explanation by natural selection seemed very difficult. Mr. G. H. Carpenter pointed out how some of these cases might be explained. Miss M. Newbigin and others also brought up further difficulties, and some speakers discussed natural selection as a form of isolation and as being of less importance than other forms. In his reply, Prof. Poulton dealt with many of the cases cited, and showed how they could be brought under the operation of natural selection.

Finally, a paper by Mr. C. Shearer, on the early development of the head kidney in Polygordius and Eupomatus, and the usual votes of thanks to the president and officers brought a very successful meeting of Section D to a close.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THE changed spirit that is coming over geography was in evidence at Belfast. Accounts of explorations proposed or executed were limited in number, and half of them related to the unknown Polar lands. On the other hand, papers dealing with the morphology of limited areas and with applications of geographical knowledge to economic problems, branches of geography which are rapidly growing in importance, this year outnumbered the accounts of pioneer travels.

The president, Sir Thomas Holdich, in his address on the progress of geographical knowledge, emphasised the fact that the area for pioneer work was rapidly diminishing, and that the exploration required was of a more exact and comprehensive character, which necessitated a more restricted scene of operations. He very properly insisted on the need for an exact knowledge of the previous work done in any region before attempting to carry out new investigations in it, and that the investigators should be thoroughly trained men. In much of the world, a topographical knowledge is wanted intermediate between that given by pioneer surveys and that of elaborate national surveys such as our ordnance survey, *i.e.* a knowledge sufficient to show on a fair scale the salient features, and capable of being adjusted to the triangulation of a geodetic survey. Following a recent American authority, Sir Thomas Holdich called this a geographical as opposed to a topographical survey. As geographical survey means a survey of the distribution of all phenomena within a selected area, and not merely of its topographical features, it would be well to find another term. Topography and geography are too often considered synonymous, and it does not help to an appreciation of the true significance of geography to identify it with a topography. Why not simply say large- and small-scale topographical surveys? The president of Section E is the last man to limit geography to topography, as many paragraphs in his address showed, although as a surveyor of long and special experience he naturally dwelt most fully on map making.

The travel papers were of a high standard. The audience had to listen, not to uninteresting extracts from diaries, but to well-digested summaries of results. Major Molesworth Sykes discussed the geography of southern Persia, in a paper which might equally well be classed among those applying geographical knowledge to practical needs. He pointed out the influence of the dry, barren conditions of southern Persia and Baluchistan, bounded by an inaccessible coast and so escaping invasion from the sea, in determining a hardy, warlike race, which has held in subjection the plains of Mesopotamia and even of India. He traced the influence of physical features on trade routes and the new telegraph line. Part of his paper was a contribution to physical geography, for it dealt with the changes of the bed of the Helmand River. He remarked that the desert of Lut is traditionally associated with Abraham's nephew, and condemned our maps for distinguishing between it and the Dasht-i-Kavir, as Kavir is the name of Arabic origin applied to all saline portions of Dasht-i-Lut, the general name for the whole desert area. A very serviceable paper was communicated by Captain Ryder on hilly Yünnan, in which the possibility of the much-discussed railway line from Burma was not denied, though its utility or financial success was. The natural route was by the Red River through Tongking, and a railway would soon be ready through the French territory. Mr. Hawes, an energetic young Cambridge graduate, told us how he could find out so little about Sakhalin that he visited it to discover for himself what it was like. It is almost as long as from the Shetland to Land's End, rises to about 5000 feet as Great Britain does, has two rivers each about 300 miles in length, and is covered with the forest primeval, wherein bear, wolf, fox, sable, reindeer and other animals wander. The climate is one of extremes, but popular ideas about a perpetual fog enshrouding it must be abandoned. The natives are the Ainus, Gilaks, Orochons, Yakuts and Tunguses, but the majority of the inhabitants are Russian exiles, few of whom are political prisoners. The Rev. W. S. Green brought us to a little island nearer home and showed views of Rockall. Prof. Libbey, of Princeton University, described his recent visit to Petra and showed magnificent views of its impressive rock temples, tombs and still older "high places" of Moab, and of the gorges through which this depression is reached.

Prof. Libbey read a prophetic note from Sir Clements Markham on the Sverdrup North Polar Expedition, and subsequently gave a graphic account of the expedition to renew Peary's supplies two years ago, in which he took part. Both communications expressed belief in the safety of these explorers, and were verified within a few days. Interest, however, was concentrated on the South rather than on the North Polar regions. Dr. Mill gave one of his admirably lucid expositions, in which he traced the sequence of ideas about a great southern continent and the various phases of Antarctic exploration. A crowded audience listened to Mr. Bruce's account of the plans of the Scottish National Antarctic Expedition, which will concern itself mainly with oceanographical and meteorological investigations, for which it is exceptionally well equipped. Much is hoped from the kite flying by the meteorologists, for which elaborate apparatus has been provided. The audience sympathised greatly with Mr. Bruce, who has unhappily found himself compelled practically to rebuild his ship, the *Scotia*, at the cost of transforming an estimated surplus of 2000*l.* collected above the sum required for the expenses of one year's work into a deficit of 4000*l.* A grant of 50*l.* was voted by the Association to the expedition.

Of physical papers, that which attracted most attention was Prof. J. Milne's account of world-shaking earthquakes, with special reference to the recent volcanic eruptions in the West Indies, of which 93 per cent. are submarine. He associated periods of volcanic activity with periods of upheaval, and those Antillean eruptions of which we possess records with huge readjustments of the Hispaniola-Jamaica fold or of neighbouring folds on the American continent. A report was read by the Committee on Terrestrial Surface Waves and Wave-Like Surfaces, which was drawn up by Dr. Vaughan Cornish, whose well-known recent work was outlined in it.

Prof. Libbey discussed the evolution of the Jordan Valley, the origin of which he traced to a rift at the close of the Cretaceous period. It was subsequently widened and deepened by ice action to the Sea of Galilee, if not throughout its whole length; then submerged nearly as far north as the Sea of Galilee and covered with 4000 feet of sedimentary deposits, which were afterwards gradually elevated, the stream cutting its bed through them the while. Some 3000 feet of this sedimentary rock were removed when conditions altered, and probably the glacier disappeared or the water supply failed, or the rate of elevation increased, or all three took place and connection with the ocean was blocked. After 1000 feet of rise, the present conditions were obtained. Mr. Herbertson read a note on the windings of the Evenlode, and suggested that we must look some 150 feet above the present level, where the river flowed over Oxford Clay, for their initiation. Mr. Porter traced the origin of the valleys of county Cork, which change abruptly from one strath to another, to glacial interference, and explained the meridional character of many tributary glens as the outcome of faulting plus the rapid flow of pre-Glacial streams. Prof. W. W. Watts described the features of Charnwood Forest, where old mountains rise above Triassic deposits which cover their lower slopes, these slopes being here and there exposed in the river valleys. He compared the Triassic landscape in Charnwood Forest with that of the Great Basin of North America at the present day.

A report was read from Dr. T. N. Johnston on the Scottish Lakes Survey, in which the seiches which have been recently observed were described and illustrated by curves. (See NATURE, June 12.)

The only paper on biological geography was that by Mr. Lloyd Praeger on geographical plant groups in the Irish flora. A careful analysis of the distribution of plants in Ireland reveals the existence of several fairly well-defined types. There is a marked tendency to a "central" or "marginal" distribution, the result of the configuration of the country, the central group

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being largely composed of lowland, calcicole, and aquatic or paludal species; the marginal of calcifuge, upland and dry-soil plants. Well-marked northern and southern, eastern and western groups also exist, the boundaries between them consisting of lines running not exactly east and west or north and south, but rather north-north-eastward from Cork to Londonderry and east-north-eastward from Galway Bay to Dundalk Bay. For these six types of distribution the author proposes the names Central, Marginal, Ultonian, Mumonian, Lagenian, Connacian, the last four being taken from the old names of the four provinces of Ireland, in each of which one of the groups attains its maximum. The characters of each plant-group, and its relations to the climatological and physiographic features of the country, were pointed out.

Two papers of economic importance were read. Prof. Johnston showed the distribution of peat bogs in Ireland by means of a new map prepared by the Intelligence and Statistical Branch of the Irish Agricultural and Technical Instruction Department. They cover 1861 square miles, chiefly in counties Donegal, Mayo and Galway, and have an average depth of 25 feet. An account was given of the character of the different layers of a bog as seen in a vertical section, and an explanation suggested of the origin of a bog-slide. Specimens of the bog-flora, of the different kinds of peat and of the economic products derivable from turf or peat, lent from the botanical collections of the National Museum in Dublin, were exhibited. The second paper, by Mr. R. B. Buckley, on colonisation and irrigation in Uganda and the British East African Protectorate, began with a clear picture of the existing physical and economic conditions of these dependencies, and enunciated comprehensive and judicious views as to their development in the future. The question of irrigation was exhaustively treated, and the author concluded that the prospects of great transformations taking place through its aid are not very hopeful. A. J. H.

ENGINEERING AT THE BRITISH ASSOCIATION.

ON Thursday, September 11, after the president's address, a paper by Mr. H. A. Humphrey on recent progress in large gas engines was read. This paper, which was illustrated by lantern slides, gave an account of the extraordinary development of large gas engines which has taken place during the past few years, and which has, as the author said, had but few parallels in the history of engineering enterprise. In the Paris Exhibition of 1900, a 600 h.p. Cockerill gas engine was, from its size, the object of much interest. The same makers are now building engines of 2500 h.p., and they are prepared to undertake one to develop 5000 h.p. In this country it is only as recently as 1900 that engines above 400 h.p. have been made, the first two being constructed for Messrs. Brunner, Mond and Co.'s works at Winnington, yet when the paper was written (August) the two chief manufactories in Great Britain had under contract or had already delivered no less than fifty-one gas engines ranging in size between 200 and 1000 h.p. But it is on the Continent and in America that the most remarkable advance has been made. The author gave in a very complete table particulars of all engines of more than 200 h.p. capacity which have been built abroad or are under construction, the total amounting to 327 engines, developing 181,605 h.p. Slides shown by the author illustrated the various uses to which these large gas engines have been put so far, such as dynamo driving, air compression for blast-furnace work, and other similar uses. Perhaps the most interesting detail in connection with this increase in the size of gas engines has been the use of blast-furnace gas for working them. The author in the latter part of his paper explained in some detail the improvements in construction and governing which have made these large engines possible, in particular the changes which have been necessary in the old "hit and miss" governor mechanism, where, as in dynamo driving, perfect uniformity of speed is necessary. As several large engineering firms in this country have now acquired the rights for manufacturing some of the most successful foreign types of these engines, there is little doubt that we are on the eve of important developments in this country in the gas-engine industry, especially in the utilisation of producer and of blast-furnace gases.

In the afternoon of September 11, the Section made a special visit to the harbour works, under the guidance of the engineers to the Belfast Harbour Commissioners, in order that members might see for themselves some of the remarkable developments which have taken place in Belfast Harbour and have been brought about by constant increase in the size of ocean steamships.

On Friday, September 12, the first paper was a brief communication by the Hon. C. A. Parsons on steam turbines, in which figures were given to show the rapid increase in the use of the compound turbine since 1884. Up to 1890, though a number of compound turbines had already been constructed for driving dynamos, the largest size had not exceeded 120 h.p., the total h.p. at that date being 5000; by 1896 the total h.p. had increased to 40,000 and the largest individual plant to 600 h.p., and now the largest unit has increased to 3,000 hp. and the aggregate h.p. sold in Great Britain to 200,000. On the Continent, also, their use has been rapidly extending, and the total aggregate of horse-power at home and abroad for driving dynamos up to the present time is not far short of 300,000. As a proof of the remarkable economy obtained in the very large machines, the author stated that a steam consumption of 17·3lb. per kilowatt hour had been recorded during a test of a 1000 kilowatt continuous-current machine belonging to the Newcastle and District Electric Light Company; this would be equivalent to about 10·2lb. of steam per i.h.p. hour, a very remarkable figure, and he anticipates still greater economy in the future in turbines of large size when using superheated steam. Many engineers had feared that these machines would fall off notably in their economy after they had been running for some time, but the author stated that careful tests had now been made with several plants to determine the steam consumption after the machinery had been in use for several years, and no appreciable increase had been found. The second half of the paper was devoted to an account of the application of the steam turbine to marine work; seven vessels have so far been fitted with turbine engines, including the two unfortunate destroyers—the *Cobra* and the *Viper*—and the two well-known Clyde passenger boats—the *King Edward* and the *Queen Alexandra*. In addition to these, a third-class cruiser, the *Amethyst*, would shortly be completed, and orders have recently been placed on the Clyde with Messrs. Denny Bros. for the construction of two cross-channel boats which are to have turbine engines of about 8000 h.p.; this means a total of about 83,000 h.p. in use or in construction. Mr. Parsons stated that if the coal consumption of the *Duchess of Hamilton* (fitted with ordinary reciprocating compound engines) was compared with that of the *King Edward*, and if various allowances for the difference in speed of the two boats and for various other factors were made, then the turbine boat showed a saving of 20 per cent.; he again, as at the Dover meeting, prophesied the eventual use of turbine engines for Atlantic liners, cruisers and battleships. In his reply to a brief discussion, in which several points were raised with regard to the use of superheated steam in the turbines, the author stated that he estimated a gain of efficiency due to superheating of about 1 per cent. for every 10° of superheat.

The next matter dealt with by the Section was the report of the Committee on the Resistance of Road Vehicles to Traction, the first eleven sections of which were devoted to a complete *résumé* of the experimental work which has already been carried out on this subject, and to a summary of the opinions which have so far been expressed (based on these experiments) of the effects on traction on the level of the three independent elements of road resistance, namely, axial friction, rolling resistance and grade resistance. The last two sections of the report were devoted to a brief description of the special apparatus which has been designed and made by the Committee; the first series of experiments undertaken will be confined to measurements of the resistance of single wheels. The tractive force will be transmitted through a system of levers to a small ram which presses upon a rubber diaphragm enclosing a space filled with water or other liquid; the pressure exerted by the levers on the ram will vary with the tractive force, and the consequent varying fluid pressure will be registered by a recording pressure gauge of the Bourdon tube type, and since the drum of the instrument carrying the recording paper will be rotated in strict accordance with the movements of the car, a diagram will be drawn giving the tractive force at all points on the journey. The instrument has been so designed that the leverage on the ram can be altered to ensure diagrams of a reasonable size even when the tractive force is very small, and a revolution counter will be used for obtaining independentiy the revolutions of the experimenta

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