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AN ADDRESS

DELIVERED TO THE STUDENTS OF THE UNIVERSITY OF MANITOBA, WINNIPEG, ON THE OCCASION OF THE OPENING OF THE CLASSES IN THE FACULTY OF SCIENCE

OCTOBER, 1906

BY

SWALE VINCENT

M.B., Lond., D.Sc., Edin., M.R.C.S., L.R.C.P.

Professor of Physiology in the University of Manitoba

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ADDRESS

Delivered at the Opening of the Classes in the Faculty of Science, University of Manitoba, October, 1906, by

PROF. SWALE VINCENT, M.B., D.Sc., M.R.C.S., L.R.C.P.,

Professor of Physiology in the University of Manitoba.

Mr. Chairman, Ladies and Gentlemen:

When my colleagues invited me to deliver this opening address, although I saw no special reason why the lot should fall to me, yet I did not hesitate to undertake the task. The chief reason for my willingness lay in the appreciation of the opportunity so afforded me of saying many things which cannot find a place in the ordinary lecture courses.

First of all, it is at the same time a duty and a pleasure to welcome back to the University those students whom we know, and to extend a hearty greeting to those we do not yet know, but who are to be our friends and fellow-students for the next four or five years.

In chooosing a subject for to-day, I have been guided by many different considerations towards a theme which is by no means a new or original one, but which I hope will interest you and meet with your approval. Since I am primarily addressing students of Science it is obvious that some remarks on the place of Science in our educational systems and in our lives will not at least be out of place.

I may sum up in a few words the general nature of the propositions I shall have the honor of submitting to you—they relate to the *methods*, the *duties*, and the *pleasures* of Science.

Let me insist at the outset that Science is not a special and restricted sphere of knowledge, but is or should be directly applicable to everything which the mind conceives or the hand executes. The scientific spirit should not be confined, as many people seem to think, to some few departments of human activity intimately related to bad odors and methods of making money. Science is simply systematized common sense; its practice consists in *using first your eyes and then your brains*, bringing in your hands as accessories before the facts, and anyone, whatever his subject may be, who carries out these

processes, is a scientific man, provided, that is, that his brains can run in harness with his intentions. The historian or the philologist, if he is worth his salt, falls as distinctly within this category as a chemist or a physicist. The difference between a scientific man and the other sort of man is not his subject but his method. The characteristic of the former is that he cares nothing for ponderous authority and crusted tradition, while he cares everything for beauty and for truth.

The ignorance of the general public, and even of that portion of it which supposes itself and is even generally supposed to be educated, on all matters connected with Natural Science, is nothing less than appalling. Most women in Great Britain and Ireland believe that the sun's rays put out a kindling fire in the grate, and they will optimistically draw down the blinds to prevent the catastrophe; while they will put up the poker against the bars to aid in combustion. Many of the same people would be capable of attempting to melt a snowball by wrapping it up in a blanket. I have heard a story of a guest at a house who asked the hostess for the loan of a compass. "I have not a compass," was the reply, "but I will lend you a thermometer." When informed in the most tactful manner consistent with the circumstances that it would not quite serve as a substitute, the lady serenely remarked: "Well, I didn't know—there's mercury in both!" Even in Canada I am asked periodically whether it is true that a man has one rib less than a woman, and *why* it is that one weighs lighter after a meal than before it!

The extent of this ignorance is so great that few people know even the names and scope of the chief subjects in Natural Science; thus scarcely any one among the general public knows what physiology is, and physics is commonly supposed to refer to drugs; few have the least idea what kinds of things are known, or what they could expect to find out by inquiry or investigation. It is, I believe, Lord Avebury who narrates that he was leaving the House of Commons one night with a fellow member when an eclipse of the moon was taking place. His companion remarked: "What a marvellous business! I'll bet that's one of the things none of you scientists will ever explain." I often pity the parents who do not even know whether children's questions are answerable or are merely elementary. Why does an apple fall to the ground? Where do stones come from? How far off is the sky? I have no hesitation in declaring that the great majority of people, even of the so-called educated, are as low in the scale as the prim-

tive savage—or lower, for the man in the stone age did at any rate know, as did our own Indians, where to get the best stone and how to make suitable implements, whereas our modern "intellectual" person knows nothing of the inwardness of *things*, but only what somebody has said about things, or in many cases, what somebody has written about some other author's views.

No wonder that in such a soil flourish all such frauds and superstitions as "Christian Science" Phrenology, Palmistry, and such medical perversions as homeopathy, bone-setting, *et hoc genus omne*. And no wonder that with such prevailing ignorance people are induced to poison themselves with a variety of patent medicines, and to tolerate obscene advertisements in our magazines and newspapers.

How much Science enters into every day life is far from commonly appreciated. One has only to mention the supreme importance of the chemical industries, dyeing, soap-making, brewing, of the various forms of electrical and engineering pursuits and of a thousand kinds of manufacturing industries, all dependent for their growth and maintenance on the employment of sound scientific advisers and the cultivation of the truest scientific spirit. It is now generally recognized also that a medical man, if he is not a scientific man, is simply a quack.

There is one branch of Science, related to agriculture, which ought to appeal in a very special way to the people of Manitoba: I refer to a subject now called Economic Biology. It has but recently been recognized that not only Chemistry and Physics, but also Botany and Zoology are of immense practical import, especially to an agricultural community. I need only remind you of the enormous loss to Manitoba from rust and smut in wheat and of the value which would undoubtedly accrue from a liberal endowment of research in the subject of plant pathology. The research should not be confined to rust and smut, or even to the plant diseases of our own provinces.

Of course it is possible for people engaged in many of the trades and occupations I have just referred to, to make a competence or by chance a fortune, even though they neglect to note the trend of modern research. But we may rest assured that the material prosperity of the future will be in the hands of those nations who are guided in their industries and commerce, as in other relationships by the soundest principles of theoretical and applied Science. Germany stands pre-eminent for her realization of this truth, while Great Britain and her

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colonies have not yet awakened from the peaceful slumber which followed the prosperous years of the last century. Some observers, however, profess to have seen indications that the sleep of the colossus is no longer of babe-like serenity.

I wonder if it has ever occurred to any of you, or if it has ever been laid before you, that a scientific man is the only servant of the nation who is expected to do his work without proper appliances. A business man has proper appointments and fittings adapted for saving of time and perfection of technique; but a scientific man has in many cases to be content with the most miserable makeshifts. The director of a scientific laboratory is indeed supremely lucky if his place of work is as well adapted for its purposes as a bank, a store, or a drinking saloon. This deficiency is painful enough in many of our older universities, but what is the state of affairs in our younger and embryonic institutions can only be left to the imagination of those who do not know by bitter experience. The reason of this deplorable condition is clearly to be sought in the lack of interest in and appreciation of scientific work on the part of the general public.

I have already suggested that the realm of Science should be co-extensive with that of human activity. There is nothing which is worth doing at all which should not be done along lines dictated by accurate observation and logical reflection. We are beginning nowadays to apply some knowledge of nature to our diet, our clothing, and our dwellings, but there are some departments into which the faintest ray of science has not yet penetrated. How rarely does one hear of a leading statesman being a scientific man! Yet I insist he ought to be, that is to say, he ought to know what has been learned of the laws which regulate the evolution of races, communities, and individuals, and be trained to see the directions in which improvements can be brought about with regard to the welfare of the human race. It is now generally admitted that at any rate in the older countries of Europe, there is a dangerous tendency towards what a farmer calls "degeneration of the stock." Our civilization, indeed, instead of assisting in the survival of the fittest, is furthering the survival of the unfittest. We take enormous pains in the breeding of our horses, cattle, and dogs; we also take a great amount of care in the breeding of the human race, but tragically it manifests itself in the provision of facilities for the breeding of the unfit. In England, for example, while the aristocrats have as a rule far from small families and the lowest laboring classes are breed-

ing at a great rate (and neither of these are to be considered the "fittest" sections of society), the middle classes, including most of the healthy bodied and healthy minded members of the community, are to a large extent childless. When we bear in mind that this middle class includes the best men of our universities, our clergymen, lawyers, and doctors, and teachers of all grades our authors, artists, and musicians, it is an obvious cause for lament that any conditions should interfere with their multiplication. The precise causes of the present defect are very complex and I am only to indicate that the matter is sufficiently serious to demand the attention of our legislators. It is refreshing to learn that in England there are signs that the casual inmates of asylums are beginning to be regarded as undesirable ancestors of the generations to come. One cause for the existing state of affairs, one may state frankly, is the deficient salary of the great majority of the professional class.

The time has come for our rulers to realize that a community of men is as subject as a community of ants or as a herd of buffaloes to the laws which rule all organic nature, and it is only by carefully studying these laws and earnestly trying to turn them to good account that we can hope to do anything to improve the condition of the human race. For a blind and blundering philanthrophy, let us substitute a keen and sound scientific ameliorism.

I have stated somewhat briefly the value of science in the arts and commerce, and I have been all the briefer because this is just the one aspect of the question of which the public have caught a glimpse. There is a danger which can scarcely be exaggerated of regarding Science too much from this standpoint, a danger, indeed, of being too "practical." Manufacturers, "pious founders," and legislators hesitate to endow or encourage research which will not yield prompt returns, results which can be measured and appreciated by ordinary men of business or by the general public. This applies to some extent to the endowment of medical as well as of other branches of investigation. It is not always the wisest policy to found a scholarship for the purpose of a definite discovery, as, for example, the cause of cancer. In such matters the longest way may prove to be the best and the surest. In the case of cancer a liberal endowment of general pathological and biological laboratories would probably do more towards the solution of the problem than the foundation of a much larger number of "cancer research" departments.

Even from the purely commercial standpoint it is a short-sighted policy to be too utilitarian. By limiting too severely the scope of investigation, one runs a serious risk of checking discovery altogether. The whole of the subject of electricity which now plays such an important part in our daily life, has been evolved not by the "inventor" or by the "practical man," but by the patient and disinterested studies of such men as Faraday and Clerk Maxwell. Our knowledge of disease has been advanced in recent years not so much by medical men as by botanists, zoologists and chemists. Even in the laboratory itself it is possible by a too close concentration to one's own particular line of work to miss great opportunities of enlarging the bounds of knowledge. I have heard of a physicist interested in scientific photography who noticed many years ago that his photographic plates always became fogged in presence of Crookes' tubes, but who *being a practical man* simply took care to keep his plates away from the tubes! Here is an example of a man who just missed, through failure to keep his eyes open, one of the greatest discoveries of modern times, a discovery made some few years later by Röentgen of Würzburg.

Our technical education of which we hear so much in these days has in many instances been in my opinion little else than a failure, a failure because the main object of scientific education has been missed, one might almost say, avoided, by the prevailing conditions. I know a technical school in London where the students, who are supposed to be learning electrical engineering, cannot state Ohm's Law, and when asked to do a simple sum in arithmetic declare they are "no scholars"! The students in our technical schools have not been and are not, properly speaking science students at all; they have been simply learning certain portions of their trade which it was found could be more conveniently taught in a municipal school than in the workshop. This, of course, has proved a matter of considerable convenience to the manufacturer, but it is becoming a very serious menace to the future of our scientific industries. What is needed is to train our young men to think and to act scientifically, and this means especially to prepare them to adapt themselves to new conditions. Any person can be readily taught to do the proper thing under ordinary regular circumstances, but the test of a sound training becomes applied when new methods have to be thought out and utilised for industrial purposes. A German professor was recently visiting one of the largest municipal technical schools

in Great Britain and was taken into the chemical department to see the students at work. One room, he noticed, was crowded with eager students. "What is that room?" he enquired. "That is the 'applied chemistry' class, was the reply." Another room with only a few listless students he ascertained was the ordinary chemistry course. "As long as your students behave so foolishly," observed the German visitor, "we need never fear English competition in the chemical industries."

So great and so widespread is this utilitarian spirit in scientific education that one almost feels tempted to exclaim, "Here's to pure Science, and precious little good may it ever do anybody." There is a phase of the pursuit of Science which is capable of rising above the paltry consideration of "doing good," for this usually means putting money into the bulging pocket of the capitalist. Most individuals with a grain of the aesthetic in their nature will see a reason for the cultivation of *Science for its own sake*, or rather for the sake of the enjoyment afforded by the contemplation of its beauties. There is, I venture to think, an almost universal misconception among unscientific people upon this matter. A man does not enjoy nature the less for knowing a little of her ways. A glance at the starry heavens is not defiled by some knowledge of physical astronomy. A tour in the country is not vulgarized if one knows something of the geology of the neighborhood, or of the anatomy, physiology and relationship of the animals and plants encountered by the way. A voyage across the ocean is not a less sublime experience if one sometimes knows the latitude and longitude or can form some conception of the vast and teeming population of the watery depths. We all know the superior "minor poetic" person, who, wrapped in his chilly mantle of incuriosity, trembles lest a little insight into the mysteries of nature should be fatal to what he imagines is his appreciation of her. "I shall not," he is accustomed to say, "appreciate the beauty of a wayside flower any the more for picking it to pieces. My admiration for the colors of the butterfly's wing will not be any the greater if I learn to tell one insect from another, nor should I listen with more pleasure to the song of the birds because I shall learn to distinguish the note of the robin from that of the hedge sparrow." A vain thing fondly imagined is this. In these things, as in all others, it is knowledge that enhances pleasure, and without some knowledge pleasure is merely sensuous. Who can enjoy a painting as much as the artist who knows in what

its excellence consists? Who can appreciate the subtle combination of sounds in a symphony like the musician who is able to analyze it into its elements? Who can admire the grandeur of a great edifice like the architect who knows the technique of its conception and its production? It is the same in nature as in art, and I would plead with those whose admiration of the beauties of nature has hitherto been but unstructured to believe that the pains to acquire even a little knowledge of common things and processes will do nothing but make this admiration more profound. Admiration without knowledge is not always visibly expressed by the gaping mouth, but that is at once its emblem and its stigma. "We are apt," says Lord Avebury "to think that everybody recognizes beauty when he sees it, but that is a complete mistake. Many stand both blind and deaf in the great temple of nature."

What is it, I would ask, which attracts you young men, and you young women to the study of Science? I venture to hope and believe that in the majority of cases it is no mere utilitarian motive, no desire to make a fortune or even to secure a competence, but a sheer though budding love of Science for its own sake, and over and above the desire for knowledge, I am convinced that it is the *beauty of Science* which attracts you. From the purely aesthetic standpoint what efforts of the painter can compare with the wonders of fluorescence, what painted picture can equal the spectrum? And how greatly is the beauty of these phenomena increased by a knowledge of their course and sequence? Turning to biological subjects, he is indeed blind who cannot gaze in wonder and admiration at the anatomical structure of the simplest organism. Microscopical anatomy reveals a world of beauty at present the happy hunting ground of a very small minority even of scientific men. To my mind the cutting of thin sections (whose thickness is measured in thousandths of a millimeter) of animal or vegetable tissues, fixing them on glass slides and staining with carefully selected dyes, in preparation for examination on the stage of the microscope, is one of the most refined and attractive occupations with which the human brain and the human fingers have ever been engaged. Every branch of Natural Science has its analogous beauties known only to its votaries.

There is another and a higher kind of beauty which Science displays. This is a beauty which appeals to our mental vision. Such an idea underlies the use of the word "elegant" by the mathematician. To cite a well

known example. When the mathematician investigates the attraction due to a uniform spherical shell at any external point he finds that it is the same as would be produced by all the matter in the shell concentrated at its centre. Such a result appeals to all who appreciate its meaning as being beautiful. It is beautiful in its unexpected simplicity.

The kinetic theory of gases starts from the assumption that a gas consists of a large number of quickly moving particles. This theory gives us a wonderful example of the type of beauty we are considering. From this simple assumption is built up a detailed account of the behavior of gases which not only accords with experiment but which yields results of great interest, results which experiment unaided by theory would be powerless to furnish.

I have been tempted to urge at some length the beauty of Science because there is a danger that this may be lost sight of in a too absorbing recognition of its practical applications. The beauties of Science are the beauties of nature, which reveals an inexhaustible store of treasures to the sincere investigator.

The place of Science in education must now occupy us for a short time. The reason there is so little support given to Science, so little desire to aid in its progress, is obviously to be found in the defective education both at school and university of our governing class. It follows that the only remedy is to give Science its proper place in the curricula of our schools and colleges. What, then, is the proper place of Science in education? In the past the only idea of an educated man has been one who has spent the best years of his life in acquiring a smattering of Greek and Latin and some considerable proficiency in athletics. And, although things have somewhat improved since my own school days, yet the prejudice in favor of a training which is almost exclusively literary, still lingers. I need not tell you that the object of education should be not so much the imparting of knowledge as the training of the mind, the eye, and the hand, and such subjects for study should be chosen as will best achieve this object. The advocates of the purely classical system urge that Greek and Latin are the subjects best calculated to call forth and develop the intellect. With this I cannot for a moment agree. Science ought to be taught more in schools if only for the reason that children like it. They don't as a rule like Greek and Latin, and if Science be admitted to be as good educationally as Greek and Latin, it would be a

better school subject because of the pleasure it affords the pupils. As regards mental exercise pure and simple, the Greek irregular verbs are not more beneficial nor perhaps less so than the bones of the skull. But in my opinion, although I admit I may be prejudiced, there is one important difference. If a man has learnt the bones of the skull he has acquired a solid foundation for the study of a large part of comparative anatomy, while a knowledge of the Greek verbs or rather the acquiring of this knowledge in the traditional way will probably serve to effectually deter the intelligent student from even learning to read Greek, much more from developing an ardent enthusiasm for Greek literature.

This is such an important matter that I do not wish my attitude to be misunderstood. In my opinion an ideal training for a scientific man would be to remain at school till he is, say, eighteen. At school he should gain a good knowledge of English, French, German and mathematics, and the time left over might be devoted to Greek and Latin. On leaving school he should devote himself exclusively to science, including mathematics. But suppose a boy is not going to devote himself to science—suppose he is going to be a clergyman, a lawyer, or a schoolmaster, *then*, I urge, he should have a sound training in elementary science at school, for he will in all probability never have either the desire or the opportunity after he leaves. I strongly deprecate the letting loose upon the world of any army of statesmen, clergymen, tradesmen and schoolmasters, who know nothing of natural science. Their influence on education is entirely bad. Such men have no idea of ultimate truth. If they want to learn anything they consult a book, and absorb the errors of voluminous authors whose information has been acquired in a similar way. The habit of reference to literature is common of course both to the "humanitarian" and the scientist, but in the former case the appeal is final while in the latter it is checked by reference to nature herself. Natural science brings her votaries in touch with the realities of life as no other study does.

In the Canadian universities it is not uncommon to find an Arts man, who has spent a certain amount of time over science. But the system in vogue in our own University, for example, by which an Arts student attends science lectures in his first year with no practical work, or worse still in his third or fourth year, is so bad that no one who has the interests of science at heart will seriously defend it. Our own curriculum has perhaps one worse feature. I

refer to the more purely scientific students having to spend time over such subjects as English and Ethics. But our own University course is too great a subject to be dealt with on the present occasion.

But it will be said at once, "There is not time to teach Greek, Latin, French, German, Mathematics and Science at school, even if a boy remains till he is eighteen." I am not sure that it is impossible. At the present time far too much attention is given to sport. French and German are usually so badly taught that the time spent on them is wasted. Greek and Latin are taught in such a way that comparatively few ever learn to read the languages. But if something must go, then I say most emphatically let Greek go. If something else must go, let Latin go.

Again, do not misunderstand me. I value, as much as any one, the training in the classics, not only because of the practice these languages afford in mode of expression and precise significance of slight syntactical variations, but also by reason of the philological explanation of many words in our own language. Scientific words are coined in such a way as to explain themselves to educated men all over the world, and it is sad, indeed, if a student of science, as so often happens, has to learn their meaning by rote. But this second object might be attained by quite a different mode of tuition from that usually adopted. A few hundred words in each language are all that are required, and much of the grammar might be altogether omitted.

I would on no account allow a boy to leave school without a reading knowledge of French and German, and if he is not going to pursue science in after life, he should also have a good sound elementary knowledge of chemistry and physics. But there is at present a great difficulty in introducing these subjects into the school curriculum. I refer to the lack of competent teachers, for here, as in many other departments of learning, it is only a teacher who has faithfully studied the subject, even to its higher grades, who is competent to teach the elements. It goes without saying that if science is taught at school it should be taught practically; learning science from a book or by *viva voce* tuition is worse than useless, it is positively pernicious, and if practical instruction cannot be given, it is better to omit science altogether. (I may say in parenthesis that this is much truer in the case of universities than of schools.) In our public elementary schools, it appears to me, our children would be much better occupied in simple ex-

periments in chemistry and physics than in many of the fantastic "occupations," which a succession of educational faddists insist in foisting upon them. The subject known as "Nature Study" is excellent in intention, but its proper exposition requires much more highly trained teachers than can be obtained at the present market prices.

In regard to the general question of science versus the "humanities" as a means of culture, it is too often assumed by the literary man that the scientist from the nature of his training sees only one side of the question. I venture to assert that "the boot is on the other foot." I would point out that most of us who are engaged in pure science have spent some of the best years of our early youth upon Greek and Latin. But how many clergymen lawyers, or schoolmasters have ever had even a grounding in chemistry and physics?

Notwithstanding its admitted advantages, in a purely literary training, we are apt to miss, through sheer lack of scientific knowledge, one of the elements of perfect culture—the sympathetic appreciation of nature as in detail a rationally ordered and consistent system. We may often note an excessive emphasis upon the psychological with an undue sub-ordination or even depreciation of the physical and physiological factors—an attitude implied in the distinction I once heard between the "humanities" and the "bestialities." In my school days science was always scornfully called "stinks," and no self-respecting boy was expected to have any dealings with it.

Get rid of the ancient superstition that purely literary pursuits are necessarily on a higher plane than scientific. It is a hoary tradition particularly unworthy of reverence in a new country. Do not be afraid of the word "materialistic." Our bodies, food, clothing, dwellings, the air we breathe, are "material" and deserve not less, but infinitely more attention than has ever yet been bestowed upon them.

I would go still further. A man who knows no science has no right to call himself an educated man. He may know the literature of the Greeks, Romans, Hebrews or Chinese, he may be able to wander in imagination through the streets of Athens in her glory, he may picture by his reading in history the growth of modern Europe from the ruins of the ancient civilizations, he may be able to translate Shakespeare into elegant Greek verse or Burke into powerful Ciceronian Latin, but if he does not know, for example, that a candle is not consumed when it burns, or has no grasp of the law of the

cous radiation of energy, that man is an utter ignoramus. He lives in a world as foggy and unreal as that of the monks of the middle ages. To sum up this part of our subject, an educated man must not only know books, he must know *things*, and in order to aid in the establishment of a proper balance of culture, I would propose that for people who are going to be scientific there need be no science at school, or at any rate that the systematic study of science could be more safely omitted than any other part of the curriculum, but science should form an important element in the training of clergymen, lawyers, schoolmasters, and generally of all bookish persons.

And now a word or two of advice to you as students of science. In the first place cultivate a spirit of the extremest scepticism. You can scarcely go too far in this direction: let there be a veritable apotheosis of scepticism. Never accept a statement simply because you see it in a book or hear it in a lecture, especially if it taxes your credulity—which should be highly sensitive. Verify for yourselves, so far as this is possible, everything you are asked to learn, and if there is any discrepancy between different text-books do not look in a third or ask your teacher what are the actual facts, but get a test-tube or a scalpel and forceps and look or smell or feel for yourself. You many not be able to solve the difficulty, but at any rate you may be able to discover why there is a difference of opinion, and the attempt to clear up the question will be in itself wholly beneficial. I am in the habit of classifying students as to their behaviour in this respect into four groups. The first, and I fear the commonest group, when they meet with a difficulty, shirk it altogether. The student of the second group will seek advice from his teacher: this implies an attitude of dutifulness mixed with much of innocence. A third type will attempt to ascertain the exact truth by consulting all the books available. The last and best kind of student, I admit a somewhat rare bird, will request a corner of the laboratory and material to look for himself.

This leads us naturally to the subject of original investigation. Every student who takes a degree in science, is, or should be, capable of research. You are aware that in many universities this is indeed a condition of graduation. There is a vast untrodden field in every province of science, and if we cannot all make great discoveries, we can every one of us do something towards correcting and verifying the work of others, extending in some humble way the bounds of knowledge. And here let me urge that the mere attempt to find out

something new will be beneficial even if the main object be not attained, for it frequently happens that this is the only way to acquire first hand knowledge of an abstruse subject. Every teacher knows that his lectures are infinitely more inspiring when he is dealing with those branches of a subject on which he has worked, than when he is talking of things with which he has only second-hand knowledge, for no one can personally verify all the facts of his science. There is a great difference in treatment in the two cases, and students are not slow to detect it. It is my own personal opinion that the best advanced teaching can only take place in an atmosphere of research, and if it is a professor's duty to organize and carry out such research, I consider it equally the duty of students in a laboratory to see as much as possible of such work and to learn all they can from it. Many of us are compelled to carry out the greater part of our research work in the evenings or in our vacations, owing to insufficient teaching assistance, and the fatigue during the session of endless lectures of the mediæval type. In many of the newer universities (those of Japan forming a notable exception) research on the part of professors is not looked upon with favor by the governing body. This attitude is usually adopted by the non-scientific, influential people belonging to the bookish class to which I have previously alluded. Medical men are usually sufficiently enlightened to know that every case they get in practice is in reality a subject demanding original research, and they perceive that without a well-trained spirit of enquiry a doctor is simply an empiricist without reason for the faith that may be in him.

I might venture to offer a word of advice to students who have a hope of specializing later on. Learn as much of the branches of science upon which your favorite subject depends as early and as thoroughly as possible. For example, a student may be very much attracted by electrical engineering, and hope to make it his life-long study. Such a one should, without abating his ardor for his chief study, acquire such a sound knowledge of chemistry and mathematics that these shall not be stumbling blocks in his chief pursuit. It is quite possible that such studies may be irksome to him; he may even feel that they rob his chief study of time and attention. This may have the semblance of truth in it for a year or two; but it is only a semblance. In after years he will probably deplore the want of mathematical knowledge more than that of electrical. The best electrical engineers of the future will be those who can apply their general scientific knowledge electrically.

If a student hopes to become a physiologist he must similarly become first a chemist and an anatomist, and the more he knows of physics the better for him and his subject. The most successful physiologist of the future will be he who can treat his subject from a profound physico-chemical standpoint.

The great duty of a student of science is not so much to amass information as to thoroughly understand the principles of the subject, and you will find later on that it is often much more valuable to be able to find information when it is wanted than to unduly burden your memory. The literature of a subject is one of the greatest difficulties a scientific man has to contend with, and this is unfortunately very frequently a mere matter of language. The mass of material being constantly poured out in English, French, German Italian, and even Russian, is overwhelming. Luckily there is little in Spanish, and the Russians and Japanese mostly write in the German language. How is the languge difficulty to be met? We cannot be expected to know all languages, and I fancy that the proposals occasionally made to return to the ancient method of writing in Latin, or to use "Esperanto," will not find favor. The practical solution, I feel sure, will be found in all scientific men being able to read English, French, and German. So I urge you to acquire, if you have not already done so, a reading knowledge of French and German. For medical students German is particularly desirable.

Learn the literature of your subject. Find out what journals it has and in what languages, and where they are to be found. You will rarely find all your journals in one library, though we have every hope that before long you may find most of what you will want in the library of the University of Manitoba.

Always, where possible, consult the original papers, especially upon any part of the subject you are interested in, or which presents peculiar difficulties. In some of the universities of the United States this reading of original papers is made a feature of advanced study, and it is strongly to be commended.

In reading, do not strive simply to see what the author means, but make an effort to grasp the wider significance of each fact, its relation to the main argument. *Think around the subject.*

Cultivate your imagination, and by this term I do not mean that series of delirious mental somersaults which often passes by this name, but an honest picturing in the mind of what is

known or of what is suspected to exist in nature. An international prize was once offered for an essay upon the camel. An Englishman took his gun and journeyed into a far land where camels abound. His essay was rejected. A Frenchman went into the National Library and compiled from books an elaborate account of the animal. His essay was highly commended. A German went into his study evolved a camel out of his inner consciousness, and won the prize! Now in the past there has been in our philosophies too much of this "evolving a camel out of one's inner consciousness," and the animal evolved has been very unlike the real camel. Our imaginings should be promptly and severely checked by comparison with realities. In such a subject as Anatomy imagination is a most valuable aid to study, for surely that student will have the most accurate knowledge who can best form a mental picture of the complicated maze in three dimensions whose intricate windings he has to know and to follow.

As a last word of advice, I would strongly plead that you have some recreation, some hobby apart altogether from outdoor sports. As such a recreation I know nothing so suitable as music, as affording the greatest relief from the study of science.

In the University of Manitoba we are free from certain fetters in the teaching of science which constitute a serious impediment in the way of Professors in the Old Country. We have no external examiners and no traditional syllabuses to lay down what we ought to teach and what we ought not: so we are at liberty to strike out new lines and by eliminating what is bad and choosing what is good from the curricula of the older universities we may have something of our own which is better than any of them.

In this connection I would remind you that the British Association for the Advancement of Science is to visit Winnipeg in the year 1909, and I venture to express a hope that by that time there will be in our University no departments without professors and no professors without assistants and that our equipment will be such as we shall have no reason to be ashamed of.

Although in the older universities science has hitherto played a very subsidiary part—yet even in these, as at Oxford and Cambridge, there are abundant signs of an awakening, and it is incumbent upon a young and vigorous University like our own to see to it that science shall occupy her recognized and legitimate position.