

combated. The combination of the results arrived at by microscopical investigation and experimental study appears to terminate any need for further discussion. A long step has thus been taken in defining the direction in which the future investigation of cancer is alone likely to be profitable.

The Nature of Cancer.

It follows from the argument pursued in the preceding paragraphs that a closer definition of the nature of cancer will involve an analysis of the relation obtaining between the individual developing cancer and the tumour.

In all previous reports guarded reference has been made to the mediate relation obtaining between chronic irritation and certain forms of cancer. The indefiniteness in the way of directing attention to the relationship has been deliberate. In the first place, it is due to an effort to elucidate those forms of cancer with which irritation is most constantly associated without considering other forms in which the particular irritants concerned do not play a part. In the second place, it is due to the fact, already frequently emphasised, that these irritants have nothing in common beyond their association with cancer. The varied investigations of the past nine years have added a knowledge of new forms of irritation. It has become more and more evident that irritation, effective in one case, may be, and often is, quite ineffective in another.

It has been ascertained that every fresh transplantation effects a disturbance of the cancer cells. They are thrown into a state equivalent to regeneration from which they tend to recover, as analogous as possible to reactive proliferation when naturally occurring.

Ever since the beginning of these investigations it has been maintained that the mere cultivation of cancer had important, if only indirect, bearings upon its nature and genesis. Thirty-five of the tumour-strains have now been growing for more than three years, *i.e.* for longer than a mouse lives, while fifty other strains have been grown for extended periods. The one feature all these tumour-strains have in common is the power of continuous growth which they possess, in spite of the most divergent structure, and of extremes in the rate of growth varying from an almost explosive rapidity to one much inferior to that of embryonic tissue, as determined by weighing experiments.

It can be shown that there is a constancy in the behaviour of a tumour-strain and a variability which is individual. The variations which occur are similar to those which distinguish the eighty-five different strains from one another. They are not mainly induced by the environment, but arise spontaneously; otherwise all strains would approach a common type, which they do not. The demonstration of the occurrence of these variations under artificial conditions permits of the inference that they could also occur under natural conditions, and yields objective evidence of the validity of the conclusion that the cancer-cell is a biological modification of the normal cell endowed with many inherent properties of the latter. The objection at once suggests itself that these variations during prolonged propagation are secondary, and do not necessarily indicate corresponding primary changes as responsible for genesis; but this objection cannot be maintained against the facts that the potentiality for variation has been demonstrated, as has also the tenacity with which the several varieties are adhered to.

Immunity and Therapeutic Investigations.

The dissemination of cancer has been studied experimentally both by injecting cancer-cells directly into the blood-stream and by implanting them in internal organs. It has been found possible to produce the lesions of dissemination in these ways both in the absence and in the presence of a primary growth, and what is more important also, to prevent them. Problems difficult of solution in the mouse, because of its small size and the short duration of its life, can now be studied in the more favourable circumstances obtaining in the rabbit, the extension of experiments to this animal being a new feature made possible by the successful propagation of a sarcoma from rabbit to rabbit.

Nothing but harm can result from the premature application to the treatment of the human subject of methods found to modify the growth of propagated cancer in animals. The methods which induce an *active* immunity

to propagated cancer have been tested on thirty-three mice with natural cancer, and have given no evidence of powers either to hinder growth and dissemination or to prevent recurrence of spontaneous cancer after surgical removal.

The successful treatment of animals bearing propagated cancer by means employed to induce *passive* immunity has been described by other investigators. Some of these methods have been tested in the laboratory, but have not yielded positive results. It becomes increasingly evident that the therapeutical treatment of cancer is not to be sought for along these lines.

A considerable number of cases of natural healing of spontaneous malignant new growths have now been observed in mice affected with spontaneous cancer. The changes leading to natural cure appear to depend, as in propagated cancer, on an altered condition of the cell and its contents rather than on an alteration in the general condition or constitution of the affected animal. Means must be devised for elucidating the nature of the change in the cell before curative measures can be discovered.

Since these investigations were first contemplated by those responsible for their inauguration, the provisions made for the investigation of cancer have greatly altered in this country. Whereas nine years ago, apart from special provision for treatment being supplied by a number of hospitals, there existed for the investigation of the disease only one other laboratory in addition to the Imperial organisation contemplated by the founders of this fund. To-day a number of other laboratories exist throughout the country, both in London and the provinces. England and Scotland are now provided with a greater number than any other country in comparison with their size and population. Whenever an opportunity has occurred of furthering the particular investigations upon which these institutions have been engaged, assistance has been rendered by supplying material from the laboratory and by the Imperial Cancer Research Fund in many other ways. The responsibilities thrown upon the workers of the Imperial Cancer Research Fund are not diminished, but rather increased, by the multiplication of institutions engaged in the investigation of cancer.

THE BOARD OF EDUCATION'S SCIENCE EXAMINATIONS AND GROUPED COURSE CERTIFICATES.¹

AS is well known, the Board of Education for some time past has been considering the reorganisation of the existing system of science examinations conducted by the Board, in the hope of lessening the somewhat heavy cost of these examinations and of securing greater educational efficiency. The conclusions arrived at by the Board have recently been published in a circular, accompanied by a covering letter from Sir Robert Morant, in which is summarised the principal changes which the Board has decided to bring into operation in the session 1911-12.

The general principles governing the action of the Board in respect to the proposed alterations are given in the following extract from Sir Robert Morant's letter:—

"The examinations were instituted in circumstances widely different from those of the present, at a time when no other machinery for promoting scientific or technical instruction was generally available; and they have in the past contributed greatly to the diffusion of scientific and technical knowledge throughout the country. But during recent years there has been a great development in the teaching of the subjects covered by the examinations in evening and technical schools, the organisation of which is necessarily affected by the nature of the examination tests available; and the Board have had to consider under what conditions a system of science examinations, conducted not by the teachers of the schools but by an external body, has any claim to continued existence, and how the working of the system so far as it is retained can best be coordinated with and made to supplement the work of the teaching institutions themselves."

It is evident that the Board recognises the very great difference between the general educational conditions in

¹ "Science Examination and Grouped Course Certificates." Board of Education Circular, No. 776, June 20.

force when the examination system was initiated and the conditions prevailing at the present time, and that extensive changes are necessary in order to bring these examinations into harmony with modern developments of educational thought and practice. The Board clearly realises that the annual examination must not be the dominant factor in education. The examination must be subordinate to the teaching. Further, the yearly test, to be of any value, must be mainly an "internal" one, in which the teacher plays an important part. At the present time, the examinations conducted by the Board are purely "external" examinations, carried out by an outside body which is out of touch with the teacher and the students, and necessarily unacquainted with the actual conditions under which the educational work is carried out.

The Board, however, is not yet prepared, "as regards all students, to hand over entirely to the teaching staffs . . . the functions which the Board at present discharge in regard to the testing and certification of the attainments of individual students, although a partial transfer of such responsibility has now become possible." In the future, the Board will leave the examination of, and the issue of diplomas to, full-time day technical institution students to the teachers concerned, subject to regulations to be previously submitted to and approved by the Board. Full-time day students will not in general be permitted to attend the evening science examinations. The examination of all first stage evening or part-time students is also handed over to the institutions. Further, "the Board intend to invite the assistance of some teachers in technical schools as members of the examining boards to be constituted for the reorganised examinations."

Coming to the examinations themselves, the principal changes enumerated in the circular are the following:—

(a) A number of the examinations formerly held by the Board will be discontinued. These examinations are mainly in subjects which have attracted comparatively few candidates in the past (e.g. nautical astronomy), and in certain branches of natural science, such as botany and biology, which have usually been taken only by candidates reading for university degrees. The examinations to be retained by the Board are divided into five groups as follows:—

(1) *Group A.*—Pure and Applied Mathematics:—Practical plane and solid geometry, pure mathematics, practical mathematics, theoretical mechanics (solids), and theoretical mechanics (fluids).

(2) *Group B.*—Engineering:—Machine construction and drawing, applied mechanics (materials and structures), applied mechanics (machines and hydraulics), heat engines, building construction, and naval architecture.

(3) *Group C.*—Physics:—Heat, magnetism, and electricity.

(4) *Group D.*—Chemistry:—Inorganic chemistry and organic chemistry.

(5) *Group E.*—Mining and metallurgy:—Coal mining, metallurgy.

It may, perhaps, be regretted that the Board proposes to cease its examinations in subjects such as agriculture, hygiene, and physiology, in view of the national importance of these subjects, the rapid development of public interest in them, the increasing provision of facilities for instruction, and the absence of any generally recognised and easily accessible system of examinations in these subjects if the Board's examinations be withdrawn.

(b) Up to the present the Board has held four examinations in each subject, arranged as follows: 1st stage, 2nd stage, 3rd stage, and Honours. In the future, the Board will not conduct elementary examinations corresponding to the first stage, as it is felt that these examinations are now unnecessary, the "inspection" by the officials of the Board on their visits to the classes being sufficient to test the efficiency of the teaching. The Board will only hold two examinations in each subject, termed "Lower" and "Higher" examinations respectively. The standard of the Lower examination will be approximately equal to that of the present Stage II., while that of the "Higher" examination will be intermediate between Stage III. and Honours.

The main objections which may be urged against the withdrawal of the Stage I. examinations are:—(1) The present Stage I. syllabuses are a valuable guide to many teachers, especially perhaps to those interested in the more

directly technical subjects and to those employed in the smaller, isolated technical schools; (2) the lack of uniformity in the elementary stages of technical instruction caused by the absence of syllabuses followed by schools all over the country, thus hindering the transfer of students from one institution to another. These obvious disadvantages may probably be best overcome by consultation between the representatives of the teachers and the Board of Education inspectorial staff, with a view to arrive at a common measure of agreement respecting courses, curricula, and the standard of work to be aimed at, especially in the earlier years of a student's work.

(c) Practical examinations, such as those in chemistry and metallurgy, will be discontinued, but candidates for admission to the Higher examination in subjects other than practical geometry, mechanics, &c., "will be required to furnish a certificate of having completed a satisfactory amount of laboratory work, and to submit his laboratory note-books signed and certified by the teacher."

Elaborate regulations, which will probably be found somewhat burdensome in actual practice, are outlined in the circular with regard to "grouped course certificates and diplomas, and conditions of endorsements." The Board will not, in general, issue certificates to students who have passed a given single examination. The Board will, however, endorse certificates or diplomas granted by school authorities upon the satisfactory conclusion of well-balanced courses of study, and "they trust that a certificate or diploma, endorsed by the Board under the prescribed conditions, will be recognised by all concerned as having at least a definite minimum value and standard."

"Grouped courses" are classified by the Board into two main classes: (1) evening or part-time day courses, (2) full-time day courses. Each of these is again subdivided into three groups: (a) junior courses (14 years to 16 years of age), (b) senior courses (16 years to 18 years), (c) advanced courses (18 years to 20 years).

Generally speaking, the proposed regulations as outlined in the circular mark a distinct advance upon the arrangements in force at present. In the main, the alterations are in the direction of freedom for the teachers, a greater elasticity permitting more modifications to suit local educational and industrial requirements, and the placing of examinations in a relatively less important position. The circular holds out to technical teachers the promise of speedy action by the Board of Education in regard to two important matters which they have long pressed upon the attention of the authorities at Whitehall, namely, the cooperation of the teachers in the drawing up of syllabuses and the conduct of examinations, and the improved organisation and coordination of all grades of technical education.

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THE BRIGHTON CONFERENCE OF THE MUSEUMS ASSOCIATION.

THE attendance at the Brighton meeting of the Museums Association, held on July 10-15, was large and representative, delegates being present from forty-two museums at home, as well as from the American Museum of Natural History (New York), the Australian Museum (Sydney), and the Deseret Museum (Salt Lake City, Utah). The presidential chair was occupied by Mr. H. M. Platnauer, of York. Mr. Platnauer was one of the original founders of the Museums Association, which was inaugurated at York twenty-two years ago.

In his presidential address Mr. Platnauer strove to answer the question "What is a museum?" and showed by his remarks that he conceived all museums, whether of science, art, or history, to have a broad and educational function. He deprecated the idea that a provincial museum should be purely local, would not agree that the function of an art museum is merely to make a pleasurable appeal to the emotions, and suggested that museum arrangements should convey the facts of natural evolution and human progress by exhibits arranged in more than one dimension of space.

Mr. H. S. Toms had prepared an account of the Brighton Museum, with special reference to developments since the last meeting of the association in Brighton twelve years ago. It was plainly indicative of great progress, and