The study of the more complex spectra is yielding approximate values for ionization potentials in a few cases, and also a picture of the way in which the complexities of spectra increase in passing across the periodic table. With Professor Russell's kind permission I mention a conclusion to which he has recently come, to the effect that the complexities run as follows: in column I all lines are pairs; in II they are singlets or triplets; in III pairs or quadruplets; in IV singlets, triplets or quintuplets; and so forth in a regular manner alternating and increasing across the table. Analogy indicates that the fundamental lines will lie with the least of the complexities, and it is on this ground that the singlets in Si have been assumed to furnish the ionization potential of that element. There are interesting facts now available in regard to the way in which these complexities widen out or shrink in passing down the columns of the periodic table, or across them, or from one element in the normal state to the same in various stages of ionization, or from an ionized element to others containing the same numbers of external electrons (but different nuclei). The facts are unfortunately not quite well enough known to permit much analysis, and there is little theory as yet on these difficult relations.

Another spectroscopic aspect of the atomic problem is furnished by the new atoms created by the removal of one or more electrons. These are temporary atoms, but their spectral similarities (*e.g.*, Al^{++} and Mg^{+} with Na, Al^{+} with Mg, etc.) tell us something about their probable chemical properties, and their spectral series yield their ionization potentials. Their occurrence offers a number of attractive puzzles as yet almost untouched. They appear, for instance, to have the ability to form temporary compounds, whose existence may sometimes be proved from band spectra. Somewhat similar is the occurrence of molecules in *He* which are supposed to be formed by "excited" atoms, *i.e.*, those in which one electron is displaced from its innermost position to an outer orbit.

Much praise is due to Fowler and to Paschen for their recent work on the spectra of ionized Si and Al. Paschen found it possible to sort out in the spectra furnished by sparks and other sources those lines due to Al, to Al^{+} and to Al^{++}, and to show that they form systems of series requiring four times the universal series constant N for the atom Al^{+} and 9N for the series formulae of Al^{++}. Fowler found in Si^{+++} series requiring 16N, thus furnishing a striking confirmation of a prediction originally made by Bohr.

Finally, in the direction of very short wave lengths, experiment has recently blasted out new trails which will doubtless lead us to much that is of the greatest interest. The work of Lyman, Millikan and many others is disclosing the most important radiations of many atoms, and much more needs to be known, especially about series spectra in this region, to bring about a closer connection between optical and X-ray series in the lighter elements. This is probably, to quote a happy phrase of Professor Russell's, the heroic age of spectroscopy, and in the next few years we may hope to have laid a thoroughly sound foundation for future builders of atomic models. Not until then at least shall we have begun to emerge from the darkness of ignorance in which we are still plunged, or to have begun to deserve the name imposed somewhat prematurely upon our species—Homo sapiens.

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ON CERTAIN COURSES NOT LISTED IN THE MEDICAL CURRICULUM[1]

EDUCATION in medicine has changed greatly since the war. Practically all the good medical colleges have found it necessary to limit the numbers of their students on account of the increasing masses of men and women who seek admission to the various institutions of learning. This has made it possible for us here at Cornell to select only those who have the best educational and personal qualifications. This selection is difficult, but the dean and secretary have acquired great skill and we are becoming accustomed to increasingly enthusiastic reports from the teachers of the first-year classes. The medical college secures a much better group of students. The students secure, or should secure, a better understanding of their indebtedness towards the college. Each one of you is virtually receiving a scholarship of approximately one thousand dollars a year, since it costs the university this sum in excess of the tuition fees to furnish the education that the faculty believes to be essential. The expenditure of this sum was made possible through the generosity of the late Colonel Payne, who endowed our medical college. Your acceptance of its benefits entails on your part a serious realization of your obligations to the community. The community expects not only well-educated conscientious practitioners, but also devoted public servants. If in addition your class develops, as we expect it to develop, leaders in the science of medicine, we are more than repaid for the investment of money and the labor of teaching.

The year of 1923 marks a change in the policy of the Cornell University Medical College. The faculty has realized that the curriculum is overcrowded and has decided to reduce the number of hours of instruc-

[1] An address delivered to the medical students at the opening of the college year.

tion. Unfortunately, little change can be made with those classes which started under the old régime, but the new classes will find an increasing number of blank spaces in the schedule. Why should the faculty try to cut down by 20 per cent. the hours of instruction, when the science of medicine is becoming more and more crowded with facts that the students must learn?

During the last few years, as these facts have increased in number, the teachers of medicine have increased the rate of cramming the students. This has developed the method of "spoon feeding." Our students resemble domestic fowls fattening for the market, expecting their food to be served to them in trays. We should prefer to have game birds who know how to find their own food. You can take all the courses listed in the catalogue, work hard, pass your examinations, and yet make an utter failure of your course in the medical school. The best that we can teach you now will be hopelessly inadequate in another decade. *You must teach yourself to study the medicine of this decade in such a manner that you can teach yourself the medicine of the next decade.* You must learn to do your own searching for knowledge. You must develop your own powers of observation and critical judgment. You must learn how to use the literature and must prepare yourself to substitute your own wards, your own laboratories and your own libraries for those of this medical school.

In the hope of accomplishing these ends the faculty is leaving blank spaces in the schedules. Although it has never been expressed in words, I feel sure that the faculty has intended that these vacant hours should be filled not only by electives but also by certain fairly well-defined courses in self-education, which I shall now endeavor to outline. These are all to be conducted by Professor Ego assisted by Dr. Subconscious Self. The periods in many of them are rather long, sixteen hours a day, seven days a week. The examinations last only a lifetime.

The first of these courses is entitled "How to study." You have had some preliminary training in school and college, but you are now met by sterner demands. You will find that enormous numbers of facts must be learned and that glittering generalities play a minor rôle. The manner in which these facts can best be impressed upon your memories is left largely to yourselves. Each one of you must find out for himself how he individually can study best. Some learn best from books, some from hearing. Some learn best by working with fellow-students and mutual quizzing. It has always seemed to me that the most economical and soundest method is to learn through observation, and by this I mean interested, concentrated, intelligent observation of the objects presented to you in laboratories and clinics.

The second course, and one of the most important, is entitled "What to remember and what to forget." Your success in it will depend largely upon your native ability in judging values. This is the faculty that the business man employs in judging a market or selecting for his store those goods which will find a ready sale. It is impossible to remember everything that you hear or read. When a fact that seems to you to be important is presented, you should record it clearly in your mind, coordinate it with other important facts, fortify it by illustrative examples. If this be done properly it will serve you a lifetime. The process of forgetting things which should be forgotten sounds easy but proves difficult. How can we recognize the statement that is unimportant or incorrect? Often we can make use of our knowledge of the science of heredity and study the ancestry of the statement in question. James Harvey Robinson has presented an excellent point of view in his book, "The mind in the making." He shows that our thoughts, and particularly our subconscious thoughts, are influenced by our animal heritage, our savage mind, by the period of medieval civilization and by our childhood. He infers that in scientific investigation only have we cut ourselves loose from this intellectual ancestry. This has been done successfully, however, only in the best scientific investigation, and we still have in our medical literature and thought many vestiges of by-gone ages. This can be appreciated only if you dip into the medical books of previous generations and study the history of medicine. Our journals and even some of our text-books contain unverified statements from authors who used incorrect methods and thought in terms which are incompatible with our present knowledge. These pitfalls are dangerous, but not as dangerous as the entanglements of some modern investigators, who talk our modern language, but run after the ancient gods of poor technic, artifact and unwarranted theory. In browsing through the literature the student should scrutinize the parents and sponsors of every statement. An article by an unknown author, from an obscure town, published in a mediocre journal, may contain accurate information, but the chances are ten to one against it. An article in a good journal, by a well-known man, who has on previous occasions wandered after strange gods, should be regarded with suspicion. Even the best of men, including almost all medical teachers, have their hobbies and ride them too hard. Fortunately, students are particularly skilful in detecting this more or less innocent form of amusement in their instructors.

Why is it important to forget these misstatements, exaggerations and errors? They seem to do no harm if they are tucked away in our minds with a label of "doubtful" or "erroneous." The trouble is that they

wander into the subconscious and often mix our thoughts for years to come. The man who knows about a given subject only five things that are really so is much better off than the man who knows ten facts that are true and ten "facts" that are not true. Each "fact" that is not true distorts all the facts that are true. I am inclined to believe that a formula for a man's effective knowledge concerning a given subject could be expressed as follows: The number of true facts divided by the square of the number of untrue "facts."

A third course is entitled "How to express what you know." In this course 80 per cent. of our students have been failures. Reading over examination papers, I have been horrified by the jumble of ideas that pours out of the swiftly moving fountain pens. The facts may be given, but they are presented in hopeless confusion. The student plunges into the middle of the subject, then demolishes the end and finally, if he happens to remember, hurriedly jots down the all-important beginning. One of the most common faults is to write down a heterogeneous mass of statements which has nothing to do with the question. Some of these are truths, some half-truths, but usually we find that there is no truth in them. One year in the examination in medicine we asked the fundamental cause of ketosis in diabetes. This was the last question on the paper and most of the industrious students used all their spare time in long discussions. One man had only a minute left for the question and he wrote "The cause of ketosis is the inability to oxidize carbohydrates." That was all he wrote; that was all he needed to write. His answer was the best of the lot.

The blank hours in the schedule will, for the first time, leave room for a course which seems to me to be of great importance. This is a practical course in the care of your own bodies. Many of you have been accustomed to athletics and regular exercise. The medical student in a city like New York often drops this suddenly, and his health and work suffer in consequence. We preach the necessity of fresh air and exercise to our patients, but give our students no time to apply our teachings. I wish to take this opportunity to call to your attention the branches of the Y. M. C. A. which are scattered throughout the city. I wish to warn those who are working their way through college that there is no point in securing a doctor's degree for a physical wreck. I believe that many of our students suffer permanently from studying too late into the night. A brain that is tired and sleepy works inefficiently and this causes a vicious circle. You must decide the question for yourselves, but I suggest regular hours of sleep, regular hours of exercise, and intensive hours of study with a brain at its highest efficiency instead of long hours devoted to reading over and over again pages which make little impression.

It seems to me that there should be a distinct place in your curriculum for a course "in the joy of life with excursions into the realm of youth." This used to be the chief occupation of the medical student a few generations ago. Now you seem to have gone to the opposite extreme and have become prematurely aged. There is no particular reason why the four years of medical study should be bereft of all joy and made into the bitter experience upon which many of us look back with horror. Our dean has recognized this fact and has given this course "in the joy of living" an official place in the college schedule. I refer to that day in the springtime when the faculty and students meet on equal terms of youth. On this one day of the year the instructors became almost as young as their students who sometimes actually beat them at baseball, though I doubt if they would do quite as well at tennis or golf. Our spring "Get Together" is the happiest day of the year, but there is no reason why it should be the only happy day. Stay young while you are still in your twenties. They say that it becomes difficult in the fifties.

It is of vital importance to stay young if you wish to succeed in the most important of all the courses that are not listed in the catalogue. This course might be called the "Seeing of visions." "Where there is no vision the people perish," says the writer of the Book of Proverbs. Unless the medical student is able to look forward to something bigger and better than the existence of the average man or the average practitioner of medicine he will scarcely be repaid for his years of labor.

Different individuals will, of course, have different visions of the goals they wish to attain. The faculty of seeing ahead and dreaming of great things develops as a result of stimuli from without, but chiefly as a result of inward growth. Therefore, it is necessary for you to grow as men and women, as servants of the public welfare and as leaders of men. You must learn to accept responsibilities and train yourselves to join the ranks of those having authority.

Leadership on your part is not a voluntary matter. It is an obligation which should be realized from the very beginning. In trying to find the best words in which to express this I have gone back to the time when the world was young, when Homer wrote the story of the battles of the Trojan Plain. You may remember Sarpedon and Glaucus, royal allies of the Trojans, are about to lead their troops against the strong Greek wall. Sarpedon says:

> Why, Glaucus, are we honored, on the shores
> Of Lycia, with the highest seat at feasts,
> And with full cups? Why look men up to us

As to the gods? And why do we possess
Broad, beautiful enclosures, full of vines
And wheat, besides the Xanthus? Then it well
Becomes us, foremost in the Lycian ranks,
To stand against the foe, where'er the fight
Is hottest; so our well armed Lycian men
Shall say, and truly: "Not ingloriously
Our kings bear rule in Lycia, where they feast
On fatlings of the flock, and drink choice wine;
For they excell in valor, and they fight
Among our foremost." O my friend, if we,
Leaving this war, could flee from age and death,
I should not be here fighting in the van,
Nor would I send thee to the glorious war;
But now, since many are the modes of death
Impending o'er us, which no man can hope
To shun, let us press on and give renown
To other men, or win it for ourselves!

This responsibility and obligation is perhaps best realized by one group of students with a vision clearly defined when they enter the medical school. I refer to the men and women who are preparing themselves to become medical missionaries. In this group one feels that the work has been lifted out of the rut by the buoyancy of the high spirit in which it is undertaken. It is difficult to imagine a loftier cause to which a man may offer the devotion of his life. Here in this country we help our hundreds of patients who could find another doctor around the corner. In Asia and Africa the medical missionaries help the thousands, the millions, who have no other touch with Christ's teachings and no other means of receiving the benefits of the civilization that has developed only in Christian communities.

Those of us who intend to remain in this country must aim high to approach the vision of these medical missionaries. If we intend to work as practitioners of our science and art, we must not only perfect ourselves in our knowledge of the science, but we must also develop to the utmost all those higher senses which will aid us to do good for the sake of doing good. We must defend ourselves against the sins of laziness, carelessness and avarice, and in defending ourselves, we can not do better than to remember the old adage of the U. S. Navy, "The best defense is the rapid and well-directed fire of your own guns." The best defense against the sins that I have mentioned is the rapid and well-directed effort to do good in your own community.

There is another vision which I would like to call to your attention, since it is particularly well adapted to all of you who are receiving the benefits of a training at Cornell. I refer to a career in academic medicine and research. Throughout the land far-seeing philanthropists are endowing medical schools and institutions of learning. These are helpless without well-equipped teachers, and the supply of such teachers is becoming inadequate. A life devoted to medical teaching, and particularly to the teaching of the fundamental sciences, entails a sacrifice of many of the pleasures that accompany worldly goods, but the harvest is reaped by the community and by all that is best in the man himself.

Far be it from me to attempt to dictate your visions. You must find them yourselves. I can only suggest one method of procedure. Set your goal as high as possible according to your own lights. Then study the best, the finest man you know and try to understand the goal that he would have you attain. Even this is incomplete unless you seriously consider what our Master, Jesus Christ, would expect of a man of your opportunities. The writer of the Psalms has said, "Good luck have thou with thine honour; ride on, because of the word of truth, of meekness and of righteousness; and thy right hand shall teach thee terrible things."

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SCIENTIFIC EVENTS

BAYER 205

THE Berlin correspondent of the London *Times* writes that a new stage has been reached in the struggle against sleeping sickness, for Bayer 205 has been tested in Central Africa and has been proved beyond dispute to surpass in its effectiveness any remedy that had previously been tried. The new compound discovered by the Bayer Chemical Works in Leverkusen, near Cologne, is extremely complicated and contains neither arsenic nor antimony; only carbon, nitrogen and hydrogen enter into its composition. Like salvarsan, it is ultimately derived from atoxyl, and as salvarsan bore the number 606 so Bayer was christened 205 because 205 successive transformations of the original substance, atoxyl, were made by the Bayer chemists before the Bayer medical staff pronounced the result satisfactory enough to merit practical experiments. From first to last ten years were occupied in its production.

In 1919 the remedy was passed on to Professor F. K. Kleine, director of a department in the Robert Koch Institute in the study of infectious diseases in Berlin, with a view to his carrying out experiments in Central Africa. Dr. Kleine had studied the trypanosome diseases for many years in German East Africa, now Tanganyike Territory. In earlier cases he had acted as Koch's assistant. Together the two experimented with atoxyl in the Sesse Island of Victoria Nyanza.

In the autumn of 1921 the British Government granted permission for Dr. Kleine and his colleague Dr. Fischer to proceed to Northern Rhodesia. A