Sheffield School is not altogether a school of mines looking down into the bowels of the earth, its liberal founder has presented it with an object glass having an aperture of nine inches. It is placed in a tower constructed for it; and with a meridian circle and other instruments, enables students to learn all the work of a regular observatory, as well as the operations of astronomical geodesy. Any one interested in the training of the young men of Canada can scarcely avoid a feeling of envy in visiting such an institution as this, furnished with so many facilities for enabling the active mind of youth to grasp all that is of practical utility or provocative of high and noble thought in the heaven above and in the earth beneath. At this moment a Canadian Sheffield, judiciously aiding any University having an adequate and permanent basis, would do more to promote the trade and manufactures of this country and its scientific reputation, than can be done by any other agency.

The faculty of the Sheffield School includes twenty-three names, and its roll of students numbers one hundred and forty. It is scarcely necessary to say that several of the professors at Yale are active and successful original workers, and that the place is not only an effective scientific school, sending out each year a large corps of trained men into the higher practical pursuits connected with science, but also an important centre of discovery and original investigation, further materials for which are being constantly accumulated. More especially in geology, mineralogy, palæontology, zoology, and chemistry are such men as Dana, Silliman, Marsh, Brush, and Verrill adding to the stock of knowledge for the whole world, as well as training their students. And this is one of the results in all cases of a well appointed and efficient school of science.

An additional endowment of about $50,000 has been collected during the past year for this excellent school, which in its provisions for scientific, in connection with academical education, is second to none in the possession of the English race.

One most important feature of the Sheffield School is that it combines what is valuable in a science degree with the special training of a practical science course. Students who have the necessary literary acquirements may thus obtain the degrees of Bachelor and Doctor of Philosophy along with their special scientific training as civil or mining engineers, assayers, &c., while others can secure the practical advantages without the degree. In a recent article in the Yale College *Courant*, Prof. Dana explains the details of this system and its advantages and economies. He maintains that "the modification in American colleges, which is demanded by the vast development of the sciences of nature within the past century, and also by the contemporary progress of linguistic and other sciences, is accomplished by the Yale scheme through a method which does not sacrifice in any degree classical education, and which at the same time combines thorough literary culture with the widest range and highest development of scientific education."

GERMANY AND SWITZERLAND.

Though much is being done in England and the United States, science and technical education are carried to a still higher point in Germany and in Switzerland, which perhaps excel all other countries in this respect. In the former country, while every one is educated, general education is made to lead to technical education in a great variety of schools, suited to persons in all conditions of life, and culminating in the great technical Universities, a kind of institution as yet unknown in the English-speaking world, unless Cornell University can be regarded as a step in this direction. In Germany there are now no less than six technical Universities, and a large number of technical colleges or higher schools to train students for these Universities, or for directly entering into employments in arts and manufactures.

TECHNICAL UNIVERSITIES.

Mr. Scott Russell, in his work on Technical Education, takes the Polytechnicon, or Technical University of Switzerland, as an example of the most perfect organization of this kind; and I may abridge from his notes the following facts as to its scope and organization. Its courses of study are arranged under 145 subjects, divided among 31 professors, 10 assistant professors, and 16 private teachers and lecturers. They consist entirely of science, applications of science to the arts, and modern languages, literature and history. Among the few subjects not included under these heads are the Swiss federal constitution and rights, and the Biblical History of Creation, a subject scarcely thought of in the English world, even in the education of theological students The students are either regular or "free," the latter taking selected courses; but of 762 students only 173 are free or occasional. In the regular programme of study the 145 subjects above referred to are divided into eight groups: (1) Preparatory subjects necessary for those who come imperfectly prepared; (2) subjects relating to architecture and building; (2) civil engineering; (4) mechanical engineering; (5) practical chemistry; (6) agriculture and forestry; (7) subjects necessary for scientific workers, professors and teachers; (8) a general course of philosophy, statesmanship, literature, art, and political economy. In aid of these courses of study the University possesses an astronomical observatory, arranged for teaching observers; a chemical and mechanical laboratory, for experiments in new inventions, &c.: a chemical laboratory, for ordinary practical teaching, which Mr. Scott Russell calls a palace of science in comparison with similar places in England; collections of drawings, models and machines; a collection of architectural models and sculpture; collections in zoology, geology, and antiquities; and a botanical garden. To the foundation of the University the Federal Government of Switzerland contributed £20,000, and the canton of Zurich £136,000. Its annual expense is very moderate, being only £13,459 sterling. From such institutions in Germany and Switzerland annually proceed numbers of educated young men who are prepared to advance every branch of art by the applications of science, who are distancing England in so many manufactures, and who are now contributing so largely to the wonderful success of the German armies. It is well for us to remember that the Technical University of Zurich ministers to the wants of a population of only two millions and a half, or considerably less than that of Canada, and that even the little state of Wurtemberg, with a population of less than two millions, has its Technical University at Stuttgardt, with no fewer than 57 professors and teachers. It is further to be observed that these Universities are but the higher pinnacles of a complete system of technical education, descending from them to the humblest schools of practical science, for the children of labourers. It is scarcely necessary to add that they do not detract from or interfere with the great general Universities of Germany, in which scholarship and philosophy have reached so high a pitch of development.

A recent English writer thus eulogizes the Prussian system :—

"The Prussians, whatever their other qualities, are emphatically a scientific people, and to that predominating characteristic first and foremost are their recent military triumphs due. We do not mean that because they are great chemists, astronomers, and physicists, therefore are they necessarily great soldiers: so narrow a proposition would hardly be tenable. What we mean is that the spirit of science possesses the entire nation, and shows itself, not only by the encouragement given throughout Germany to physical research, but above all by the scientific method conspicuous in all their arrangements. What does the word Science, used in its wider sense, imply? Simply the employment of means adequate to the attainment of a desired end. Whether that end be the constitution of a government, the organization of an army or navy, the spread of learning, or the repression of crime, if the means adopted have attained the object, then science has been at work. The method is the same, to whatever purpose applied. The same method is necessary to raise, organize, and equip a battalion, as to perform a chemical experiment. It is this great truth that the Germans, above all other nations, if not alone amongst nations, have thoroughly realized and applied. In all the vast combinations and enterprises with which they have astounded the world, no one has been able to point to a single deficiency in any one essential element. Every post has been adequately filled and every want provided for; from the monarch, the statesman, and the strategist, to the lowest grade in the army. This is the method of science, literally the same method which teaches the chemist to prepare his retort, his furnace, and his re-agents, before commencing his experiment."

WANT OF SCIENCE TEACHING IN CANADA.

Let us now turn to our own country, and study its means and appliances for the pursuit of practical science. The task is an easy one, for with the exception of two or three small and poorly supported agricultural schools, this Dominion does not possess a school of practical science. With mining resources second to those of no country in the world, we have not a school where a young Canadian can thoroughly learn mining or metallurgy; and, as a consequence, our mines are undeveloped or go to waste under ruinous and unskilful experiments. With immense public works, and constant surveys of new territories, we have not a school fitted to train a competent civil engineer or surveyor. Attempting a great variety of manufactures, we have not schools wherein young men and young women can learn mechanical engineering, practical chemistry, or the art of design, or we are very feebly beginning such schools. We have scarcely begun to train scientific agriculturists or agricultural analysts. Our means for giving the necessary education to original scientific workers in any department, or of training teachers of science are very defective. Hitherto we have been obliged to limit ourselves to the provision of general academical courses of study, and of the schools necessary for training men in medicine, law and theology. Other avenues of higher professional life are, to a great extent, shut against our young men, while we are importing from abroad the second-rate men of other countries to do work which our own men, if trained here, could do better. Let us enquire then what we are doing in aid of science education, more especially in this commercial and manufacturing metropolis of Canada, which we may surely venture to regard as at least a Canadian Manchester, and something more important than a Canadian Zurich.

WHAT IS BEING DONE IN MONTREAL.

(1) We have at least advanced so far as to regard physical science as a necessary part of a liberal education. In this University some part of natural or physical science is studied in each year of the College course, and we provide for honour studies in these subjects, which are are at least sufficient to enable any one who has faithfully pursued them to enter on original research in some department of the natural productions and resources of the country, and to receive some considerable portion of the training which such studies can give. We have provided in our apparatus, museum, and observatory, the means of obtaining a practical acquaintance with several important departments of science. But in a general academical course of study too many other subjects require attention to allow science to take a leading place; and it is not the proper course of educational reform to endeavour to intrude science in the place of other subjects at least quite as necessary for general culture. We require to add to our general course of instruction special courses of practical science, presided over by their proper professors, and attended by their own technical students

(2) The lower departments of science education are to some small extent provided for by the teaching of elementary science in the schools. This, imperfect though it is, is of value, and I attribute to the partial awakening of the thirst for scientific knowledge by the small amount of science teaching in the ordinary schools in the United States and in this country, much of that quickness of apprehension and ready adaptation to new conditions, and inventive ingenuity which we find in the more educated portions of the common people. The Provincial Board of Arts and Manufactures also deserves credit for the attempts which it has made, under many discouragements, to provide science and art classes for the children of artisans. Proposals are also before the Local Legislature for Schools of Agriculture. The Local Government has procured reports on this subject from the Principals of the Normal Schools, and has also sent a special agent to study and report on the Agricultural Schools of France, Belgium and Ireland, which are well worthy of imitation. A still more important suggestion has been made to the Dominion Government by the Director of the Geological Survey for the erection of a School of Mining.

These arrangements and proposals are valuable as far as they extend; but they fall short of providing the full measure of the higher education, whether with reference to the training of original investigators, or of the various kinds of professional men required for the development of the resources of the country. Let us enquire how this wider and higher science culture can be secured.

SUGGESTIONS FOR HIGHER SCIENCE TEACHING.

The higher technical and science education may be provided for in either of the following ways. (1) We may have special schools of mining, engineering, &c., each pursuing its own course, and not connected with any general institution. The objections to this are, that it is not economical, that it cannot provide the necessary literary and general training, that the pupils of such schools are very likely to be of various degrees of excellence and very partially trained. Such objections are applicable to schools like the Royal School of Mines in London, and I think they would prove fatal to the influence of such schools in this country. (2.) We might imitate the German technical universities. This would be the most thorough course possible; and were the means forthcoming, I cannot conceive of any greater educational benefit to this country than the institution of such a University. But it may be long before we shall find in our Legislatures, general and local, the wisdom and patriotism which actuated those of Switzerland in establishing the Zurich School; and we may have to wait quite as long for the appearance of a Canadian Cornell to give and to stimulate legislative liberality by his giving. (3.) The last, and, it appears to me, the only practicable course at present, is to ask for endowments similar to those of Lawrence and Sheffield, and thus to establish special courses of Science in connection with academical institutions, on the plan so well carried out in Owen's College, Manchester, and in the Sheffield School of Yale. This has proved the most successful course in the United States and in the Mother Country, and I have no doubt will prove so here. It is to be observed in this connection that I would not propose merely the institution of a Science degree. We have in this University the means to do this now, but I doubt its expediency, more especially as our honour course in Mathematical and Natural Science is equivalent to that for such a degree and something more, and can be as readily and easily pursued. Nor would I follow the advice above referred to as given by the Principal of Edinburgh University and the Chairman of the Endowed Schools Commission, to curtail the classical part of the ordinary course in favor of science studies. Such an arrangement would, I have little doubt, injure the literary part of the academical course more than it would benefit science. I would prefer a regular and definite science school, with a course extending over three or four years—the first year to be identical with or similar to that of the ordinary course, or an equivalent examination to be exacted, at least, in modern literature and science; and the remaining years to be occupied with mathematical, physical and natural science, and modern languages, branching in the closing two years into special studies leading to particular scientific professions. The staff and appliances of such an institution would depend on the extent of its range; and this, to ensure success, should not be small.

In this University large provision has been made in apparatus, collections and teaching power, for the foundation of a good science school; but to enable us to undertake the task effectually would require, in addition to our present means:

1. The separation of our mathematical and physical chairs, or the employment of an assistant professor.

2. The division of our natural science chair into two, or the appointment of an assistant professor.

3. The endowment of a chair of civil engineering and surveying.

4. Professors, lecturers, or tutors in mining, assaying and metallurgy, practical chemistry, agriculture, and agricultural chemistry, and mechanical drawing.—Some of these departments might be taken up by persons otherwise employed, and not depending for their whole support on the University.

5. Some improvement of, and additions to, our present apparatus, and the addition of collections of models, machines, and objects relating to the arts.

This might involve an additional annual expenditure of say $8,000, a very trifling sum in comparison with the cost of similar institutions elsewhere. With this, and the fees of students, we might here establish an efficient School of Practical Science and Technology for the Dominion of Canada, which would at once raise the character and reputation of this city throughout the world, and confer incalculable benefits on education and the arts of life. Such an Institute is wanted to crown the educational fabric reared here by the liberality of Montreal merchants, with its success and the full measure of its utility. I would go further than this, and hold forth the hope of the full realization of the object in view, if an annual revenue of even half the sum above mentioned could be secured at once by private endowment. We could begin on an economical scale, and with the more important subjects only, and could, surely, with some reason expect the Government of the country to supplement such a private endowment with a like sum.

It may be asked, would students be forthcoming? I may with confidence answer the question in the affirmative. From the applications made to me on the part of young men for whom I can do little or nothing, I believe that one central well-appointed technical university in this Dominion, would be well sustained, in so far as the number of students is concerned; and that the extension of population, of mines, manufactures, railroads, and other works, would afford an ample outlet for all the men it could train, while the professional work of such men would itself tend to increase the demand.

It is certain, however, that if the Government of this country could be induced to sustain a system of elementary technical schools similar to those of the Department of Science and Art in England, or similar to those of Prussia, a double benefit would be secured, in so far as the higher science education is concerned, in finding occupation as teachers of science for some of the graduates, and in giving the necessary preliminary training to students. At the same time the effects of such schools would be of incalculable importance to the working classes of this country. Local benefactors might do something for such schools; but for a proper system the Legislature must intervene, and it can secure the end only by payment for results on the English system, under proper arrangements for examination and inspection.

CONCLUSION.

In conclusion, I may remind some of my audience and inform others, that the views advanced in this lecture, and which are now sweeping on in a resistless tide in every civilized country, are not new with me. When, in 1855, I entered with much diffidence on the arduous and then not very hopeful office which I now have the honour to occupy, I held views on this subject as advanced as those which I hold now, and saw quite as clearly as at this moment, the improvement and extension of science education to be the greatest educational movement of our time. I had then studied the Reports of the University Commissioners in England, and had read the admirable exposure of the evils of the existing systems made by Sir Charles Lyell. I was familiar with the details of the Prussian system. I had recently been engaged, with several leading edµcationists, under the presidency of Sir Edmund Head, in the organization of a scheme for the reform of the University of New Brunswick. I had just returned from conferences with leading educational and scientific men in England and the United States. I was strongly impressed with the necessity of science education in this country, zealous for its introduction here, and hopeful that, if any kind of education would commend itself to the sense of progressive, commercial community, this would.

Confessing in my inaugural address that I came among you "in the hope of promoting the study of the subjects to which I had devoted myself, and at the same time advancing the cause of education," I maintained that the spirit now abroad with regard to University reform "had for its object to make the carefully elaborated learning of all the great academical centres become more fully than it has yet been the principal moving power in the progress of practical science, of useful art and of popular education," and I specially indicated the institution of schools of civil and mining engineering and of scientific agriculture, as enterprises which should be at once entered upon.

When I look back on the hopes and struggles of those earlier years, though I entertain a feeling of profound thankfulness to God for the measure of success and prosperity which has attended this University, and though I am most grateful to its many benefactors, I cannot forget the dissappointment of my own hopes. Much has been done for general education, and McGill College has grown to be a comparatively great and prosperous institution. But all that I have done toward this any one could have done. The one thing that I could have done, for which I was willing to sacrifice all that I would have gained as an original worker in Geology, and which would have been of more real importance, not only to Montreal, but to all this great country from Red River to Newfoundland, than all the rest, has not been done. I confess I often almost sink under the despairing feeling that it will not be done while I live; and that I may never have the opportunity of doing for this community the only great service that I believe myself competent to confer upon it.

Yet I know that much good preliminary work has been done, that material has been accumulated and tastes for science created; and I am reluctant to abandon the hope that I may yet see in Montreal a thoroughly equipped Institution, in which any young man, with the requisite ability and preliminary education, may learn the scientific facts and principles, and receive the training in scientific methods, necessary to qualify him for mining, metallurgy, assaying and engineering, agriculture, chemical manufactures, or other applications of science to art. Until this can be realized, I shall feel that the work of my life has been only very partially and imperfectly successful; and I shall know that this city has not taken the means to prepare itself fully for that greatness which its position and advantages mark out for it, but which it cannot attain, except as the educated metropolis of a country—educated not merely in general learning and literature, but in that science which is power, because it wields the might of those forces which are the material expressions of the power of the Almighty Worker.

MISCELLANY.

Science.

— *Standard Measures.*—One of the most important standard measures is that for distances or measures of length. A practical want has always been felt of some fixed and invariable standard, by means of which all distances might be compared, and such fixed standard has been sought in nature. There are two natural laws, either of which afford this desired natural element. Upon one of them the English and Americans have founded their system of measures, and upon the other the French have based their system.

First. The English and American system is based on the law of nature that the force of gravity is constant at the same point of the earth's surface, and consequently that the length of a pendulum which oscillates a certain number of times in a given period is also constant. It is accordingly decreed by English law that the 1-3.26159th part of the length of a simple pendulum, beating seconds at the Tower of London, shall be regarded as a standard English foot: and from this, by multiplication and division, the entire system of linear measures is established.

Second. The French system of measures is founded upon the principle of the invariability of the length of an arc of the same meridian between two fixed points. By a very minute survey of the length of an arc of the meridian from Dunkirk to Barcelona, the length of a quadrant of the meridian was computed, and it has been decreed by French law that the ten millionth part of this length shall be regarded as a standard French metre; and from this, by multiplication and division, the entire system of French linear measures has been established.

On comparing two accurate scales, Captain Kater found that the French metre was equal to 3.280899 English feet, or 39.37079 English inches. This relation enables us to convert all measures in either system into the corresponding measures of the other system.

The standard of linear measures having been established on natural and invariable laws, the standard measures of weight have been in turn founded on them. Thus it has been agreed that a cubic foot of pure water, at its maximum density, shall be regarded as weighing one thousand ounces. This fixes the standard ounce, and all other weights are determined by being referred to this as a standard.

As stated above, the American unit of length is the same as the English unit. The comparison is made by means of a scale eighty-two inches in length now in the possession of the Treasury Department, and manufactured by Troughton, in London.

The standard unit of weight is the Troy pound, copied, in 1827, by Captain Kater, from the imperial pound Troy in England. The standard is at present kept at the mint of the United States at Philadelphia.

— *The Right Hand.* — The *Journal of Psychological Medicine* for July contains an interesting article on the preference of the human race to use the right hand. The different theories to account for this well-admitted fact are examined, and it is shown that all fail to explain the superior strength of the right side of the human body. One theory is based upon the anatomical arrangement of the arteries from the arch of the aorta, and experiments and examinations, it is alleged, show conclusively the connection, between the arteries and the arms and hands. But it is objected that this explanation does not account for the more frequent use of the right leg, the right eye, and, perhaps, the right ear. Another theory is, that the greater efficiency of the right side depends on the larger development of the left half of the brain, but the facts do not support all the phenomena. Again, it is advanced that the use of the right hand is entirely a matter of education; but it is asserted that it is not uncommon to see a child belonging to a right-handed family become most perversely left-handed, notwithstanding its earliest motions have been carefully watched and directed. Another curious fact has been discovered, that while the sense of touch is most developed on the right side, the sense of temperature and the sense of weight, very nearly allied to the muscular sense, are more acute on the left. On surveying the whole ground, the writer arrives at the conclusion that we shall probably never know the nature and origin of the impulse to use the right side of the body in preference to the left, and why such impulse is occasionally inverted.

— *New Medical Chirurgical Society, Montreal.* — For some years past, the want of a society among the medical practitioners of Montreal for the advancement of medical sciences, and the holding of periodical meetings at which subjects of general interest to the profession might be discussed, has long been felt. In all large cities new phases of the theory and practice of medicine are frequently occurring, and the intelligent discussion of these and other matters of special interest to the profession, cannot fail to be of advantage. At a large meeting of members of the Medical Faculty, held recently, the "Montreal Chirurgical Society" was organized on the basis of the report of a committee which had been appointed at a preliminary meeting held at the Natural History Society Rooms. The new society will be composed of recognized medical practitioners and will hold fortnightly meetings at the above Rooms, at which papers will be read and matters referring to the medical branch of science discussed. At the late meeting the following office-bearers were elected viz:—President—Dr. G. W. Campbell, Dean of Medical Faculty: 1st Vice President—Dr. R. Godfrey; 2nd Vice-President—Dr. T. H. Pelletier; Secretary Treasurer—Dr. T. G. Roddick; Council—Messrs. Drs. Fraser, Reddy and David.

ART.

The South Kensington Museum has become the possessor of a collection of jewels purchased from the Treasury of the Virgen del Pilar of Saragossa. The jewels have been arranged in the Prince Consort Gallery. Independent of their value as works of art, they deserve special attention from the historical interest attached to them. Among the most interesting lots purchased for the department of Art the following jewels of the Cinque Cento period may be especially noted; and these are the more important to the student of goldsmiths' work of that time, from the fact that they have been preserved in the Treasury of the Virgin since the date of the presentation and are undoubted genuine examples, therefore exceedingly valuable for the opportunity they afford of comparison with less authentic pieces, and leading to the detection of modern imitations which are at present so numerous: No. 321 is a gold pendant ornament, with a beautiful enamel group of the Adoration of the Magi, set with diamonds; No 332 is a reliquary of rock crystal mounted in gold, enriched with enamel and pearls, containing two exquisite enamel groups of the Crucifixion and the Blessed Virgin and Holy Child. It was presented by Louis XIII. of France to the Treasury. No. 333 is a similar reliquary, with miniatures on gold of our Lord and His Virgin Mother, in gold enamelled mounts. No. 335 is an exquisite specimen of Cinque Cento work; an enamelled gold pendant in form of a pelican and pearls. Nos. 334 and 336 are two enamelled pendant ornaments of dogs, supported on scrolls, with pearls and finely enamelled chains, enriched with precious stones. Nos. 341 2-3 are three representations in richly enamelled gold of the Virgen del Pilar, as the statue has appeared at different periods. They are set with rubies and emeralds, and have been worn suspended from the neck. No. 319 is a beautiful specimen of goldsmiths' work of the nineteenth century, representing a large bouquet of enamelled gold flowers, set with diamonds, tied with a blue enamelled knot of brillants, 8¼in. long by 4in. wide. This jewel was presented by Dona Juana Rabasa wife of the Minister of Finance to Charles IV. No. 320 is a breast ornament of Spanish work of the eighteenth century formed of gold, open work scroll pattern, with bosses and small pendants, set with diamonds, presented by the Marquesa de la Puebla. No. 322 is a striking example in enamelled gold of a lace edged tie, set with table diamonds, presented by the Marquis de Navarens in 1679. No. 325 is a costly pectoral ornament of gold open work scrolls, set all over with fine emeralds. We have here enumerated only a few of the specimens contained in the collection, but there are many others of fine workmanship which require close examination. Among the minor objects may be observed a child's bauble of silver, in form of a Nereid holding a mirror and comb attached to a whistle and bells, doubtless an offering to Our Lady of the Pilar from a child to obtain intercession for the cure of some malady; also various toys of silver filigree. To give some idea of the intrinsic value of many of the jewels offered for sale, the first day's sale realised upwards of £10,000. A jewelled decoration of the Order of St. Esprit, set with fine brillants, offered to the Blessed Virgin by Maria Teresa, wife of Don Louis de Bourbon, was sold for £3,280; a diamond and lace given by Queen Marie Luise, £1,050; a brilliant diadem, offered to Our Lady in 1865 by the wife of Don Sebastian de Bourbon, £1,113; and a brilliant medallion, portrait of Ferdinand VII., given on his return from France, £250.

—*Paintings in the Louvre.*—The collection of the Louvre contains at present about two thousand paintings, five hundred of which are of the Italian school, six hundred and twenty of the Northern schools, seven hundred of the French, two hundred and fifty of the Spanish, and the rest of different other schools.

Among those of the Italian school, there are twelve paintings by Raphael, three by Correggio, eighteen by Titian, twenty-two by Albano, thirteen by Paul Veronese, nine by Leonardo da Vinci, eight by Perugini, and four by Giorgione.

Of the Northern school there are forty-two painting by Rubens, twenty-two by Vandyck, eleven by Gerard Dow, seventeen by Rembrandt, eleven by Philip Wouverman, fourteen by Teniers, seven by Adrian van Ostade, six by Ruysdael, two by Hobbema, eleven by Berghem, ten by Van Huysmans, and three by Lucas van Leyden.

Of the French school, there are forty paintings by Poussin, forty-eight by Lesueur, sixteen by Claude Lorrain, twenty by Philip de Champagne, seventeen by Sebastien Bourdon, twenty-six by Lebrun, twelve by Mignard, forty-one by Joseph Vernet, one by Largillière, one by Watteau, thirteen by David.

Of the Spanish school, there are eleven by Murillo and six by Velasquez.

-On the 3rd Nov. Prince Arthur unveiled a handsome stained glass window at Guildhall. It was constructed at the expense of the Corporation, in memory of the late Prince Consort. His Royal Highness, who was received by the Lord Mayor at a special Court of Common Council, expressed his deep sense of the hearty greeting he had received, and of the beauty of the memorial to his illustrious father.

—*Foreign Academies and English Artists.*—The Antwerp Royal Academy of the Fine Arts has nominated among its effective members Sir Edward Landseer, in place of the late M. Overbeck and M. Dyckmans in place of the late Baron Leys.

—The Society of Arts (London) are proceeding in their work of affixing commemorative tablets to the houses formerly inhabited by men of genius. Dryden's reputed house is among the projected number. It is scarcely necessary to remind the Society that the old house in Fetter-lane, long inscribed with Dryden's name, was never tenanted by "Glorious John."

Statistical.

The Census of Manitoba.—The census lately taken in the Province of Manitoba shows that the population is scarcely so large as we have been in the habit of supposing it to be. The total population is 11,965. Of these 4,070 are English half-breeds, 5,690 French half-breeds, 581 Indian house holders; the remainder, 1,614, being white inhabitants, half of whom are natives of the North West Territory, and the remainder Englishmen, Scotchmen, Canadians and foreigners. Of Protestants there are 5,906; of Roman Catholics, 6,059. 11,903 are British subjects, only 62 being American subjects; 3,928 are married; 6,761 are single; 265 are widows, and 102 are widowers. There are 6,212 males, and 5,703 females in the Province. Of these there are:—

	Males.	Females.
Under 10 years	1,934	1,992
From 10 to 20	1,534	1,392
" 20 to 30	1,040	910
" 30 to 40	589	577
" 40 to 50	469	453
" 50 to 60	245	217
" 60 to 70	220	144
Over 70 years	181	68
	6,212	5,753

Out of the 199 persons over seventy years of age, no less than sixty-two are whites from a population of 1614, while only 110 are from among the half-breeds, who number 9,770 persons. This seems to indicate that the admixture of white and Indian blood does not promote longevity. Among the sixty-two whites over seventy years of age, there are thirty two Scotchmen, and six Scotchwomen, together with seventeen natives of Canada and three Englishmen. Out of the 1611 white inhabitants of the Province, 771, or very nearly one half, were born in Manitoba; only four of these have attained the age of seventy. There are 312 Canadians, 128 Englishmen and women. 247 Scotch, 49 Irish, and sixteen natives of France, 67 born in the United States, and 24 in other foreign countries. Among the 581 Indian householders (Christians) are 27 persons over seventy years of age.

Discoveries.

—Very interesting discoveries at Rome and Florence are reported in the *Architect.* In preparing the space before the palace for the fêtes in honour of Princess Margherita, the workmen came upon the remains of Roman mosaic pavements; to the north was a portico, and at right angles were three halls, one of them with a mosaic 10 ft. 1 inch. by 8 ft. 7 inch. This last is a conventional representation of Orpheus charming the beasts. The portico is much dilapidated; a large group in the centre, where horses' hoofs and the tail of a monster are traceable. Suggests the "hipolytus." Fazello mentions an ancient building on this site called the Sala Verde, a kind of amphitheatre which was levelled in 1549. The frescoes had been covered with whitewash, and cut to pieces to make room for cumbrous monuments. Starnina's paintings form two series from the lives of St. Anthony and St. Nicnolas respectively, and were executed before he was compelled to leave Florence in consequence of his share in the rising of Ciompi, in 1378.

—M. Castellani has found in one of the houses at Pompeii two medals, mostly silver, of the Consular and Imperial periods; and a large collection of gold jewellery, including a magnificent chain, nearly three yards in length, formed of golden tresses. There have also been found two splendid bracelets, called *ophis*, composed of great serpents, to be worn on the upper part of the arm, two gold ear-drops or pendants, set with pearls, two other bracelets formed of a double row of large globes cut in two and chained together, and six rings of various size and value. The chain is the third of the kind which M. Castellani has seen: the first was found at Cervetti, the ancient Agilla, in the celebrated tomb of Regulini-Gatassi, the other at Boulak, in an Egyptian tomb. The clasp of the chain just found at Pompeii is, however, of very peculiar design, but is not uncommon in jewellery of the Roman Empire. M. Castellani also speaks of an item discovered by him in the same excavation—namely, a well-defined impression of the body of a native of Pompeii in the act of flying from the doomed city. A plaster cast has been taken of it, and is now, with two other casts, in the Bourbon Museum at Naples.

Meteorology.

From the Records of the Montreal Observatory, Lat. 45° 31 North; Long. 4h. 54m. 11 sec. West of Greenwich; height above the level of the sea 182 feet; For the month of December, 1870. By CHARLES SMALLWOOD, M.D., LL.D., D.C.L.

DAYS.	Barometer corrected at 32°			Temperature of the Air.			Direction of Wind.			Miles in 24 hours.
	7 a m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m	9 p.m.	
1	29.825	29.714	29.621	34.0	43.2	39.4	s w	s w	w s w	120.74
2	.552	.517	.475	36.0	55.6	38.7	w	w s w	w	204.24
3	.825	.823	.811	24 8	39.6	35.2	w	w	w	119 11
4	.801	.810	.789	35.2	36 6	33.1	w	w	w	109.00
5	.992	.814	.600	26.9	33.4	30.0	N E	N E	N E	74 21
6	.499	.677	.761	33.1	32.7	32.2	N E	N E	N E	64.10
7	.925	.850	.801	31.7	32.0	30.1	N E	w	w	80.42
8	700	.820	.849	29.4	31.1	31.7	wbyN	N E	N E	61.11
9	30.061	30 200	30.301	29.4	34.6	25.4	N E	w	w	104.00
10	.247	.302	.325	21.1	26.4	29.1	N E	w	w	79.80
11	.424	.560	.442	17.7	41.4	29.0	w	N E	N E	81.14
12	.351	.304	.123	31.7	33.2	34.0	w	N E	N E	17.00
13	29.987	29 987	29.800	34.2	35.2	34.7	N E	N E	N E	66.20
14	.610	.548	.575	33.1	34.7	32.2	N E	s w	w	51.11
15	.562	.644	.851	18.0	18.2	16 3	s w	w	w	112.21
16	.850	.917	.948	15.4	27.0	16.6	w	w	w	292.14
17	.899	.751	.587	16.0	25.2	25.7	w	w	s w	280.10
18	.622	.842	.900	19.1	20.1	15.0	w	w byN	wbyN	181.12
19	30.031	.854	.779	10.2	33.4	24.7	w byN	w	w	104.00
20	29 300	.474	.492	22.1	31.1	26 8	N E	w	s w	91.12
21	.520	.625	.901	22.0	28.4	23.2	w	w s w	w s w	81.24
22	30.000	30.074	30 098	15.1	26.2	13.2	w	w	w	197.14
23	29.964	29.943	29 925	10.1	16.4	8.0	w	w	w	84.29
24	.900	30.092	30.141	–1.9	8.1	–2 9	w	w	w	71.10
25	30.301	.311	.349	–2.9	10.0	8.9	w s w	w	w	193 24
26	.002	29.984	29 999	16.1	20.1	24.2	s w	s w	s w	114.16
27	29 961	.842	.768	23.0	28.6	23.2	s w	s w	s w	106.10
28	.800	.947	30.016	25.1	23.0	–0.2	s w	N E	N E	108.00
29	.911	.904	29.900	–5.8	16.2	–1.0	N by E	N by E	N by E	84.21
30	.901	.784	.650	–4.4	12.8	9.2	w	N E	N E	94.10
31	.461	.522	.716	23.7	33.1	19.6	s w	s w	w	102.01

The highest reading of the Barometer was on the 11th day, and was 30.560 inches, and the lowest was on the 31st day, and was 29.461 inches, giving a monthly range of 1.031 inches. The mean of the month was 29.867 inches, and the range 1.099 inches.

—Observations taken at Halifax, Nova Scotia, during the month of December, 1870; Lat. 44°39' North; Long, 63°36' West; height above the Sea 175 feet; by Sergt. John Thurling, A. H. Corps.

Barometer, highest reading on the 12th	30.386 inches.
" lowest " " 16th	28.992
" range of pressure	1.394
" mean for month (reduced to 32°)	29.540
Thermometer, highest in shade	48.2 degrees
" lowest "	3.7
" range in month	44.5
" mean of all highest	36.4
" mean of all lowest	22.2
" mean daily range	14.2
" mean for month	29.3
" highest reading in sun's rays	79.2
" lowest on grass	1.2
Hygrometer, mean of dry bulb	31.4
" " wet bulb	29.4
" " deduced dew point	24.0
" elastic force of vapour	129
" weight of vapour in a cubic foot of air	1.5 grains.
" " required to saturate do	0.6
" the figure of humidity (Sat. 100)	73
" average weight of a cubic foot of air	558.5
Wind, mean direction of North	12.50 days.
" " " East	3.00
" " " South	2.50
" " " West	13.00
" daily horizontal movement	374.89 miles.
" daily force	2.2
Cloud, mean amount of, (0-10)	7.6
Ozone, " " (0-10)	2.8
Rain. No. of days it fell	9 days.
Snow	11
Hail	3
Amount of rain and melted snow collected	6.17 inches.

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