some of which have been successfully surmounted.

The following remark will be read with appreciation by those having the forest policy of the British Empire at heart. "The general forest policy may be stated as the perpetuation of the indigenous forests and the provision of a supplementary exotic-forest capital which, by rapid growth, will eke out the supplies of indigenous timber and bridge the gap between the exhaustion of the overmature indigenous forests which otherwise would occur, and their conversion into healthy productive forests. With the establishment of the exotic plantations now approaching completion, it will be possible to give proper attention to the silvicultural treatment of the indigenous forests. The timber-supply position of the future envisages a balanced yield from both exotic and indigenous forests, and the future alone will determine the relative importance of the two sources of supply."

It is refreshing to have a forest policy for a country so clearly laid down, and one calculated to fulfil the objects aimed at and the requirements of the people.

British Hydro-Electric Development

THE paper on "Hydro-Electric Development in Great Britain", read at a meeting of the Institution of Electrical Engineers on November 8 by Messrs. A. S. Valentine and E. M. Bergstrom, dealt more particularly, as indicated by its sub-title, with the works of the Grampian Electricity Supply Co., but it contained an interesting summary of the present situation of hydro-electrical development in the country. It is well known, of course, that the water-power resources of Great Britain do not compare in extent with those of some other countries, but, on the other hand, there are abundant supplies of coal, and by reason of this cheap and adequate supply of fuel for steam-power plants, water-power developments here do not present the same attraction as they do in countries lacking carboniferous deposits but possessing abundant water resources.

At the beginning of the present century, the census of power production showed that less than two per cent of the power requirements of Great Britain was produced from water-power. "By reason of the fact," say Messrs. Valentine and Bergstrom, "that in Great Britain water power can only be regarded as a contributory element, supplemental to the main power supply derived from coal, the technical and economic factors enter far more prominently into the problem of its utilisation than in countries where the economic policy is dictated by far less onerous conditions and where the natural advantages facilitate the solution of the many difficult technical questions inevitably connected with water-power developments".

According to the report of the Water Power Resources Committee constituted by the Government in 1918, the estimated output on a continuous basis for Great Britain was 250,000 kilowatts, in the ratio of 8 per cent, 77·5 per cent and 14·5 per cent for England, Scotland and Wales respectively. The limited resources of England, say the authors of the present paper, are easily appreciated in view of the low average elevation above sea-level, and the consequent flat gradient of the rivers, which must form the principal source for water-power development. Developments of any size cannot be looked for, but notable examples of what can be achieved to a limited extent are provided by the installations at Chester and Worcester and the more recent development at Linton Lock, York. The available fall does not exceed 11 ft. in any of these installations and the total electrical energy generated aggregates not more than an average of 5·25 million kwh. per annum.

In Wales, the conditions are more favourable, particularly in the northern area. The total energy available from the hydro-electric plants in operation in North Wales is about 95 million units a year. This total can probably be increased to approximately 140 million units a year. Apart therefrom, any further large developments cannot be anticipated in Wales, owing to the limited extent of available catchment areas.

The topographical features of the Highlands of Scotland, which are the most prolific source of supply in Great Britain, are favourable, the country being mountainous and consisting mainly of impermeable strata with steep slopes and comparatively high average rainfall. The area is also characterised by numerous lochs, situated at a considerable elevation, which can be utilised as impounding reservoirs at low cost. Among installations already made, or in progress, may be instanced those at Lochaber (800-ft. head; 33,000–75,000 kw.), Tongland (102-ft. head; 36,000 kw.), Tummel (160-ft. head; 34,000 kw.), Rannoch (465-ft. head; 32,000 kw.) and Kinlochleven (900-ft. head; 23,000 kw.).

If the cost of transmission be left out of consideration, it can be accepted as a general condition for the adoption of a hydro-electric scheme in Great Britain that the economic limit of capital cost is the amount represented by the capital cost of a thermal station of equivalent output plus the capitalised value of the annual cost of fuel. When the cost of coal is relatively low, as here, the economic margin in favour of hydro-electric power is correspondingly reduced in comparison with countries in which the cost of fuel is high, and consequently the field for development is much more restricted. The load factor is also a matter of importance. With continuous operation at a high load factor, the economic margin is increased, and it diminishes with a decreasing load factor to a point at which it changes over in favour of steam plant. Questions of transport of material and availability of skilled labour also enter into the problem. The interconnexion of steam and hydro-electric power plants will, in certain cases, promote the best economic results by utilising the available water flow to the greatest advantage, particularly if possibilities of storage are absent or deficient. With the construction of a Grid and the co-ordination of electric supplies on a regional basis, opportunities are afforded for a wider application of hydro-electric stations to supplement the supply from large steam generating stations.

Messrs. Valentine and Bergstrom also touched upon the subject of electrical generation by tidal power, the conditions for which are most favourable on the west coast of England and Wales. They state that the technical difficulties in obtaining efficient results from water turbines operating under the onerous conditions of a widely fluctuating head of water have now been satisfactorily disposed of through the introduction of the Kaplan and other

types of propeller turbine. The utilisation of tidal power resolves itself, therefore, into an economic question in relation to other available, or potential, power supplies in the area under consideration. As a rule, the cost of the civil engineering works is considerable, so that tidal-electric developments can only be contemplated at certain selected sites, as on the Severn, where the topographical features and other conditions in respect of the foundations, the tidal flow and the geographical position in general, favour the production of a large block of electrical energy at the lowest possible cost per unit. The large amount of capital required in such cases makes it unlikely that they could be financed from private sources alone, and Government aid must be forthcoming for their realisation.

Inheritance and Mental Deficiency

IN a paper on the inheritance of mental ability read at Aberdeen before Section J (Psychology) of the British Association, Dr. L. S. Penrose gave an account of a survey of a group of mentally defective patients whose relatives were tested by standardised intelligence tests. The patients were grouped into severe and mild cases, and certain significant differences were found between the two groups. The relatives of the severe cases were, on the whole, distinctly more intelligent than the relatives of the milder cases, and there was a marked incidence of consanguinity among the parents of the severe cases.

Dr. Penrose concludes that the influence of heredity in the causation of severe mental deficiency is shown (1) by the sharp distinction between normal and abnormal brothers and sisters; and (2) by the high incidence of consanguinity among the parents, which indicates the presence of rare recessive characters. The arguments against hereditary influence are the possibility of causation by physical disease among the patients and the demonstrable importance of environmental factors—as in mongolism. The low familial incidence is not strong evidence against hereditary causation here because severe mental deficiency tends to cause family limitation, and the affected individuals do not have offspring.

Within the group of mild cases, where the mental ability extends from 40 per cent to within the normal range, hereditary influence is indicated (1) by the high familial incidence of mild defect, and (2) by the characteristic regression towards the normal of the mean intelligence of relatives. In the absence of sharp segregation, these findings suggest multifactorial inheritance. The points indicating the influence of environmental causation are the lack of correlation between mentality of patient and mentality of relative as judged by the Binet tests, and the poor social conditions under which defectives of this group are nurtured.

A practical consequence of the lack of correlation between the test scores of patients and their relatives is that, within a wide range, the knowledge of the mental grade of an individual gives no information about the probable mentalities of brothers, sisters or children. One can only say that, given a large enough group, the average mentality of the relatives of defectives will be a certain distance below the normal. This fact puts serious difficulties in the way of the application of eugenic measures designed to control mental defect; it points to the importance of exercising educational and social influences to the fullest extent.

Mr. D. Kennedy-Fraser discussed in a paper before Section J the immature reactions to number of older feeble-minded boys. A group of 200 older feeble-minded boys reacted to five groups of x n dots. The responses are classifiable into 288 primitive unit counting, 445 adding by groups, and only 289 multiplicative reactions. On the other hand, a comparative group of 76 normal boys of the same age only gives 2 per cent unit counts, 9 per cent additions and 89 per cent multiplications. Further investigation is to be made into the probable relation between mental age and number maturity with both normal and subnormal girls and boys.

Structure of Amphoteric Ions

IN a communication to the September issue of the *Berichte der deutschen chemischen Gesellschaft*, Werner Kuhn and Hans Martin discuss recent conclusions as to the structure of amphoteric or *zwitter* ions from measurements of dielectric constants.

The important part which amino-acids play in biochemical processes has attracted attention to their properties, and numerous observations of dielectric constants of aqueous solutions of these compounds have been made in recent years.

It has been noticed that the rate of change of dielectric constant with concentration, particularly in dilute solutions, varies between -10 and zero in the case of compounds like aniline, biuret or acetanilide, which do not yield amphoteric ions, whereas the amino-acids and their derivatives give high positive values, ranging from $+23$ in the case of alanine to $+290$ for heptaglycylglycine. While there seems to be general agreement that this discrepancy is the direct outcome of amphoteric ion formation, the present authors believe that incorrect conclusions have been made about the form of the molecular chains. Thus in the United States, Messrs. Wyman and McMeekin have found that the rate of change of dielectric constant with concentration increases proportionally with the length of the chain, and conclude that the molecules exist as long, rigid, extended rods.

Now the nature of the equilibrium between different dipolar molecules is not yet well understood, so that at present one has to be content with an incomplete mathematical analysis. Even an approximately accurate determination of dielectric constants in a strongly polar medium like water is at present out of the question. Nevertheless, one ought not to ignore the requirements of the existing formula, which, as is shown, leads undoubtedly to low values for μ, the effective electric moment. Thus for hexaglycylglycine, the value of μ works out to about $3{\cdot}4 \times 10^{-18}$, whereas an extended rod-like structure would necessitate a value of about 180×10^{-18}. The authors feel justified, therefore, in concluding that the rod structure is highly improbable, and point out that existing evidence does nothing to invalidate the older theory of chain-coiling.