

are typical of the group course system, a feature which is not surprising when we consider the way in which the course system has developed. It illustrates, perhaps, more clearly than any other fact the lack of "guidance from the mind that sees the needs of the country from the greater and national point of view." Cast-iron schemes and syllabuses are not required: the Board's rigid syllabuses have during recent years proved a failure from the teacher's point of view; but surely some greater degree of uniformity can be obtained than is shown above, whilst retaining the necessary pliability to suit local requirements of the industries. Before any uniform system of endorsement of certificates can be introduced, coordination of the courses in different institutions must be secured by the standardisation of the courses, as a guide to the standard to be arrived at in any one year, or at the end of a given course. A very grave injustice will be done to a great number of students, and, further, there will be a danger of the loss of many students, unless the conditions outlined in the circular are modified, either (1) by delay in the operation of the scheme for one or two years, or (2) by modifications of the conditions, such as reduction of the entrance fee, the granting of certificates by the Board, particularly in the lower stage, and the revival of examinations in such subjects as light and natural sciences, during the transitional period that must ensue until institutions can come into line with the new requirements.

The time is opportune, too, for revision of the award of Government grant on the work done by evening students. Local authorities are sufficiently hard pressed at the present time without taking over the burden of the cost of examination systems, and the time has arrived for allocating an increased amount of money in the form of a capitation grant for those taking group courses, somewhat on the lines of the grant made at present for day courses in technical institutions, thus differentiating between group courses and single-subject courses. Teachers are convinced that three nights per week, under present conditions of daily employment, are too much in the cases of youths under eighteen, and up to the end of the second year in the senior course the Board might reasonably make the full grant for two evenings (five hours) per week, extending over a thirty weeks' session, instead of encouraging, as at present, courses which are overburdened, for the local authority cannot afford to reduce the number of hours per week in the institution expected from the student, owing to the loss of grant which this would entail. A better grounding in the elementary branches of the work would at the same time undoubtedly be secured.

As to the best method of carrying out a national system of examinations, which is absolutely independent of centralised examinations such as those of the Board of Education, and City and Guilds Institute, the feeling is growing in some quarters that this will be most successfully accomplished by the cooperation of county education authorities with the local education authorities in county boroughs, to form examination boards of teachers and representatives of the local industries, acting as external examiners or assessors in conjunction with the teachers in the institutions of a given area as internal examiners. Such boards would be more in sympathy with the local requirements than any central board could possibly be, and the Board of Education, through its inspectorate, and a National Examination Board should be able to maintain a moderately constant standard throughout the country once the system is in thorough working order. Such a National Examination Board should contain representatives, who should be teachers, from the local examination boards.

Each year in a student's work marks a distinct stage in his career, and this should be recognised on successful completion of the work of each year by the award of a local certificate or record, to be exchanged at the end of the course for the full endorsed certificate, giving a national stamp, or hall-mark, to the work. At the same time, it is worth consideration whether certain single-subject courses of a highly technical character are not worth the award of a special endorsed certificate, particularly in cases where the student is able to take up the higher work without passing through the preliminary grind of the earlier years, or in cases where the subject-matter does not readily adapt

itself to inclusion in a course. There is undoubtedly the need for a national evening course system, so that the smaller institutions may readily and naturally feed the larger, in which the more advanced work will be concentrated, and so that this work may lead up systematically to the day diploma work of our specialised technical institutions.

#### INDUCED ACTION OF LEUCOCYTES.<sup>1</sup>

SCIENTIFIC workers may like to have a brief account of some recent researches which, I think, are likely to be of both theoretical and practical interest. The researches commenced nearly five years ago in a special study of leucocytes by a method devised by my brother, Mr. H. C. Ross, and myself. This consists in placing liquid blood under a cover-glass, not, as usual, upon another surface of glass, but upon a bed of transparent jelly with which various reagents, including stains, have been mixed. The original object of the method was to try to cultivate human leucocytes *in vitro*. At first careful studies of the rate of absorption of stains by the leucocytes under various chemical conditions of the jelly were made by Mr. Ross. Two years later he found that extract of hæmal gland, extracts of apparently many dead and decomposing tissues, and globin, when mixed with the jelly, force a large proportion of the leucocytes to divide before the eyes. Subsequently, he and his assistant, Dr. J. W. Cropper, ascertained by a series of lengthy studies that many of the substances which possess this property (in different degrees) belong to the amidine grouping. They have found, also, that a second series of substances, though by themselves they cannot produce division of leucocytes, have the power of augmenting very greatly the power of the former group of substances to do so. They give the names *auxetics* and *augmentors* to the two groups respectively. The principal auxetics are extracts of organs, creatine, xanthine, creatinine, guanidine, benzamidine, theobromine, acetamidine, caffeine, theophylline, methylamine, ethylamine, propylamine, &c., and certain aniline dyes. Some of the augmentors are various alkaloids, atropine, choline, cadaverine, neurine, &c.

The technique, though simple, requires considerable care. If a stain such as polychrome methylene blue is added, the cells become coloured progressively as the division advances. All the varieties of the human leucocytes can be made to divide; but the technique is slightly different for each variety. The proportion of cells affected in a given preparation of blood varies according to perfection of technique up to, say, 80 per cent.; but as death occurs rapidly, especially if stain be used, it usually overtakes a large proportion of them before the division has been completed. After about twenty minutes all the cells die, and by that time the process is complete in only a small percentage. Efforts to keep the cells alive longer upon these medicated jellies or in solutions of auxetics have not yet been very successful and would not be easy. After their death the leucocytes give up again most of their stain, and the jelly preparation rapidly spoils; but a method has been found of making (with some difficulty) permanent specimens of such of the blood as adheres to the cover-glass by fixing the whole preparation with osmic acid vapour, and then freezing and picking off the cover-glass from the bed of jelly.

To watch the same cell passing through the whole process requires an accurately adjusted warm stage or microscope-incubator and considerable patience, because the cell which we happen to select for observation will most probably belong to the majority which die before completion of the division; but partial division can be easily witnessed. If, however, the specimen is incubated for ten minutes, and is then surveyed rapidly from field to field, numbers of the leucocytes caught in all stages of the process can be readily seen. The fixed films just referred to show exactly the same objects, but enable us to examine them repeatedly and at leisure. And in both these cases the dividing forms are so numerous and similar that there

<sup>1</sup> From a paper read at the meeting of the Pathological Section of the Royal Society of Medicine on November 7 by Sir Ronald Ross, K.C.B., F.R.S.

can be no question of their being exceptional artefacts or distortions, such as may sometimes simulate almost anything. Division of the mononuclear variety of leucocytes is produced and studied the most easily.

In films in my possession numerous examples of dividing mononuclears fixed at all stages demonstrate (together with observations of the jelly preparations) the following steps in the process. In a few minutes after the blood is drawn from the subject and mounted the round, so-called nucleus becomes oval and then kidney- or bean-shaped, leading on rapidly to the outline of two circles cutting each other, and, lastly, touching each other in a "figure of eight." When the process is about half complete, and if the direction of division is parallel to the surface of the jelly or glass, another phenomenon is seen. About four to eight finger-like processes, radiating from the point midway between the centres of the two circles, are protruded or divided off, giving the whole body roughly the appearance of an ant, of which the head and abdomen are simulated by the two spheres and the legs by the processes just mentioned. Such forms are numerous and characteristic; but, of course, when the direction of division happens to lie at an angle to the surface, they are foreshortened, or may be distorted by the pressure of the jelly. As the division proceeds the processes are retracted into each daughter sphere, until the final figure of eight is produced.

If polychrome methylene blue is put in the jelly the cells become coloured progressively as the division advances. At first, after a few minutes, the so-called cytoplasmic, or Altmann's, granules take a purple tinge; then the so-called nucleus becomes a pale blue, and last of all the so-called nucleolus is stained, after which, apparently, the cell dies. As the so-called nucleus proceeds to take the hour-glass and figure-of-eight forms, strands of coloured substance are seen, especially in the fixed films, passing between the two daughter spheres, and such connections are maintained until complete dissociation occurs. The behaviour of the so-called nucleolus is not easy to follow, because, as just noted, it does not stain until the cell dies and further division is checked. On the other hand, the behaviour of the so-called cytoplasmic granules must be described as very curious. In the middle of the division they are found to number about eight (when they can be easily counted) and to lie, each one, at the end of one of the finger-like processes mentioned above; and appearances suggest that half of each granule is distributed to one daughter cell and the other half to the other daughter cell. No distinct chromosomes are seen at any stage *inside* the so-called nucleus; and there appears to be no sign of astral fibres, though perhaps the finger-like processes may be interpreted as being bunches of these fibres which have not been rendered individually visible by the process of staining employed. On conclusion of the process the so-called cytoplasmic granules appear to be equally distributed between the two daughter cells, and to place themselves on the outer surface of the so-called nucleus of each, that is, in the position in which they were seen in the original parent cell. Apparently asymmetric forms are also frequently seen, but need not be described here.

Such seem to me to be the facts as observed by myself in preparations shown or given to me by Mr. Ross and Dr. Cropper. I will not touch here upon the similar divisions of the so-called polymorphonuclear leucocytes, which have also been already described and figured by Mr. Ross. Nor will I attempt to reconcile the observations with current cytological teaching, even as regards the division of leucocytes. Very probably different methods of staining may bring them, at least partly, into closer conformity. Though engaged for years in the study of blood I have never seen these forms before, nor, indeed, have I ever seen in any ordinary preparation what could certainly be called a dividing leucocyte. I have been shown bodies claimed to be such; but these are admittedly so rare that they are open to the usual logical fallacies connected with very exceptional observations. The observations here referred to are not open to these fallacies. As I have said, the dividing forms are so numerous and characteristic that we can have no doubt that they really are dividing forms—whatever other observations or theories may be on record. It seems to me, therefore, that we are now compelled to

admit two new facts:—(1) that large numbers of human leucocytes can be made to divide *in vitro*; and (2) that this division occurs entirely, or at least specially, in the presence of certain chemical substances.

In 1900 J. Loeb showed that parthenogenesis can be induced in the eggs of sea-urchins (Arbacia) by the addition of a definite proportion of  $MCl_2$  to sea water; and since then many workers have studied such phenomena among other animals, while Wassilieff has used hyoscyamine, nicotine, and strychnine for similar researches. The independent observations now recorded would appear to extend cognate principles to body cells by showing that the division of leucocytes may be suddenly forced on at a great rate and in a few minutes by the absorption or presence of appropriate chemical agents, and may perhaps be inhibited by other chemical agents. The author added some remarks on the application of these observations to the genesis of tumours, and a discussion followed.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. W. Bateson, F.R.S., honorary fellow of St. John's College, Cambridge, and director of the John Innes Horticultural Institution at Merton, Surrey, has been appointed the next Herbert Spencer lecturer. The subject of the lecture, which is announced to be given on Wednesday, February 28, 1912, will be "Biological Fact and the Structure of Society."

The following courses of lectures and laboratory instruction in mathematics, astronomy, and physical science have been announced for next term, which begins on Monday, January 22, 1912:—Prof. Esson, F.R.S., will lecture on the comparison of analytic and synthetic methods in the geometry of conics; Prof. Love, F.R.S., on rigid dynamics; Prof. Elliott, F.R.S., on elliptic functions and on the theory of numbers; Prof. Clifton, F.R.S., on optics and acoustics; Mr. J. Walker, on double refraction and polarisation of light. Practical instruction in physics will be given by Prof. Clifton, Mr. J. Walker, Mr. I. O. Griffith, Mr. O. F. Brown, and Mr. G. H. Clough. Prof. Townsend, F.R.S., will lecture on electromagnetic induction; Mr. E. S. Craig, on mechanics and physics. Practical instruction in the electrical laboratory will be given by Mr. F. B. Pidduck, Mr. E. S. Craig, Mr. H. T. Tizard, Mr. S. Smith, and Mr. W. B. Gill. Prof. C. F. Jenkin will lecture and give practical instruction on strength of materials and thermodynamics; Mr. D. R. Pye will lecture on drawing, for engineering students; Prof. H. H. Turner, F.R.S., will lecture on elementary mathematical astronomy.

DR. H. BASSETT, demonstrator and assistant lecturer in chemistry at the University of Liverpool, has been appointed professor of chemistry at University College, Reading.

DR. W. R. BOYCE GIBSON, lecturer in philosophy at the University of Liverpool, has been appointed by the council of the University of Melbourne to the chair of mental and moral philosophy.

THE President of the Board of Education has appointed Mr. L. A. Selby-Bigge, C.B., to be permanent secretary of the Board when that post is vacated by Sir Robert Morant, K.C.B., on his appointment to the Insurance Commission. Since 1908 Mr. Selby-Bigge has been principal assistant secretary of the elementary branch of the Board.

THE council of the Royal Horticultural Society has requested the following gentlemen to act as a committee to inquire into the desirability of establishing a National Diploma in Horticulture, and to recommend what steps, if any, should be taken for the purpose:—the Rt. Hon. A. H. Dyke Acland, Prof. W. Bateson, F.R.S., Mr. E. A. Bowles, Mr. F. J. Chittenden, Prof. J. B. Farmer, F.R.S., Mr. C. R. Fielder, Mr. W. Hales, Mr. J. Hudson, Prof. Keeble, Sir Daniel Morris, Lieut.-Colonel D. Prain, F.R.S., Mr. H. J. Veitch, and Mr. W. P. Wright.

THE London County Council has arranged to hold its sixteenth annual Conference of Teachers on three days, Thursday, January 4, Friday, January 5, and Saturday,