knowledge to be acquired, which here comes into consideration. So far as I can judge, the only practical way of securing such an increased amount of knowledge consists in elevating the standard of the *matriculation* examination. I am loth to advocate anything which is an addition to the troubles of the embryo medical man, but I can conceive no other means of inducing the school authorities to realize Sir William Treloar's word that the English boy "wants more work" than by raising the requirements of the "matriculation" examination. Moreover I hope to compensate for the additional burden here proposed by lightening the one at present imposed by the requirements of the preliminary and intermediate examinations.

I am fully conscious, I repeat, that the substitution of a mixed classical and modern education for a purely classical one will be at the best but a slow process. The practical experience of Germany, which I have reported in an earlier part of this paper, shows how slowly people are becoming alive to the advantages of such a change, and in this country, moreover, several of the universities would have to make modifications in their matriculation examinations. At the same time the advantages seem to me so obvious, that I have no doubt that they will ultimately assert themselves, and I think the van ought to be taken by medical men who intend their sons to follow their father's profession.

Whilst the question of school education just discussed, and most of the other problems referred to in this address are of such a nature that they can only be solved by a process of slow evolution, and whilst in solving them, not only medical, but other interests also have to be gravely considered, matters are different with the one remaining subject of my parallel—the most important of all, namely, the question of the medical curriculum in this country. This is a domestic affair, which can and ought to be solved without delay by the action of the profession itself. The present condition of things is, as I trust I have sufficiently shown, simply anomalous. To spend three years on preliminary and intermediate subjects, and two years only on those which form the real preparation for the life task of the British practitioner, is a distortion of the rational proportions of the two periods.

The experience acquired in Germany, where the regulations quoted by me have been in force for nearly forty years, conclusively shows that a sufficient amount of anatomy, physics, biology, physiology, and chemistry, such as is required for a medical career, can well be taught in two and a half years or less; and in earnestly pleading for a reduction of the time devoted to the preliminary and intermediate studies to such a period in this country, I wish pointedly to draw attention to the fact that it has been found practicable in Germany to teach all those subjects which in this country are called primary and intermediate *concomitantly*—that is, not one *after* the other, but all of them *at the same time*. If the German boy can simultaneously be taught anatomy, physiology, physics, and chemistry, I fail to see why the English student could not be taught them as well, and equally effectively. It is in the opinion of competent judges the not doing so which is one of the causes why the study of medicine has become extended to seven years in this country.

The half-year thus gained would be an extremely valuable addition to the present but too short time devoted to clinical studies, and its usefulness would, I think, be greatly increased, if its first three months were devoted to *systematic* instruction in all the important methods of clinical observation, such as auscultation and percussion, ophthalmoscopy, laryngoscopy, otoscopy, rhinoscopy, examination by means of Roentgen rays, methods of staining, examination of the opsonic index, etc. When a man is expected to use his tools in his profession the very first thing he ought to be taught is, I think, the use of the tools themselves, and when he approaches the sick bed, having previously been fully instructed how to examine patients according to modern methods, he will from the beginning of his clinical studies derive much more benefit from the instruction of his clinical teachers than when he merely stands by and sees others use instruments with the use of which he himself is not acquainted. It is in this way, I think, that, without any violent measures, an important reform of medical education can be introduced at once, resulting in benefit to the medical profession and to the community at large.

To the half-year thus gained I should like to see another six months added in the curriculum, to be devoted to further perfecting in clinical work. Seeing the indisputable fact, that the British student nowadays on the average studies nearly seven years unofficially, the official addition of another six months to the five years' curriculum could be effected, I venture to say, without doing harm to any body and with decided benefit to the plan of studies.

That in a subject of such magnitude as is the question of medical education I should find everybody to agree with the views which I have laid before you I do not for a moment expect. Even those who may think as I do on some of the more important questions I have touched may find fault with the details of my proposals. I think I may say, however, with tolerable confidence that on the question of the necessity of a rearrangement of the medical curriculum most clinical teachers in this country are agreed.

The purpose of this address will have been fully attained if I have succeeded in setting a number of medical men in this country thinking about the great and ever-present problem of medical education, and if some of the proposals which I have made should be thought worthy of further consideration and discussion.

BIBLIOGRAPHY.

- University of London, Faculty of Medical Sciences, University College: Prospectus, Calendar, Regulations.
University of Manchester, Faculty of Medicine, 1906-7: Course of Study, etc.
Die gesetzlichen Bestimmungen über die ärztlichen Prüfungen für das Deutsche Reich, Mai 28th, 1901.
Lehrpläne und Lehraufgaben für die höheren Schulen in Preussen, 1901.
Die Berufsausbildung nach den Berechtigungen der höheren Lehranstalten in Preussen, 1903.
Wie studirt man Medizin? Von Dr. med. Ad. Bickel, 1906.
Gymnasium und Realgymnasium. Vortrag von Professor J. Baumann, 1898.
Ordnung der Reifeprüfung an den neunstufigen höheren Schulen in Preussen, 1901.
Studiengang der Studirenden der Kaiser Wilhelm-Akademie für das militärärztliche Bildungswesen, 1907.

THE CANCER PROBLEM—A SUGGESTION.

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ALTHOUGH the experimental investigation of the propagation of cancer in mice seems to afford little clue to the origin of the cancer cell, yet it lends itself admirably to the study of those conditions, both artificial and natural, which make for recovery. A knowledge of the cause and origin of the cancer cell would doubtless lay the foundation of a rational preventive treatment, but this we may find beset with great practical difficulties; the second half of the problem—the cure of cancer—might then take precedence over the first, and it is to this side of the question that this short article belongs.

The essential characteristic of the cancer cell is its apparently unlimited power of multiplication; relatively to its neighbours it is a young vigorous embryonic cell.

It is a well-recognized fact that the nucleus determines the division of cells, and takes the chief share of work in that process, the separation of the protoplasm being secondary. Our attention must, therefore, be centred on the cell nucleus. Is it possible to act upon and so modify this as to rob it of its abnormal power of proliferation, to bring it down in this respect to the level of those in its neighbouring tissue cells?

Chemically the nucleus consists of nuclein which is identical with the chromatin of histologists. What, then, is the source of the nuclein bodies in which cancerous growths are so rich? Let us first consider the question: At the expense of what tissue does the cancer cell thrive and multiply? But before answering this it is necessary to briefly revise our knowledge of the process of repair of tissue. Formerly it was thought that the leucocytes of the blood took the chief part in the regeneration of a damaged tissue, but there is a growing tendency now among pathologists to emphasize the importance of the local tissue cell itself. This is the cell that multiplies and ultimately restores the tissue. What part, then, do the leucocytes play? They congregate at the damaged area, some of them break down and form a nutritive pabulum in which the fixed tissue cells can develop.

Whether they supply the stimulus to growth is uncertain, though highly probable, but they doubtless supply the nuclein bodies which are so necessary for the nucleus of the now actively multiplying tissue cell. May not the cancer cell, therefore, receive its stimulus from and depend for its nourishment and growth on certain leucocytes, which by breaking down or actual conjugation supply the necessary nuclein? The induration around a cancerous growth is evidence of the infiltration of leucocytes, which, however, is hardly inflammatory in nature, seeing that it is not always accompanied by the cardinal signs of that condition. Pure blood plasma within the blood vessels does not contain nucleo-proteid (the progenitor of nuclein), which would produce intravascular clotting, but becomes coagulable lymph in the tissues by the addition of fibrin ferment derived from the breaking down of certain leucocytes. It seems legitimate, therefore, to suppose that certain leucocytes supply the nuclein bodies so necessary for the rapid mitosis of the cancer cell. Let us assume that this is the case; it will certainly account for some very significant facts connected with cancer growth. It is well known that malignant growths have been noticed to be benefited by an attack of erysipelas. Presumably in a diffuse spreading inflammation like this, within the lymphatic system itself, more leucocytes are concerned in repair than in an ordinary circumscribed abscess. The determination of leucocytes to the diseased area might rob the cancer cells of their normal requirements in the way of nourishment provided a sufficiently extensive surface is involved, and it is only natural to suppose that repair of an injury is of more vital importance to an organism and must take precedence over mere growth.

It is a significant fact that cancer tumours in mice remain stationary at a certain stage of their development, possibly when the limit of nutrient supply is reached, and it would be interesting to know whether metastases were more numerous with smaller or larger primary growths.

The difficulty of inoculating a second tumour after a primary growth of fair size is also explicable on the theory of a limited supply of essential food. The theory of immunity due to a toxin formation does not appear sound, because we are dealing with what might be called an abnormal physiological growth rather than a purely pathological process.

Quite recently¹ in this JOURNAL Dr. Mackay, followed by Dr. Sommerville, reported very interesting cases of amelioration of carcinomatous growths following pleuritic effusion. I did not accept the explanation there given as final, because it seemed to me the circumstances were capable of being explained otherwise. The pleural cavity may be regarded as an enlarged lymphatic space. In acute effusion, which these cases presumably were, innumerable leucocytes take part in the formation of the layers of lymph and adhesions which result; there is probably a general determination of leucocytes to this most extensive lymphatic space, and, as in the case of erysipelas, less important processes, such as growth, must wait their turn. Moreover, as the whole energies of the cancer cell seem to be spent in the function of reproduction, may not the suppression of this function by the absence of essential food endanger its very existence, for, as far as whole organisms are concerned, the young and growing are said to feel the effects of lack of nourishment first and most severely. When a growth is locally damaged it responds by increased growth, the damage having probably caused an increased determination of leucocytes to the damaged area. Similarly when ulceration of a large tumour occurs, cachexia and wasting, hitherto absent, soon make themselves evident. The acquired immunity to re-inoculation of cancer is on this assumption explained by the exhaustion of some particular nutrient material necessary for the growth of the rapidly-multiplying cancer cell, this essential consisting chiefly of nuclein bodies supplied for the most part by certain leucocytes.

If, then, nuclein is so important for rapid mitosis, would it not be possible to considerably modify this process by its withdrawal from the food altogether, or to so act upon it chemically as to alter its functional activity? The key to such chemical alteration might be supplied by the following considerations: From a chemical point of view nuclein is remarkable amongst organic bodies for its high percentage of phosphorus. Could we not substitute for phosphorus a chemical having somewhat similar

affinities? Turning to the periodic system of elements we find that the phosphorus group contains the well known bodies: Arsenic, antimony, bismuth, and three rarer elements.

Arsenic and antimony are already known to have a profound action upon epithelial tissues, probably because these are always multiplying, and, therefore, need much nuclein. Arsenic seems also to have an action on leucocytes, for it diminishes their number in leukaemia. Perhaps the action is due to the part substitution of the element used for the phosphorus of nuclein. Bismuth as ordinarily given in the insoluble form only acts mechanically. The internal administration of arsenic² has been praised in America, and has been said to have an inhibitory action on malignant growth. I should think the heavier metals of this group, if substituted for phosphorus in the nuclein molecule, would be more detrimental to its functional activity.

Now that the experimental investigation of cancer is possible in mice, and there is no question of human suffering, the experiments that naturally suggest themselves out of the foregoing considerations are as follows:

1. The action on carcinomatous tumours of a diet free from nuclein and its progenitor—nucleo-proteid. Such a diet in the case of man would correspond somewhat with the purin-free diet suggested for gout and its manifestations—and by the way, any observed associations between this disease and cancer would be extremely interesting. Cancer has much greater incidence among those taking a mixed diet than among vegetarians, and a vegetarian diet as well as a restricted nitrogenous diet has been extolled as beneficial in both external and internal cancer.² This plan "the nuclein-free diet" could also be tried in conjunction with the internal administration of arsenic or other member of its periodic group.

2. The action of a "phosphorus-free diet" with or without the internal administration of arsenic, etc., might be tried. Seeing, however, that phosphorus is such an important element in the nervous system of vertebrates, it is doubtful whether the living organism could withstand its entire withdrawal from the food, and it is possible a cancerous growth might still draw its necessary phosphorus from the nervous system, thus producing mental depression or other nervous state.

3. The production artificially of extensive inflammatory conditions far away from a cancerous growth with a view to withdrawing the leucocytes thereto and noticing the effect, if any, might prove interesting if of no practical importance.

In conclusion, the present helpless state of our knowledge of the cure of cancer behoves those engaged in cancer research "not to leave a stone unturned," so to speak, and alone justifies the trouble of any experimentation, even though based on purely theoretical considerations.

REFERENCES.

- ¹ BRITISH MEDICAL JOURNAL, July 20th and August 3rd, 1907.
- ² *Ibid.*, October 6th, 1906.

AN X-RAY METHOD FOR IMMEDIATE LOCALIZATION OF FOREIGN BODIES.

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WHILE recognizing the value of the various ways which have been suggested for the localization of foreign bodies by the x rays, not omitting the stereoscopic method, they all appear to present certain disadvantages; either they require somewhat complicated and expensive apparatus, or they involve rather elaborate calculations, or again they need the exposure and development of plates which with subsequent measurements, etc., involves much valuable time. Therefore a method giving a fairly accurate idea of the position of a foreign body, such as a needle, shot, or piece of glass, in a hand, foot, or even a thicker part, from a simple fluorescent screen examination, and that at once, is, I venture to think, worth consideration.

The plan I am using, which is an elaboration of a suggestion of Mr. Shenton, is based on the principle that an upright thin plane, illuminated vertically from below, gives a linear shadow. If the illuminant be moved to a position on the same horizontal plane as it originally occupied and at right angles to the plane examined, then the shadow of the original thin plane becomes a figure