and therefore to make thick sediments, otherwise the sediments quickly rise to sea-level, and stop the process of sedimentation at that place. But it is precisely a want of complete isostasy which is necessary to make an isostatic slope landward. Dutton refers to Herschel as having suggested a similar cause of strata crumpling and slaty cleavage (*Phil. Mag.* vol. xii. p. 197, 1856); but the principles involved in the two cases are almost exactly opposite. Herschel supposes sediments to slide down steep natural slopes of sea-bottoms, and therefore sea-ward. Dutton supposed sediments to slide up natural, though down isostatic slopes, landward. Herschel's is a theory of strata-crumpling and slaty cleavage, Dutton's a theory of mountain formation.

"There has been no attempt to carry this idea of Dutton's to quantitative detail. It was probably thrown out as a suggestion in mere despair of any other explanation, for he had already repudiated the contractional theory. But the least reflection is sufficient to convince that such slight want of complete isostatic equilibrium as may sometimes occur, would be utterly inadequate to produce such effects."

III. Reyer's Gliding Theory.[1]

"Prof. Reyer has recently put forward certain views fortified by abundant experiments on plastic materials. His idea in brief seems to be this: strata are lifted and finally broken through by uprising fused or semi-fused matters, and these appear above as the granitic axis. As the axis rises, the strata are carried upward on its shoulders, until when the slope is sufficiently steep the strata slide downward, crumpling themselves into complex folds and exposing the granitic axis in width proportioned to the amount of sliding.

"No doubt there is much value in these experiments of Reyer, and possibly such gliding does indeed sometimes take place in mountain strata, and some foldings may be thus accounted for. But the great objections to this view are: (1) that there is no adequate cause given for the granitic uplift, and (2) that it utterly fails to account for the complex foldings of such mountains as the Appalachian and Coast Range, where there is no granite axis at all. Reade, indeed, holds that the Piedmont region is the granite axis of the Appalachian, and that the original strata of the eastern slope are now buried beneath the sea. But American geologists are unanimous in the belief that the shore line of the great interior Palæozoic Sea was but a little east of the Appalachian crest and the sea washed against land of Archæan rocks extending eastward from that line."

Conclusion.

"After this rapid discussion of alternative theories, in which we have found them all untenable, we return again to the contraction theory, not indeed with our old confidence, but with the conviction that it is even yet the best working hypothesis we have."

GEOGRAPHY AT THE BRITISH ASSOCIATION.

AS in other sections, an absence of sensational papers, and an unusual abundance of good solid work, the outcome of study and research, were the characteristic features in Section E. The president's address was well adapted to his audience; the simplicity of its language, and the vivid descriptions of scenes in the Arctic Basin, with which it abounded, sustained the attention of every listener, and went over the head of none. Perhaps it was better calculated for the extension than the advancement of geographical science, but in many ways advance in geography depends on conditions different from those which determine advance in other sciences. Mr Seebohm rightly felt that to enforce principles familiar to professed geographers by a picturesque concrete example which no one could misunderstand was better than to record advances in specialised research, which could only appeal to the few geographers whose grasp of the subject equalled his own.

The section met on four days, and, including the presidential address, twenty-seven papers were read; a large number of members, in addition, took part in various discussions. A feature of the papers was the small number of mere records of travel, and the general striving after some kind of scientific elaboration of the data described. This was in some cases imperfectly done, but the imperfection was a consequence of the neglect of higher geographical education in this country, and the necessary beating out of new paths by independent workers, who, seeing the need for scientific treatment, are not always sure of the right methods to employ.

An inter-sectional discussion with Section C, on the limits between physical geography and geology, had been looked forward to with much interest, but proved somewhat disappointing. Few of the speakers addressed themselves to the subject announced, and in the extempore speeches it was evident that, after a faint attempt to come to the point, there was a tendency to fall off on some familiar tack, and repeat irrelevant phrases often said before. In fact, there was no true discussion, as there was no distinct issue put forward.

Mr. Clements R. Markham, F.R.S., president of the Royal Geographical Society, commenced the proceedings by reading a paper, put together with consummate skill, in which he argued for the limit of human testimony as the line of demarcation between the domains of physical geography and geology. Thus he established a purely chronological division between phenomena of the same kind, which would fall to the province of one science or the other, according to the date of their manifestation. He concludes—

"Meanwhile, and until better instructed, I should define geology as the study of the condition of the earth and of the changes on its surface during the cycles of ages before the dawn of history; and I should define physical geography as a knowledge of the earth as it is, and of the changes which have taken place on its surface during historical times. These changes, derived from human testimony, explain to us the laws according to which similar changes are now taking place around us.

"The two sciences depend upon each other, and are very closely allied. The geologist finds the same phenomena in the rock formations of the past as the physical geographer discovers on the surface of the earth of the present. Both, for example, have the duty laid upon them of seeking out the agencies which rule in the processes of upheaval and depression. The fold, with its crest and trough, is common to both sciences; and geographers have rejoiced at the announcement of 'a wedding-ring of geology and geography uniting them at once and for ever in indissoluble union.'"

Mr. W. Topley, F.R.S., who followed, admitted the very close relations of geology and physical geography, but he devoted his attention to establishing the closeness of this relation by bringing forward numerous instances of the dependence of geographical features on geological structure, rather than to defining the limits of the two departments. His contention was that they merged the one into the other, and were not merely contiguous subjects separated by a discoverable line. Mr. E. G. Ravenstein supported Mr. Markham's chronological boundary, and summed up the conclusions of a racy speech in the statement that geology stands to physical geography in precisely the same relationship as history does to political geography. Prof. C. Lapworth, F.R.S., acknowledged the great difficulty of finding any satisfactory dividing line, contending that the geologist is in many ways absolutely dependent on the physical geographer, and the physical geographer in his turn absolutely dependent on the geologist, the physical geography of the present being indissolubly bound up with the physical geology of the past. Prof. Valentine Ball contended that the relation between geology and geography was similar to that between anatomy and art. Dr. R. D. Roberts, viewing geology as the history of the earth, argued that physical geography was merely the last chapter of that history. Dr. H. R. Mill suggested that a definition between the two departments of knowledge might be found rather in the aspect in which the phenomena of the earth were viewed than in the subject-matter or in chronological order. Physical geography being concerned with the present forms of the earth's surface borrowed from geology an explanation of the observed facts, taking results but not copying methods. Mr. H. Yule Oldham spoke of the unity of geography and of the importance of studying old travels in order to keep a record of recent physical changes. Prof. Bonney, F.R.S., characterised the discussion as waste of time and a search after the unattainable, for the words geography and geology contained in themselves all the definition that was required or could be found. Colonel Godwin-Austen and Mr. J. Y. Buchanan, F.R.S., made a few remarks; and Sir Archibald Geikie, who, by the consent of the presidents of Sections C and E, occupied the chair, summed up in a judicial manner. He

[1] NATURE, vol. xlvi. p. 224, 1892, and vol. xlvii. p. 81, 1892.

sympathised with the desire to determine the best line of cleavage between the two contiguous portions of science, but had to acknowledge that any line which might be definitely formulated would, to a large extent, be artificial and arbitrary.

Several papers on physical geography were read to the Section, but they did not approach the geological border. Mr. J. Y. Buchanan communicated the preliminary results of some new experiments he has been conducting on the effect of land, water and ice on the temperature of the air, which promise, when completed, to extend our knowledge of climatology. Dr. H. R. Mill summarised the effect of different degrees of isolation from oceanic influences on the seasonal changes of temperature in the water and air of the Clyde Sea area, and Mr. H. N. Dickson communicated a brief preliminary note on the results of his recent trip in H.M.S. *Jackal* for the Fishery Board for Scotland, in the course of which he had examined the temperature and salinity of the water between the north of Scotland and the Färoe Islands. Dr. Schlichter submitted a piece of solid work in pure physical geography in the form of a series of ten vertical sections drawn across northern and central Africa from west to east. These sections exhibit graphically the relative heights of the continent as far as they have been ascertained, and by the blanks which occur where fixed points are wanting, they bring into sharp prominence the regions which are still practically unexplored.

Papers on the latest explorations were read by Mr. E. G. Ravenstein, who traced the opening up of Msiri's country by the Katanga Company's expeditions, and by Mr. E. Delmar Morgan, who communicated an admirable summary of recent exploration in Tibet. Mr. W. M. Conway described his work in the Karakoram mountains. Dr. H. R. Mill referred to the work which he and Mr. Heawood had carried out this year in the "unexplored England" of the lake-beds.

Most interesting amongst the explorational papers were the brief accounts, given by Mr. W. S. Bruce and Dr. C. M. Donald, of the cruise of the Dundee whalers *Balæna* and *Active* toward the Antarctic regions.

Mr. Bruce's communication may be summarised as follows:—

"After a boisterous passage of over a hundred days on the steam whaler *Balæna*, from Dundee, we met the first iceberg on December 16, 1892, in 59° 40′ S. 51° 17′ W. We continued on a more or less southerly course, passing to the east of Clarence Island. Danger Islets were sighted and passed on December 23, and on Christmas Eve we were in the position Ross occupied on New Year's Day, 1843. Until the middle of February we remained roughly between 62° S. and 64° 40′ S. and 52° and 57° W., the western limit being Terre Louis Philippe and Joinville's Land.

"All the land seen was entirely snowclad except on the steepest slopes, which were of black, apparently igneous, rocks. The few specimens of rocks obtained from the ice and from the stomachs of penguins bear this out; Prof. James Geikie finding olivine, basalt, basalt lava, and possibly gabbro among them. Rock fragments and earthy matter were seen on some of the bergs and ice. On January 12 we saw what *appeared to be* high mountainous land and glaciers stretching from about 54° 25′ S. 59° 10′ W. to about 65° 30′ S. 58° 00′ W. I believe this may have been the eastern coast of Graham's Land, which has not been seen before.

"The whole of this district south of 60° S. is strewn with bergs, and south of 62° S. they become very numerous. No entire day was recorded when bergs were not seen; as many as 65, all of great size, to say nothing of smaller ones, were counted on one day. The longest we met was about 30 miles long, one was about 10 miles long, and several from 1 to 4 miles in length. The highest the *Balæna* sighted could not have been over 250 feet high, and many were not over 70 to 80 feet high. All the bergs were tabular, or weather-worn varieties of that form. The base of the bergs is coloured brown by marine organisms.

"The pack ice is said not to be heavier than that of the north, and is similar in nature. It is frequently coloured brown by *Corythrum criophyllum*, a very abundant diatom. We first met pack ice on December 14, in 62° 20′ S. 52° 20′ W.; it was dense, and ran east and west. In January we met the pack edge running east and west in 64° 37′ S. from about 54° to 56° W.

"A few observations for the freezing and melting-point of ice were made, and some sea temperatures recorded. The lead was cast in the vicinity of Danger Islets, and some bottom samples obtained, the depth varying from 70 to over 300 fathoms.

"Periods of fine calm weather alternated with very severe gales, usually accompanied by fog and snow. The lowest air temperature recorded was 20·8° F. on February 17, and the highest 37·60° F. on January 15. December showed an average of 31·14° F., January 31·10° F., and February 29·65° F. The barometer never rose above 29·804 inches.

"No whale resembling *Balæna mysticetus*, *i.e.* the Bowhead or Greenland black whale, was seen; but many finbacks, some hunchbacks, bottlenoses, grampuses, and several kinds of seals, the hunting of which in default of whales was the object of the voyage."

Messrs. Bruce and Donald showed a very creditable collection of observations, but the main outcome of their papers was a demonstration of the immense value of the results which would accrue from a purely scientific expedition to Antarctic waters. Mr. Bruce announced that he was prepared to spend a year, with an assistant who had volunteered to accompany him, on South Georgia or on Grahamsland, if he could be landed there, and to undertake systematic scientific work during that time, if his passage-money and maintenance were paid for. Mr. J. S. Keltie, Mr. H. O. Forbes, Mr. Coles, Dr. H. R. Mill, Mr. Ravenstein, Sir George Bowen, Mr. G. J. Symons, F.R.S., Colonel Fred. Bailey, and others, pointed out the immense importance of Antarctic exploration to geography, geology, meteorology, and other sciences, and warmly commended Mr. Bruce's resolution to conduct a series of preliminary observations. The audience, which included Dr. Burdon Sanderson, the president of the Association, received the papers and discussion with enthusiasm, and a subscription list was started in order to supplement any grants which might be obtained from learned societies to provide a scientific outfit for Mr. Bruce and his assistant. A committee of Section E was charged with the necessary arrangements, with Mr. Clements R. Markham as chairman, and Dr. H. R. Mill as secretary. The Committee of Recommendations voted a grant of £50 for the purposes of this committee. The question of Antarctic exploration was supported by a letter from Sir Erasmus Ommaney, enclosing an appeal from the Australian Antarctic Explorations Committee, suggesting that the British Association should take steps to induce the Australian Government to subsidise southern sealing voyages. A collection of water-colour sketches, by Mr. W. G. Burn-Murdoch, of Edinburgh, who was a passenger on the *Balæna*, illustrating the scenery and incidents of the voyage, was arranged round the meeting room, and attracted a great deal of attention. The collection has already been shown in Dundee, and arrangements have been made for exhibiting it in London in the map room of the Royal Geographical Society. Unfortunately, there were no press representatives in the meeting-room during the greater part of the Antarctic discussion, and it has consequently almost entirely escaped attention in the daily papers.

Papers on special parts of the world, summarising results of travellers and geographers, were read by Mrs. Lilly Grove, on the Chiloe Islands; by Mr. Howard Reid, on the relation of Lake Tanganyika to the Congo; and by Mr. Cop Whitehouse, on the Lower Nile Valley, with reference to the various delineations of it in Ptolemaic and later maps. Mr. E. Heawood read a paper recounting his experiences in the Bengal Duars, with special reference to the settlement of Santal colonists in that region. Mr. Heawood said:—

"The term 'Duars' is applied to a tract of country lying along the foot of the Himalayas of Bhután, and including the 'doors' or passes into that country. The first ranges here rise like a wall, wooded to their summits, from an undulating plain of slight elevation, which embraces a strip of forest-clad 'Terai' and a more open country further south. Over a great part savannahs of gigantic grass alternate with patches of forest, sál on the higher and lighter soils, and mixed forest fringing the streams. The grass is burnt down annually, and the trees with which it is dotted are usually quick growing and shed their leaves annually, and are thus less affected by the burnings. The tiger, leopard, bear, elephant, rhinoceros, buffalo, bison (so-called), pig, and several kinds of deer inhabit the jungles. The peacock, jungle-fowl, florikan, parrots, and a handsome pigeon are the most prominent birds. The rainfall is very great, and the climate unhealthy, though this improves with clearing. The tract is sparsely inhabited, except in the southern and newly-settled parts, by Mechs, a tribe of Mongolian affinities who can thrive in spite of the malaria. They are of wandering habits, cultivating by

burning patches of jungle, and moving on to new spots after a few years. Much of the land is very fertile, and well suited for both early and late rice crops. Channels, often of great length, are dug by the Mechs from the numerous streams for the irrigation of the late rice crops, though the tendency of the rivers to deepen their beds in the friable soil is a difficulty to more permanent settlers. The climate and the exposure to raids from Bhután have keep the country in a backward state. It became British territory as a result of the war of 1864. Much land has since then been settled and tea-gardens opened, especially in the western part; while within the last three years a large tract of jungle has been provisionally set apart by Government—at the instance of the Rev. A. J. Shields, C.M.S. missionary to the Santals, warmly supported by Mr. D. Sunder, settlement officer at Jalpiguri—for settlement by Santals, who in their hill country south of the Ganges are often unable to obtain sufficient land for cultivation. Forty families were taken up in 1891, the author assisting in their settlement, and still larger numbers have followed since. Although the partial failure of the rains in the first season caused unforeseen difficulties at first, these, it is hoped, are now in a fair way to be overcome. It should be mentioned that a similar experiment has been tried with success in Assam by a Norwegian mission."

Captain Williams, R.A., gave a popular address on the people of Uganda; Mr. Herbert Ward sent a short paper on the people of the Congo Basin; and Dr. R. W. Felkin submitted a new scheme for a map of the distribution of diseases in Africa. The Rev. C. H. Robinson gave an interesting account of the adventures of a Hausa pilgrim who passed through Khartum on the way to Mecca immediately after the capture of the town by the Mahdi, and gave a new version of the story of General Gordon's death. Mr. E. G. Ravenstein read a brief report of the Committee on African Climatology, which is engaged in accumulating meteorological data from the tropical parts of the colony.

Many of the communications were illustrated by the lantern, and the last paper read was on a system of geographical teaching in which the lantern is adapted for general use in schools, by Mr. B. Bentham Dickenson, of Rugby. A small association has been formed in order to promote this object.

The meetings of the Section were never attended by a larger average number than this year, and on the whole the scientific value of the papers has seldom been greater.

MECHANICS AT THE BRITISH ASSOCIATION.

IN Section G, that devoted to mechanical science, at the recent Nottingham British Association meeting, there were fewer papers read than usual. This, however, was a distinct advantage, for this section has generally suffered from an over-abundance of matter. It is far more satisfactory to have a few good papers well discussed than a multitude of mediocre or inferior contributions, which only weary the audience, and lead to no good result. The section held its meetings in the Engineering Lecture Theatre, at University College, and the first sitting took place on Thursday, September 14, according to precedent. The president this year was Mr. Jeremiah Head, whose address we reprinted on September 21. The first paper taken was a contribution by Mr. Beaumont, entitled the "Automatic Balance of Reciprocating Mechanism," and referred to a method of utilising the vibration caused by a revolving weight for working sieves. In the discussion which followed, the opinion was expressed that the device might find a useful place in other applications than that for which it was originally intended. The rest of Monday's sitting was taken up by a description of lace machinery and hosiery machinery. Although the subject is one of considerable interest, it would be impossible to give any adequate idea of the proceedings without the numerous diagrams and lantern slides which were used by the author of the paper. Several of the most interesting machines described were shown at work in an adjoining room, and their action was explained by Mr. W. Robinson, the Professor of Engineering at University College, Nottingham.

On Friday, the 15th inst., two reports were down for reading; the first that of the committee on the dryness of steam in boiler trials, in regard to which Prof. Unwin stated that practically nothing had been done during the past year, and therefore there was no report to present. It was hoped, however, that by following certain lines of investigation which had been suggested by some American experimentalists, that good results might be arrived at, and it was hoped that a satisfactory report would be prepared for the next meeting. The report of the committee on Graphic Methods was a contrast to Prof. Unwin's statement; it being of an exceedingly voluminous character. This is the second long report that has been presented by the committee. It would be quite impossible to deal with the subject in an account of the proceedings such as we are able to give, which must necessarily be brief, and as the report will be printed in full, in common with all reports of committees, in the Proceedings, we will refer our readers to the volume when it is issued, for information on this really important subject. It is fair, however, to notice the immense amount of good and sound work that Prof. H. S. Hele Shaw has done, as secretary, in preparing the reports of this committee.

Two papers on the disposal of refuse followed; one by Mr. C. C. Keep, and the second by Mr. William Warner. In these various descriptions of destructors which had been placed upon the engineering market were described. Both authors are, we believe, members of firms which manufacture and sell apparatus of this description, and trade interests were not altogether lost to sight. The subject of refuse destruction is one of great importance, but it requires, in the interests of sanitary science, to be handled in a somewhat different manner to that pursued by the section in the reading and discussion of the papers. Mr. Frank Ashwell next read a paper on "Warming and Ventilating," in the course of which he discussed the merits of the plenum system, as against the method of ventilation by partial vacuum. He had not much difficulty in establishing the claims of the former; the chief advantage, of course, being that with a plenum inside the building any leakage there may be at doors, windows, &c. does not admit draught; the air for ventilation always coming in through the proper entrance, where it may be warmed, filtered, and, if necessary, moistened. Watchmaking by machinery next occupied the attention of the section, Mr. T. P. Hewitt, of Prescot, reading an interesting paper on the subject. As was stated by a speaker during the discussion which followed, watchmaking in England has been lately at a very low ebb. For many years it has had to meet the competition of cheap labour in Switzerland, but the most fatal blow to the system was struck by the introduction of the factory system for the manufacture of watches in America. By the use of machine tools and labour-saving appliances the Americans have been able to produce excellent timekeeping watches at a very moderate cost; for the industry is one specially suited to the genius of the American mechanic, whose inventive faculties are proverbial. So serious a blow has thus been inflicted on the English watchmaking industry that its operatives were brought to the greatest distress. Prescot, in Lancashire, is a very ancient centre of watchmaking, that is, so far as the movement of the watch is concerned, and many of the best English watches have Prescot works. It is in this town that an endeavour is being made to revive the English watchmaking industry, but on entirely new lines. A large factory has been built, and the most improved appliances introduced. These, of course, are largely American in origin, but it is satisfactory to know that the beautiful machine tools, such as used by the Waltham and Elgin Watch Companies, can now be made in England, and are equal to the productions of the United States. Several examples of these machines were exhibited during the reading of the paper.

Mr. Ross, of Glasgow, next described a pneumatic caulking and chipping tool. This is a hand-tool, working, as its name would imply, by compressed air, or steam may be used. It will make over 10,000 strokes per minute, and consists essentially of a small cylinder and loose piston, which works on to the caulking or chipping chisel. The only thing the operator has to do, therefore, is to guide the tool, and the enormous rapidity of the strokes enables the finest work to be done, either in caulking a metal seam or in chipping down a metallic surface. Some very beautiful specimens of work were shown at the meeting, and the instrument itself was exhibited.

It is the custom of Section G to devote Monday of the Association meeting to electrical science, and the first paper taken on the 16th was a contribution by Mr. Gisbert Kapp, entitled "Relative Cost of Conductors with Different Systems of Electrical Power Transmission." This was a most useful paper, and a good example of the form contributions on electrical subjects should take in Section G, where, it must be remembered