of Geiger and scintillation counters; the decay curves of irradiated silver; the use of nuclear emulsions; and the production of gamma-radiographs. On the chemistry side, the experiments include the production and isolation of radioactive iodine; slow-neutron activation analyses; isotopic dilution analyses; separation using exchange resins and the solubility of lead sulphate. The experiment schedules are modified to cater for the differing academic levels of students using the laboratory.

The laboratory caters for a maximum of thirty students at a time, of whom about twenty would be on the physical side and the rest doing chemical experiments. This represents a fairly high concentration of personnel in the working space, and constant vigilance is required to prevent excess local background, especially when sources are moved. Writing records of experiments is then usually carried out in a neighbouring building.

The capital cost of conversion, including benching, ventilation and drainage, for a laboratory on this scale, is likely to be in the region of £5,000; a brand-new building would cost much more and take longer to construct. Equipment at the standard adopted

for this laboratory is comparable in cost. It is felt that the high initial cost of carefully chosen commercial apparatus has been fully justified in the sequel by the excellent service it has given and by the low maintenance costs.

We wish to record our indebtedness to those members of the Atomic Energy Research Establishment and the Atomic Weapons Research Establishment, who were consulted during the planning stage, for their valuable advice and to the Garrison Engineer at Shrivenham and his staff for their co-operation and professional skill. To those who contemplate similar ventures we would warmly recommend a close study of laboratories of high standard. There are many points of detail which cannot be included in an account of this kind, but which make a difference to smooth and efficient running of the laboratories and reduce the risk of accident. The close co-operation of physicist and chemist in the design and operation of the laboratory has played a notable part in promoting its efficiency and its usefulness to the students, who gain a more balanced picture of the subject in this way.

THE ELECTRICAL RESEARCH ASSOCIATION

THE Electrical Research Association has recently completed its first year of work, under the direction of Dr. H. G. Taylor, at the new laboratories at Leatherhead. Changes and developments are reflected in some measure in the form as well as in the content of the annual report for 1957* which was presented at the annual general meeting held on May 7.

It is with regret that we record the death, on the day of the meeting, of Mr. F. H. Bramwell, chairman of the Council of the Association, over whose signature the report of the Council appears in the annual report.

In the matter of framing research policy it is noteworthy that the Council now has the benefit of drawing upon the knowledge and experience of an Advisory Research Board, the constitution of which is given in the report under the list of committees and panels. On the administrative side a new post of research manager has been established and is occupied by Mr. L. Gosland, who was formerly head of the switchgear department.

In order to form some assessment of the extent to which the Association's research effort is co-ordinated with the interests of members, a questionnaire was issued during the year inviting opinion as to the application of the Association's research funds. The results were weighted in relation to the value of members' subscriptions and a final percentage analysis prepared. This analysis is found to be in reasonably good correlation with the relative scale of the Association's activity in its various fields, and although it does not show a pressing demand for work in any field in which the Association is not at present engaged, there is a significant emphasis on the subject of the nuclear irradiation of dielectrics, cathodic protection, climate proofing, nuclear power and semi-conductors.

The results of this questionnaire provide very useful guidance for future policy.

Mention is made of the difficulties which have been experienced in filling vacancies on the senior scientific staff and of the efforts which are being made to interest young university graduates in engineering and in physics in the work of the Association. The total number of staff employed by the Association at the end of the year under review was 348.

In the field of insulation, which constitutes one of the major areas of the Association's work, a result of considerable practical significance has been obtained in the demonstration of the importance of moisture content in controlling the discharge inception-level of cellulose. Confirmation has also been obtained, in the case of one of the new high-density polyethylenes, of the recently propounded electro-mechanical theory of breakdown.

It is interesting to note that it has been found desirable to initiate a fundamental study of the mechanism of oxidation of hydrocarbon oils. This programme is being carried out in three university departments. The need to supplement the great body of existing knowledge of the behaviour of hydrocarbon oils as insulants for electrical apparatus arises from the urge to raise the working temperature of transformers.

In another important branch of the Association's work, that of circuit breakers and circuit-breaking phenomena, progress is reported in the breaking of both low and high currents in vacuum and, in relation to the arc itself, theoretical predictions of high arc-core temperatures (35,000° K.) have been confirmed by spectroscopic measurements.

Two interesting full-scale experiments relating to electric power systems are reported. These were carried out in collaboration with the Central Electricity Authority. The stability of a large national electricity supply system under conditions of overload or of transient disturbance is naturally a matter of

* Electrical Research Association. Thirty-seventh Annual Report for the year ended 31st December, 1957. Pp. 119+8 plates. (Leatherhead: Electrical Research Association, 1958.)

importance and studies of system stability are made using network models known as network analysers. The validity of the results of such studies is in large measure dependent upon the correctness of the values of the system constants used in setting up the model system, and these have often to be based on indirect computation. There is therefore great interest in the carrying out of stability tests on actual power systems whenever such full-scale tests can be arranged. The first large-scale experiments on system stability to be made in Britain were carried out during a Bank Holiday week-end at the Cliff Quay Generating Station of the Central Electricity Authority. The performance of the system was predicted on three models, the network analysers of the Association and of the Associated Electrical Industries organization together with the 'Micro Réseau' of Electricité de France. The results of these tests will be communicated in a group of papers to be read before the Institution of Electrical Engineers. It is, however, stated in the report that the behaviour of the system was in general agreement with prediction.

The second experiment concerned the strength of the foundations of transmission towers. The opportunity to make tests on a series of erected towers occurred as a result of the decision of the South Eastern Electricity Board to discontinue the use of a

section of 33 kV. line in the Guildford area. Mechanical loading tests were carried out on the towers with the view of determining the strength of their foundations. The report on these tests has not yet been issued, but it is stated that the strength of the foundations was considerably less than had been expected.

The Association's work on intrinsically safe circuits for measurement and control in an atmosphere of explosive gases has included acetylene and ethylene. As a result of this, ethylene has been included in the list of gases covered by the appropriate British Safety Standard, and certification is now available for apparatus to be used in an ethylene atmosphere.

An attractive new feature of the annual report is the inclusion of a group of photographs illustrating aspects of the research work. One of these is a reproduction of a thunderstorm distribution map for 1957 for England, Wales and Scotland. The accumulation by the Association of data concerning lightning flashes is proving to be of increasing value. Towards the end of the report is given a list of universities, colleges, Government establishments and national authorities in which the extramural research of the Association is being carried on, in each case stating the subject of the research programme and names of those responsible for the work.

J. GREIG

GENETICS OF BETA-GLOBULIN POLYMORPHISM IN BRITISH CATTLE

By G. C. ASHTON

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IN a preliminary communication five serum β -globulin phenotypes of cattle, identified by starch gel electrophoresis, were described¹. A sixth phenotype has now been found, and as a result it is possible to propose a genetic mechanism for the system.

The six phenotypes are shown in Fig. 1 together with the postulated genotypes. The mating data and symmetrical appearance of the phenotypes suggested that a three-allele system (genes β^A , β^D , and β^E) with no dominance is operative. The homozygotes type I (β^A/β^A), type IV (β^D/β^D), and type VI (β^E/β^E) are individually recognizable. The heterozygotes are also recognizable as such; thus type II (β^A/β^D) is clearly a composite of types I and IV, type III (β^D/β^E) a composite of types IV and VI, and type V (β^A/β^E) a composite of types I and IV. Equal mixtures of the appropriate homozygous β -globulin sera are indistinguishable qualitatively from genuine samples of heterozygous serum when run side by side. Each of the phenotypes I-VI is thus a single genotype, and it is therefore appropriate to discard the numerical terminology and name each phenotype by its genotype. The expected distribution of phenotypes (genotypes) is shown in Table 1, while pooled mating data for a number of breeds are shown in Table 2. The expected and observed results agree when tested by the χ^2 test.

In the preliminary communication¹ only five phenotypes had been recognized, and to fit the mating data reported at that time it was necessary to

postulate a series of linked genes. However, with the finding of the sixth phenotype (β^{EE}) the genetic mechanism became clear and it was apparent that five of the 150 matings previously reported¹ (two $I \times IV \rightarrow I$; one $I \times IV \rightarrow IV$; one $III \times V \rightarrow I$; one $III \times V \rightarrow IV$) were not possible on the 3-allele

Fig. 1. The six β -globulin types. Alb., albumin; p.a., post albumin; α , α -complex; β , β -globulins. Solid bands, intense staining; cross-hatched, less intense