Chief Mineral Constituents of the Marlioz Spring.

	Per litre.
Calcium carbonate	0.1912 milligrams
Sodium hydrosulphide	0.0295 ,,
,, sulphate	0.2631 ,,
Calcium sulphate	0.0605 ,,
Magnesium chloride	0 0640 ,,

With minute quantities of sodium iodide and silicon and a trace of bromine.

The Marlioz treatment is chiefly appropriate for chronic forms of laryngeal and bronchial catarrh, granular pharyngitis, adenoid vegetations, hypertrophy of the tonsils, ear disease, eye diseases, and chronic conjunctivitis. The waters are specially indicated in the case of lymphatic children who are in an anaemic state from city life, and for children suffering from scrofula, glandular enlargements, and hereditary syphilis. Pastilles containing the natural salts of the waters are manufactured at Marlioz.

Saint Simon.

The St. Simon spring is about fifteen minutes' walk beyond Marlioz. The water is clear and transparent, with no taste and a slight alkaline reaction. Its chief mineral constituents are sodium sulphate and magnesium carbonate, chloride, and oxide. It is used as a table water, and, owing to its slight mineralization and the salts of magnesia it contains, is useful for gouty people and for persons with delicate digestion.

The Aix-Massonnat Source.

These waters are conducted from the property of M. Massonnat on the hills north-east of Aix to a kiosque in front of the thermal establishment, and sold there. The water is a pure spring water, containing little more than traces of mineral constituents. It is soft and slightly alkaline in reaction, and its use tends to moderate vascular excitement, and keep up the normal activity of the kidneys, thus helping to eliminate toxic products.

Mechano-therapeutic Institute.

There is a large Zander institute at Aix, containing a complete set of apparatus, the mechano-therapeutic treatment being found useful in certain cases, in conjunction with the bathing cure. Even here the Aix sporting instincts break out, for in the circular issued by the directors we read, under the description of the Zander treatment: "It gives exercise, or even a kind of sport, without fatigue, to old people who could not otherwise take exercise."

THE tenth Congress of Polish Scientists and Medical Practitioners will be held this year at Lemberg some time between June 16th and July 24th. There will be a scientific and medico-hygienic exposition in connexion with the congress.

THE late Mrs. Emily Rachel Merton, of Hove, left £50 each to the Hospital for Sick Children, Great Ormond Street; Brompton Consumption Hospital; the Royal Hospital for Incurables, Putney; and the Jews' Hospital and Orphan Home, Norwood.

THE seventh International Congress of Physiologists will be held this year at Heidelberg, August 13th-16th, under the presidency of Professor A. Kossel. The previous congresses were held at Basle, in 1889; Liége, in 1892; Berne, in 1895; Cambridge, in 1898; Turin, in 1901; and Brussels, in 1904.

M. REGNAULT, French Minister at Tangier, in a speech delivered over the body of the late Dr. Mauchamp before it was put on board ship for conveyance to France, stated that the Government of the French Republic intended to perpetuate the memory of the unfortunate doctor by a hospital to be founded at Marakesh at the expense of the people of Morocco. In this way, said M. Regnault, one of the punishments inflicted on them for the murder of a Frenchman would be a benefit to themselves. This ingenious method of practising the precept to return good for evil—at the culprit's expense—may furnish a hint to penologists.

MOTORS FOR MEDICAL MEN.

[FROM A CORRESPONDENT.]

(Continued from page 822.)

THEORY OF EXPLOSION ENGINES.

IN order to get the best results and to get them with economy of fuel, it is essential to understand, so far as it is known, exactly what takes place in the cylinder of an explosion engine. The first point to realize is that the power is wholly derived from the expansion of the gases by the heat generated by the explosion, and not by the formation of products which are more bulky than the contents of the cylinder before the explosion. It is true that the products of the combustion of petrol vapour and air do occupy, when reduced to the same temperature, a little more space than they did before combustion, but it is only a little; it is the enormous heat produced, a heat higher than the melting point of platinum, to which the gases are raised that expands them. Thus in the strictest sense an explosion engine is a heat engine, and were it feasible to employ a red-hot cylinder, the gain in power would be enormous. The cooling by means of a water circulation is all waste of power, but it is unavoidable. So, too, the engine when cold does not develop its full power; the cold walls of the cylinder rob the charge of its heat and so lessen its expansion, even perhaps extinguishing the flame along the stratum of gas which lies in contact with the cylinder walls.

Compression.

The more combustible material we can get into the cylinder the greater the heat developed; the charge is therefore compressed before being fired. The gas engine, the pioneer of explosion engines, only became a success after the compression of the charge was adopted, and nowadays compression is truly said to be the soul of explosion engines. Of course the engine has to do work in compressing the charge to a pressure of from 60 to 80 lb. on the inch, but this work expended is nothing as compared to the gain, although Professor Hopkinson has found that in a 17-h.p. engine with four cylinders the work expended in compression and in turning the engine is as much as 1 h.p. Precisely similar charges were exploded in a closed chamber, and the pressures reached measured; it was found that the charge when compressed to 6 or 7 lb. and fired, only gave a pressure of 45 lb. on the inch, and took so long to attain to this that it would have been useless in the cylinder of an engine. But the same charge compressed to 60 lb., and then fired, gave a pressure of 300 lb. on the inch, and reached this very quickly. To this subject we shall need to recur later in connexion with the operation of the engine; for the moment it will suffice to point out the importance of prior compression of the charge.

The fuel burnt, known as petrol, is not a pure chemical compound, but is a mixture of several of the more volatile constituents of crude petroleum, separated by a kind of fractional distillation; it should, however, chiefly consist of pentane, a hydrocarbon. Hence the products of its complete combustion should be only carbonic acid and water, but as a matter of fact, under the conditions of actual use, other compounds are formed in small quantity.

There is some reason to suppose that, at the high temperatures involved, the hydrocarbon does not entirely burn as such, but that dissociation occurs, and the hydrogen burns first and the carbon afterwards. Hence, if there be an insufficiency of air, all of the hydrogen burns, but some of the carbon escapes in the solid form, making smoke or deposits of carbon.

The Carburettor.

Hence it is of the greatest importance to get a properly apportioned mixture of petrol vapour and air, a function discharged, often imperfectly, by the carburettor. It might have been supposed that the best mixture would be that which contains the exact amount of air requisite to provide oxygen for the complete combustion of the hydrocarbon, but in practice some excess of air is found to be advantageous. If, on the other hand, the excess of air be too great, forming what is termed a weak mixture, the results are far from satisfactory, and, notwithstanding the excess of oxygen, some of the hydrocarbon always escapes unburnt.

The Construction and Working of a Petrol Engine.

We may now pass on to the actual construction of a petrol engine and the manner of its working. The cylinder, which is usually placed vertically, is open at its lower end, whilst above the part bored true is a space termed the combustion chamber which is closed, though two openings shut by valves are made into it. The piston is of the trunk engine type; that is to say, it is a hollow cylinder, closed at the top but open below, and the connecting rod is attached to a rod which crosses the hollow of the piston near its upper end. Thus both cylinder and piston are open below into the crank chamber. The piston is forced downwards by an explosion above it, but is returned by the momentum of the fly-wheel of the engine.

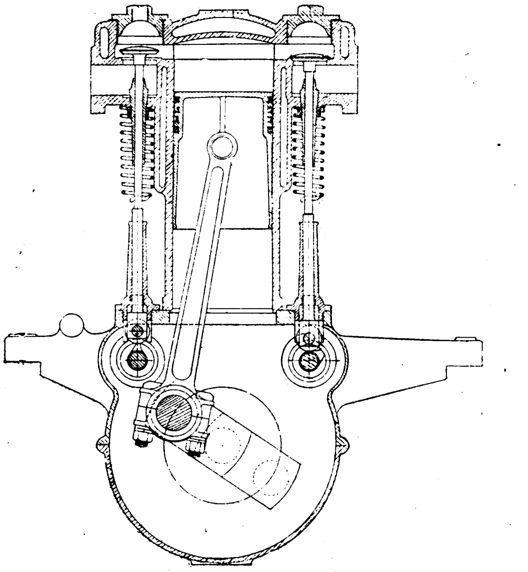

Fig. 1.—Sectional view of a cylinder. The piston is near the top of its stroke; the connecting rod is seen, its lower end with an adjustable bearing ("big end"). The crank chamber is seen below. At the sides of the cylinder are the inlet and exhaust valves, opened by cams on the half time shafts and closed by strong spiral springs. The inlet valve is open for the admission of a charge. The exhaust valve is closed. (Lent by the Humber Company.)

The sequence of events in the working of the engine is as follows:

First Revolution.

First Half.—The piston is at the top of its stroke, the inlet valve open and the exhaust valve shut. The piston descends, sucking in a charge through the open inlet valve.

Second Half.—The piston ascends, both valves being shut, and compresses the charge above it.

Second Revolution.

First Half.—The piston being at the top, both valves shut and the charge under compression, the spark occurs, and the piston is driven down by the explosion.

Second Half.—The piston ascends, the exhaust valve having opened, and expels the burnt charge. This sequence of events, in which the piston receives only one impulse during two complete revolutions of the engine, is known as the "Otto cycle," having been first introduced in the Otto gas engine. As this cycle is the source of the power, and its accomplishment correctly is a vital matter, it will be well worth while to consider somewhat closely what happens.

The compression is effected in the cylinder, and, supposing the valves and the piston to be airtight, its degree will be determined by the ratio of the cubic area swept by the piston to that of the explosion chamber above it into which the piston does not enter. The importance of good compression has already been alluded to, and the first point to notice is that, as the piston commences to descend again, the compression diminishes rapidly. Hence, unless the effective firing of the charge takes place at the moment the piston is at the top, full advantage of the compression will not be utilized; in other words, retarded ignition comes to just the same thing as poor compression, and that means waste, for the petrol used is not burnt so as to develop its utmost power.

To understand this aright it is desirable to study a diagram embodying the results of Messrs. Bairstow and Alexander's experiments on explosions, not in a motor cylinder, but in a closed vessel. They found, in the first place, that there was a lag of one-hundredth of a second after the spark took place before the explosion developed any material power. Hence, if the spark be so timed as to occur exactly when the piston is at its highest point, a hundredth of a second will elapse during which the compression is diminishing by the descent of the piston before much force is exerted.

Now if the engine is running at 1,000 revolutions a minute—a fair average speed—the piston traverses the whole length of the cylinder in three-hundredths of a second, so that a third of its compression effect would be lost. Moreover, in practice it is found necessary that the exhaust valve should open a little before the completion of the explosion stroke, else the return of the piston will be impeded, and so there is less than three-hundredths of a second during which the full force is exerted;

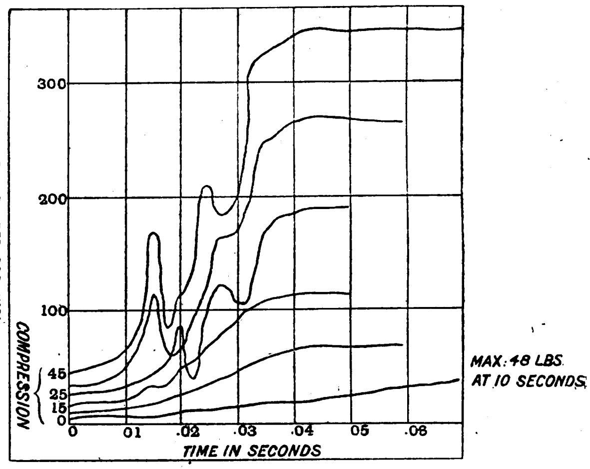

Fig. 2.—The horizontal line at the bottom marks the time, measured in hundredths of a second. Along the vertical line are marked pressures in lb. per square inch. The traced curves show (1) the initial compression before the charge was fired, (2) the maximum pressure attained, (3) the period of time in which this maximum was reached, and the period of its decline. The spark took place at the point marked 0.

hence the spark is made to occur in practice a trifle before the piston reaches its top point, and this allowance, when the engine is running fast, causes the force of the explosion to coincide nearly with the highest position of the piston and with the best compression. But if the engine is not running fast, as, for instance, when it is being revolved by the starting handle, the explosion will attain to force before the piston has reached the highest point, and will drive it backwards, reversing the action of the engine, and constituting a "back fire." Or, if the engine is running faster than this, but still not fast enough to carry the piston past its highest point before the pressure comes upon it, the action of the engine will not be reversed, but a sharp knock will be heard, a condition of things very detrimental to the engine. It will therefore be understood that while, to give the best results, the ignition should always be advanced as far as it can without producing a knock, care must be taken that it is not too much advanced.

If the diagram be examined with the view of seeing what the condition of things during the available three-hundredths of a second is, it will be seen that not only is good compression essential in order to get a great pressure per inch as the result of the explosion, but also that good compression is indispensable in order to arrive at the maximum pressure speedily. For with a low initial compression (say, 7 lb. to the inch) the low maximum explosion pressure of 45 lb. will not be reached during the piston stroke, but, in fact, takes ten hundredths of a second to develop—that is, the time of three piston strokes—and thus only a very low pressure can be attained before the exhaust valves open and the charge escapes; but with a compression of 60 lb. to the inch the maximum of 300 lb. per inch will be reached in two hundredths of a second, and if the ignition be advanced to a period one hundredth of a second before the piston reaches the top to allow for the lag almost all will be available. The diagram will therefore repay study as to what can actually be got into the three hundredths of a second period.

It must not, however, be supposed that this diagram can be taken as exactly representing what takes place in a motor cylinder, for the experiments were conduced in closed chambers with fixed walls, whereas one side of the explosion area of a motor engine is formed by the moving piston, which yields before the force of the explosion. Hence, although the diagram is most instructive, the pressures which it gives are not attainable in the motor cylinder. Recent experiments have shown that an average pressure of eighty to a hundred pounds throughout the stroke is more like what is actually attained.

The general lesson to be learned, then, is to see, in the first place, that the compression is made good by the accurate fitting of the piston and of the valves, and, in the second place, that the compression is fully utilized by accurate timing of the spark, so that effective explosion takes place while the compression is at its best. It will also be noticed that, inasmuch as the piston does not sweep out the area of the explosion chamber at the top, the whole of the exploded charge will never be expelled, but some part of the burnt charge must remain behind to mix with the incoming fresh charge.

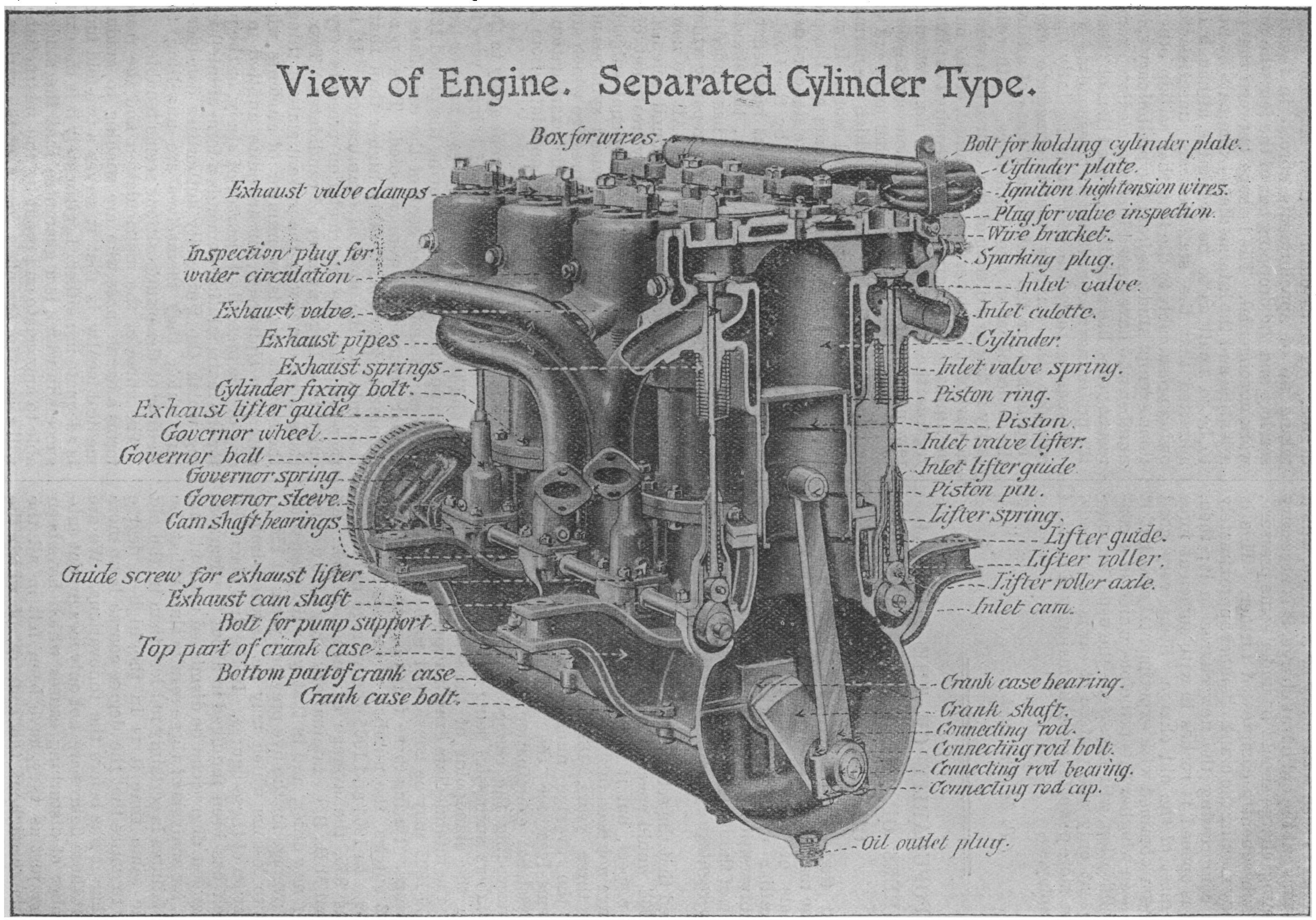

Fig. 3.—General view of a 4-cylinder engine, one of the cylinders and its belongings being bisected to show its interior. (Lent by Messrs. Panhard and Levassor).

It is further to be observed that, inasmuch as the explosion takes a very long time for its completion when the compression is low, its effect can then never be utilized within the three-hundredths of a second available. Without entering into further details, it may be said again that the diagram will convey a good deal of information which is practically useful in driving if the periods of three-hundredths of a second be studied in order to see what can occur in that time.

The valves of the majority of modern engines are what is styled "mechanically operated" — that is to say, they are opened by cams on a revolving shaft; the exit valve is always so operated, but some cars still use inlet valves held shut by a spring and opened against this spring by the suction of the engine. The spring inlet valves present this advantage: that whereas the width of the opening of the mechanically-operated valve is always the same, the spring valve opens wider if the suction of the engine becomes stronger, and so admits a larger charge. To some extent mechanically-operated valves may be made to meet this by contrivances for varying the lift of the valves. Such is the construction of the cylinders in the great majority of cars, and the differences between them are in matters of detail rather than of principle, but a car is about to be placed on the market by the Valveless Engine Company in which an entirely different plan is adopted. Instead of valves, which give at times some trouble, the cylinder has two open ports, which are simply uncovered by the piston as it passes them in the lower portion of its traverse. In order to secure the entry of a charge, which in entering sweeps out the old burnt charge, it is necessary that the incoming charge should be under some pressure, though it is subsequently compressed further. This is accomplished by making the crank chamber approximately air-tight, and compressing the new charge in it; then, when the port is opened, it rushes in with sufficient force to drive out most of the old charge. Some very good results have been obtained with experimental cars, but it remains to be seen whether this principle, which is a considerable simplification, will supersede the usual arrangement; at present only one pattern of car is to be made, and that rather more powerful than the majority of medical men would employ.

(To be continued.)

THE UNPOPULARITY OF THE MEDICAL DEGREES OF THE UNIVERSITY OF LONDON.

THE assertion that the University of London is still shunned by the majority of students who yearly enter the medical schools of London will readily be accepted by those familiar with the work of those schools. While other universities succeed in attracting between 80 and 90 per cent. of the students in their districts, in London a far smaller percentage even aim at obtaining a university degree.

It was hoped that the scheme of reorganization carried through in 1901 would speedily have led to an improvement in this respect, but it must now be realized that these hopes have not been fulfilled.

During the three years, 1899-1901, which preceded the change, the average number of students who presented themselves for the preliminary scientific, the first professional examination, was 279, but in the four years succeeding the change this average it fell to 263, the numbers successful being 141 and 140 respectively. From the standpoint of those who presented themselves for the intermediate examination for the M.B., the period 1899-1903 may be considered to belong to the old order of things. During these four years there was an average of 242 entries, the number of successful candidates being 159. In 1904 and 1905 the average number of applicants was 235, the average of successes 150. As regards the final M.B., B.S. examinations only 1906 can be classed in the new order, and in that year 126 passed as opposed to an average for the five previous years of 139.

There are two lessons which may be deduced from a brief consideration of these figures. In the first place, the idle talk which has been indulged in about the degradation of the London degree can be dismissed without further comment, for analysis of these results shows that the percentage of failures is certainly not less than in the old days. At the same time it is in the highest degree unsatisfactory to notice that the degree course is no more popular now than it was before the innovations. We are well aware that these figures are not only meagre but subject to a number of disturbing causes which have been felt in London just as they have been felt in all the medical schools throughout the country, of which the chief is said to have been the South African war. But the fact remains that the reorganization of the University has not succeeded in making it popular with the London students at the medical schools.

If we accept this deduction—and, quite apart from the statistics quoted, the fact is notorious—it becomes a matter of the utmost moment to consider what are the causes of the distaste for the University of London displayed by those now entering for medicine, and how far it is justified. At the outset, the fact that about 30 per cent. of those who pass the intermediate examination fail to graduate might appear to provide the explanation, but further consideration makes it seem probable that the causes at work are independent of the nature and standard of the final examination. The leakage is apparently to be accounted for in large measure by students taking the earliest opportunity to obtain a diploma which shall qualify them for hospital appointments. Stress of work often prevents these from subsequently proceeding to the degree. As contributory causes may be suggested the taking up of appointments abroad in the Government services and the dropping out of the few who find hospital work uncongenial. The leakage between the preliminary scientific and the intermediate examinations would appear to be so small as to be negligible, although it must be admitted that the statistics are unsatisfactory, since, owing presumably to the fact that certain other examinations exempt students from the preliminary scientific, the number who have passed the intermediate examination in recent years has actually exceeded that of those who took the preliminary scientific at a corresponding period.

Assuming therefore that it is logically impossible to consider the final or the intermediate examinations responsible for the unfortunate state of affairs, we have the choice of one of two alternatives. Either the unpopularity is due to a dislike of the course as a whole, so that no part of it can be especially blamed, or the nature of the preliminary tests furnishes the required explanation. As regards the first possibility, it is unquestionable that a few men fight shy of the London course owing to its generally reputed difficulty, but that many are so deterred is disproved by the keen interest which the normal medical student takes in his professional work. It would seem, therefore, that the great deterrents are the preliminary examinations. Many years ago the standard demanded in Chemistry, Physics, and Biology by the Conjoint Board was unquestionably lower than that required by the University. For some past, however, the standard of the Conjoint Board in these subjects has tended to rise, and there is no longer the great discrepancy which used to exist between these two bodies. All are now agreed on the advantage of a thoroughly sound scientific groundwork, failing which a satisfactory treatment of the theoretical portions of strictly professional subjects becomes impossible. In view of the revised syllabus of the Conjoint Board and the greater prestige which attaches to a degree, the preliminary scientific examination cannot be the chief factor in preventing candidates from attempting to graduate in London.

How far does the same argument apply to the matriculation? It has the reputation of being a very formidable test, and the fear which it inspires is more or less justified by the published results. During the period 1899 to 1905, between 53 and 54 per cent. of the candidates who presented themselves were rejected. This percentage of failures is very considerably higher than that which is the rule at the medical examinations. It is obvious, therefore, that the matriculation presents very real difficulty to a large number of candidates. Two considerations alone can justify the present state of things. Either there must be a large number of students who wish to enter the University, but are quite unfitted to appreciate any of the prescribed courses of study, or the preparation for the matriculation demands a form of intellectual training which the University authorities consider essential, but which they themselves are unwilling to supply. Neither of these suppositions seems tenable.

The curse of the matriculation and the reason why it forms a bar to those who are wishing to graduate in the medical faculty, is that it serves a two-fold function, and is adequate in neither. Legitimately it is the examination, success in which is a guarantee that the student will be able to appreciate and profit by the instruction which he will receive in the class rooms of the various schools of the university. But, unfortunately, it also serves as a minor degree. People have come to regard it as something more than a school-leaving certificate; in fact, as a testimony that the successful candidate is now competent to take his place among the wage earners, among the primary and even among the secondary teachers of the country. No one examination can adequately fulfil this double function, and in so far as it attains success as a test of the nature of a minor degree it fails as an entrance examination to the medical profession.