OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER:—

November 6. oh. Conjunction of Saturn with the moon, ♄ 1° 1′ N.
11. Saturn. Outer minor axis of outer ring = 16″·11.
12. 11h. 11m. to 11h. 29m. Occultation of κ Piscium (mag. 5) by the moon.
12. 20h. Jupiter in conjunction with the sun.
14–16. Expected brilliant return of the Leonid meteoric shower.
15. Venus. Illuminated portion of disc = 0·966.
15. Mars. Illuminated portion of disc = 0·991.
16. 4h. Mercury at greatest eastern elongation (22° 18′).
17. 10h. 21m. to 11h. 29m. Occultation of A^1 Tauri (mag. 4·5) by the moon.
19. 6h. 10m. to 7h. 1m. Occultation of Neptune by the moon.
19. 10h. 32m. Minimum of Algol (β Persei).
22. 7h. 21m. Minimum of Algol (β Persei).
25. 14h. 11m. to 15h. 21m. Occultation of 55 Leonis (mag. 6) by the moon.

HOLMES' COMET (1899 *d*).

Ephemeris for 12h. Greenwich Mean Time.

1899.	R.A. h. m. s.	Decl. ° ′ ″
Nov. 2	2 36 36·67	+49 14 8·0
3	35 23·08	12 57·8
4	34 9·70	11 24·8
5	32 56·63	9 29·5
6	31 44·00	7 12·1
7	30 31·92	4 33·0
8	29 20·51	49 1 32·6
9	2 28 9 89	+48 58 11·4

COMET GIACOBINI (1899 *e*).—The following ephemeris is given by Herr S. K. Winther, of Copenhagen, in *Astr. Nach.*, Bd. 150, No. 3598:—

Ephemeris for 12h. Berlin Mean Time.

1899.	R.A. h. m. s.	Decl. ° ′	Br.
Nov. 2	17 18 59	+4 42·4	0·66
3	20 33	4 58 6	
4	22 8	5 14·8	
5	23 43	5 31·0	0·63
6	25 18	5 47·1	
7	26 53	6 3·3	
8	28 29	6 19·4	0 60
9	17 30 5	+6 35·6	

NEW ALGOL VARIABLE IN CYGNUS.—The following *minima* will occur at convenient times for observation during November:—

D.M. + 45°·3062 { R.A. 20h. 2·4m. / Decl. + 45° 53′ } (1855).

	d.	h	m.
1899. Nov.	6	8	57
	15	12	27
	29	5	43

NEW VARIABLE STAR.—In the *Astronomical Journal*, No. 470, Mr. R. T. A. Innes, of the Cape Observatory, gives the individual results of his observations leading to the detection of a new variable. Its position is:—

C.P.D. − 54°·6634 { R.A. = 15h. 32m. 42s. / Decl. = − 54° 54′·4 } (1875).

The star was first suspected of variability by Prof. J. C. Kapteyn, who furnished a list of possible variables to the Cape Observatory in December 1896. Mr. Innes, from a discussion of the *fifty-eight* observations he records, finds the period to be about 12·68 days, the variation of magnitude being from 8·7 to 9·3. The fall to, and rise from, minimum seem to be very sharp; but notwithstanding this similarity to the Algol type, it is not considered likely to belong to that class. The colour of the star is distinctly red.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THE Dover meeting was characterised by the unusual quantity of solid work in physical geography and mainly in oceanography, including polar research, which was brought before the Section. Travel papers were less numerous than usual, though certainly of no inferior type, and the use of the lantern to illustrate nearly every communication added both to the interest and the value of the expositions. The hall was ill-situated and not well adapted for the purpose it was called upon to serve, and this unfortunate environment, not any falling off in the quality of the papers, accounted for the remarkably small audiences, which were the subject of general remark.

The address of the President, Sir John Murray, contained a summary of existing knowledge as to the ocean floor, and concluded with indications as to the direction in which advance during the immediate future is to be looked for. In this respect Sir John Murray gave prominence to the improved prospects for Antarctic research, and emphasised the importance of the forthcoming expeditions aiming at scientific completeness in their work. In seconding the vote of thanks for the address, Sir Michael Foster, the President of the Association, spoke of the interest which the Royal Society as well as the Royal Geographical Society felt in Antarctic exploration, and of the determination of both Societies to make the best possible use of the funds which might be placed at their disposal for the complete scientific study of the south polar area.

ARCTIC PAPERS.

The most recent results of Arctic exploration were described by three explorers who had attacked the problem in very different ways. Admiral Makaroff, of the Russian navy, gave an account of the trial trip of the great Russian ice-breaker *Yermak*, a vessel recently constructed at Armstrong's works on the Tyne for service in the Baltic during winter and in the Kara Sea in summer. The vessel is built of steel, the plates being very heavy and the ribs and cross-girders of very great strength arranged to meet the thrust of ice from all sides. She is built with two hulls, one within the other, is minutely subdivided into water-tight compartments, and fitted with an elaborate system of tanks and steam-pumps which enable the trim of the vessel to be altered very rapidly. Thus the vessel may be depressed at bow or stern, or canted to port or starboard by pumping water from one set of tanks to another. The displacement of the vessel fully equipped is 8000 tons, and her engines have power by acting on three propellers at the stern to drive her at the rate of 14 knots. A fourth propeller at the bow, intended to drive away the broken ice by the currents it generates, was found useful only in light ice, but of no value in breaking ice of great thickness. The trial-trip, which Admiral Makaroff described with many illustrations from photographs, demonstrated the power of the ship to break away through ice as much as 14 feet thick, not so much by smashing the ice as by determining the direction of cracks by which the mass is split. A cinematograph picture was obtained of the *Yermak* forcing her way through the thickest of the Arctic pack-ice north of Spitsbergen, but Admiral Makaroff regretted that the film could not be developed in time for exhibition at the meeting. During the trip the ice was not only broken to make way for the ship, but studied minutely. The powerful derricks with which the vessel is fitted made it possible to capsize large blocks of ice so as to study the parts normally under water, and also to hoist on deck masses of many tons weight, to be studied as to temperature by the insertion of thermometers to different depths, and as to chemical composition, melting point, &c. Admiral Makaroff is convinced of the perfect suitability of strong steel ships for polar research; and in reply to an inquiry as to whether he hoped to reach the North Pole in the *Yermak*, said that he only wished he might be allowed to try. There was a long discussion on the paper, in which the value of this new method of mastering the ice was generally recognised.

Mr. W. S. Bruce, who had just returned from a voyage to Spitsbergen in the Prince of Monaco's yacht, *Princesse Alice*, gave an account of the physical and biological conditions of the Barents Sea, founded on that cruise and on a voyage last year in Mr. Andrew Coats' yacht *Blencathra*. Only two of the many current floats thrown overboard by the *Blencathra* had as yet been recovered.

Mr. Walter Wellman, in an address on his recent journey to

Wilczekland, dwelt upon the motives and methods of Arctic exploration, advocating the "dash for the pole" as the only practical method of attaining the highest latitude in the short time available during the brief season available for travelling in the Far North. He recounted the incidents of his attempt in 1898-99, which was unsuccessful on account of a serious accident which befel him when camping on an iceflow which was broken up by a sudden pressure.

ANTARCTIC PAPERS.

The records of recent work in the Antarctic were of no less interest, and the display of slides from Antarctic photographs was unique, none of them having been shown in public before.

A short account of the cruise of Sir George Newnes' yacht *Southern Cross*, with Mr. Borchgrevink and his party on board, from Hobart to Cape Adare, was communicated by Dr. H. R. Mill, and illustrated by a few pictures of the Antarctic ice and of the landing at Cape Adare. The *Southern Cross* left Hobart on December 19, reached 50° S. on the 23rd. The first ice was met with on the 30th in 61° 56′ S., and 159° E., and on January 1, 1899, she was practically stopped by the pack in 63° 40′. Every effort was made to proceed southward and eastward, but with small result, as on January 31 the position was only 66° 46′ S. and 165° 28′ E. She then commenced to work northward and eastward to escape from the pack, which she did on February 12 in 65° 43′ S., and then it was found easy to cross the pack to the southward in longitude 173° E., the ship anchoring off the beach at Cape Adare on February 17. Tempestuous weather was experienced, the wind at the most southerly part of the voyage blowing usually from easterly and southerly quarters, and the vessel being more than once in danger of driving ashore. Stores were landed, huts erected, and the *Southern Cross* finally left Mr. Borchgrevink with nine companions and seventy-five dogs on the shore of what he believed to be the Antarctic continent on February 28, 1899.

M. H. Arctowski, the oceanographer and meteorologist of the *Belgica*, gave a brief account of the voyage and the wintering of the Belgian expedition in the Antarctic ice-pack south-west of Cape Horn. He showed a number of photographs of the newly explored land, and concluded by expressing his views as to the further work required in Antarctic exploration as follows :—

At the present day it is impossible to consider the land alone ; the whole Antarctic area exhibits phenomena which remain very imperfectly known, such as the great questions of atmospheric circulation, climate, circumpolar oceanography and magnetic conditions. Hence Antarctic explorations must be conducted in three ways :—

(1) A system of fixed stations arranged between the edge of the continents and the zone of ice. These stations should be supplied with all necessary magnetic and meteorological instruments, and continue at work simultaneously for one year at least.

(2) During the same year two polar expeditions should set out on opposite sides towards the South Pole. This would require two vessels strong enough to withstand the pack, and equipped for wintering.

(3) Finally a circumpolar expedition, planned to follow the edge of the pack right round, and specially equipped for oceanographical and zoological work. This expedition would also survey the accessible parts of the Antarctic coast.

Such a system of exploration must necessarily be the work of several nations. Weyprecht's idea should be revived and followed. Antarctic exploration must be conducted systematically, and it ought to be international. A series of circumpolar stations, where comparable and simultaneous observations are carried on, would make the results of the British and German Antarctic expeditions remarkably complete, and vastly enhance their value.

A polygon of stations should unite South America and the Antarctic lands. The path of the cyclonic storms passes to the south of Cape Horn, and—at least during part of the year—to the north of Palmer Land. The polygon should include stations on the east and west coasts of Graham Land, and one of the South Shetland Islands, on South Orkney and on one of the Sandwich Islands, together with stations at Cape Pillar, Cape Virgins, Cape Horn, Staten Island and the Falklands. With such a system of observation it would be possible to determine exactly the track of every cyclone crossing the polygon of stations. This is a matter of very great practical importance. These cyclones seem to travel in the general direction of the upper winds from west to east, and they seem to follow the outline of Alexander, Graham and Palmer Lands, but how and why this is so we cannot tell as yet. Between South America and the Antarctic land there is a belt of low pressure which seems to encircle the Antarctic region where there is apparently a permanent anticyclone ; but observations are wanting to determine the associated conditions of atmospheric circulation.

It seems scarcely necessary to insist on the advantages which two other polygons of stations would present, one to the south of the Indian Ocean, the other between New Zealand and Victoria Land. The second polygon would be formed by the islands of Prince Edward, Crozet, Kerguelen and a station on Enderby Land. The third polygon would include the Balleny, Macquarie and Auckland Islands. This would be a particularly interesting polygon on account of its comparative proximity to the magnetic pole.

The two vessels designed to winter in the pack should approach along the meridians of 145° W. and 35° E. Imprisoned in the pack as the *Belgica* was, these vessels would be able to carry on oceanographical and zoological work, and also to collect magnetic and meteorological observations, thus adding two stations near the pole to the various polygons. From the meteorological point of view it would be extremely interesting for these vessels to reach high latitudes, for the region near the pole will probably differ greatly from the northern edge of the Antarctic lands in everything regarding atmospheric pressure, wind and storms.

As to the circumpolar expedition, the vessel intended for this purpose should be quite independent of those which penetrate the pack. The region is too great to admit of the whole voyage being completed in one season—three would probably be necessary. It is not easy to indicate the route which should be followed, for everything depends on circumstances. Still, it may be observed that—in summer at least—easterly winds predominate near the edge of the south polar pack, and therefore it would be advantageous to proceed from east to west.

Mr. J. Y. Buchanan, F.R.S., treated of the physical and chemical work required for an Antarctic expedition, and pointed out that the principal object at the outset of the expedition should be to push energetically southwards, and effect a landing in the most suitable place in the highest possible southern latitude, and there establish the principal station. The locality should be chosen where the ship, or one of the ships, would find safe winter quarters. As the principal object is to establish the expedition as advantageously as possible on land, no time should be spent unnecessarily at sea. For this reason magnetic observations at sea should not be contemplated. They take up an enormous amount of time, and besides, if they are to be of any use, the distribution of iron in the ship has to be arranged under such restrictions as to interfere materially with the usefulness of the ship in other directions. On land, the magnetic observations would occupy a first place, also pendulum observations for the determination of the intensity of gravity and tidal observations. It has been the general experience of Antarctic navigators that the heavy pack-ice is met with at a considerable distance from land, and between it and the land there is comparatively open water. The ice which would cover this water in winter would probably loosen earlier than the heavy pack, and the ship, if wintering inside, might be able to move much earlier than it would be possible for her to pass the pack ; and this would be an additional advantage of finding winter quarters for the ship.

Perhaps the most important work to be done is to obtain a complete meteorological record during the whole of the sojourn of the expedition in Antarctic regions, whether at sea or on land. At present, any view as to the meteorological conditions on the Antarctic land may be held, because we have no facts by which to regulate our speculations. The expedition should be fully supplied with instruments for this purpose, and especially with self-recording instruments. As the station must necessarily be on land, and not on ice, geological observations will be made as a matter of course.

What distinguishes the Antarctic regions above everything is the development of ice as a geological feature, whether it is met with at sea as icebergs, or on land as glaciers, or a continuous covering. It is almost certain that any station on land will be within easy reach of a glacier, and means should be taken to establish marks as early as possible which will enable its motion to be observed before darkness sets in and after the sun reappears.

The Greenland glaciers appear to move about three times as fast as the Swiss ones. Do the Antarctic ones move faster still? In Spitsbergen the glacier streams sometimes take very large proportions. How does it stand with the Antarctic ones in this respect? The "grain" of the Spitsbergen glaciers does not seem to be larger than that of the principal Swiss glaciers. The Antarctic land ice must be dissected with a view to the determination of the size and the articulation of the grain. It is, therefore, of the first importance that the chemist and physicist should have spent some time, both in summer and in winter, examining for himself the conditions of one of the Swiss glaciers. This is quite as necessary for him as having spent a certain time in a chemical or a physical laboratory.

The papers on Antarctic exploration gave rise to an animated discussion. Prof. Rücker, speaking of the requirements for magnetic work, expressed his preference for observations on board a wooden ship cruising round the Antarctic, to the concentration of observations on a few fixed stations; although he allowed that excellent results could be obtained from fixed stations if they were numerous enough, and not established upon magnetic rocks; series of well-distributed stations being more important than a position in high southern latitudes or equipment with apparatus of remarkable delicacy. Major Darwin observed that such differences of opinion as had been expressed regarding the work to be attempted in Antarctic exploration arose simply from the want of funds to provide for the complete representation of all departments; and he indicated two guiding principles. (1) If a special Antarctic ship is to be built, it should spend the whole of the available time in the Antarctic regions proper. (2) The greatest unknown feature should be selected for study; that is, the Antarctic continent. For any kind of south polar expedition it is of the utmost importance to select the scientific staff with the greatest possible care. Mr. George Murray said that he had been carefully studying the question of the cost of ships, and had come to the conclusion that for two well-equipped vessels, each with an adequate scientific staff, a sum of 150,000*l.* would certainly be required. Dr. Koettlitz laid stress on the importance of expert supervision in the preparation of all the tinned foods of an expedition. Sir John Murray, in summing up the discussion, said it was plain that for a proper study of the Antarctic regions two ships would be required, one specially designed for magnetic work and for penetrating the ice, the other equipped for circumpolar oceanographical observations.

Oceanographical Papers.

Dr. Gerhard Schott, of the Hamburg Marine Observatory, the oceanographer of the German deep-sea expedition, gave an account of the chief results of the voyage of the *Valdivia*, illustrated by many photographs, including some fine pictures of tabular and peaked Antarctic icebergs. The expedition, sent out at the expense of the German Government, was practically a circumnavigation of Africa, though in wide curves including the invasion of the Antarctic region to the edge of the pack-ice off Enderby Land. Apart from the exploration of the edge of the southern ice and the rediscovery of Bouvet Island, the cruise was of great geographical importance on account of the exact oceanographical study of the whole of the tropical Indian Ocean for the first time. The oceanographical results include deep-sea soundings carried out with two different machines, one the Sigsbee, of American manufacture, which acted remarkably well, even in very stormy weather.

The utilisation of an electromotor for winding up the wire was a new and very successful application much to be commended, especially for polar work, when steam-pipes are apt to freeze. The most important soundings were those made between Cape-town and Bouvet Island, thence southward to the edge of the ice, and eastwards along the margin of the pack, and thence north to Kerguelen. This region had previously been almost unknown. During this part of the trip great attention was paid to ice-conditions, the ice being distinguished into *Drift-ice*, consisting of low fragmentary masses, often obviously portions broken off glaciers; *Pack-ice*, greenish stratified masses of frozen sea-water; and *Icebergs*, which in the east near Bouvet Island were rugged, much waterworn, and had obviously come from a distance; while in the east, near Enderby Land, they were tabular in form, quite fresh and unworn: their height was usually from 100 to 180 feet. The meteorological conditions were also studied throughout the cruise with great care.

Mr. H. N. Dickson discussed the observations of temperature of water and air round the British Islands. The mean monthly and annual temperatures of the surface waters of the sea during the period 1880-97 are shown for sixty-five stations distributed round the coasts of England, Scotland and Ireland. The average for the year at the entrance to the English Channel is nearly 54° F., it falls as the Channel narrows to 52° between the Start and Cape la Hogue, and remains steady to beyond the Straits of Dover, at least as far as the East Goodwin light-vessel. On the south-west coast of Ireland the annual mean is about 52°, falling to 51° in St. George's Channel, and 50° in the Irish Sea. A slow fall from 52° to 50° takes place on the west coast of Ireland until the N.W. corner is reached. The mean of 49° persists along the north coast of Ireland to the North Channel, and along the whole of the west coast of Scotland to Stornoway. On the east coast temperature falls very quickly, as soon as we get out of range of the Straits of Dover, to 50° off Suffolk and Norfolk, and then there is a gradual fall northwards, to 48° off the coast of Northumberland, 47½° off Aberdeenshire, and 47° at the Orkneys and Shetlands. The effect of the tidal streams in mixing the waters is exceedingly well marked. The annual minimum of temperature rarely occurs in March, most frequently in January, especially at stations open to the Atlantic. The annual maximum occurs almost everywhere in August.

Mean temperatures of the surface water are compared with the forty-year averages for the air, recently published by Buchan. A comparison shows that the mean annual difference has hitherto been somewhat over-estimated, especially on the western coast; in no case is the mean excess of sea over air greater than 2° F. The maximum difference occurs everywhere in November and December, and is greatest on the south coast of England between Portland Bill and the Straits of Dover.

Mr. Dickson also contributed a paper on the temperature and salinity of the surface water of the North Atlantic during 1896 and 1897. The completed series of forty-eight monthly charts of surface temperature and salinity, the mode of construction of which was described in a paper read before the Section last year, was exhibited, and along with it maps showing the departures from the mean distribution of air pressure and temperature during the same period. A number of new features in the movements of surface waters were disclosed, notably in connection with the distribution of polar waters from the western Atlantic.

Dr. H. R. Mill suggested a system of terminology for the forms of sub-oceanic relief. He said that the fact that the forms of the ocean floor cannot be seen, but only felt out by soundings, makes their study one of peculiar difficulty. Some distinguished authorities believe that our present knowledge of the deep sea is too slight to justify any systematic terminology. Meanwhile each investigator introduces a set of names of his own, for the most part based on analogies with land forms visible to the eye. It is obvious that there are two great classes of forms, elevations above and depressions below the general level of the ocean floor; but the question is how many subdivisions of each can be recognised as distinctive and deserving of generic names. The following general scheme of terminology is put forward tentatively, premising that no attempt be made to localise any precise type of form unless a considerable number of soundings exist to define it:—

Depression—The general term for any hollow of the ocean floor. *Basin*—A relatively wide depression, with comparatively gently sloping sides. *Caldron*—A relatively wide depression, with comparatively steeply sloping sides. *Furrow*—A relatively narrow depression with comparatively gently sloping sides. *Trough*—A relatively narrow depression with comparatively steeply sloping sides. *Wall*—Any submarine slope comparable in steepness to a precipice on land. *Floor*—Any very gentle submarine slope or nearly level surface. *Elevation*—Any inequality above the general level of the ocean floor. *Rise*—A relatively narrow elevation. *Bank*—A relatively wide elevation. *Shoal*—An elevation coming within five fathoms of the surface, so as to be a danger to shipping. *Shelf*—A nearly horizontal bank attached to the land and bordered seaward by a much more abrupt downward slope.

Mr. C. W. Andrews, in a paper on the relation of Christmas Island to the neighbouring lands, referred to the peculiarities of the geology and biology of the island, and traced the resemblances which seemed to associate it with the Cocos-Keeling group on one side and Java on the other. The occurrence of earthworms in Christmas Island was an anomaly in the biology of oceanic islands, and difficult to explain.

Sir John Murray and Mr. Robert Irvine discussed the distribution of albuminoid matter and saline ammonia in sea-water; and Sir John Murray with Mr. F. P. Pullar exhibited and described the sounding-machine they employed in their bathymetrical survey of the fresh-water lakes of Scotland, and gave an account of the configuration of the beds of the lakes of the Loch Katrine group. The authors expressed their intention of extending the work to the other lakes in Scotland, although they felt that it was rather for the nation than for individuals to carry out work of the kind.

OTHER PAPERS.

Colonel Sir John Farquharson, late Director General of the Ordnance Survey, gave an account of the progress of the work of that department during the last twelve years, and exhibited a number of illustrative diagrams and specimen maps. He said that during the twelve years (1887-99) there have been probably more changes made in the character of the work done by the Survey than in any other equal period of its history; and, as regards the areas covered by its operations, they have been largely in excess of the areas covered during any previous equal period. This is, of course, due to the fact that revisions have now largely taken the place of original surveys. The most important advances made were:—

The progress (to completion in 1890) of the original cadastral survey of England and Wales, including the 6-inch surveys of uncultivated districts. The progress made on re-surveys for the larger scales of various counties of England and Scotland which had been originally surveyed for the 6-inch scale only; and the progress made on the revision of the original cadastral surveys of England and Scotland, whether on the 25-inch or 6-inch scale. The progress made on the re-survey of Ireland for the $\frac{1}{2500}$ or 25-inch scale. The progress made on the completion of the original new series engraved 1-inch maps of Great Britain and Ireland, both in outline and with hills. The progress made on the revision of the new series of 1-inch engraved outline maps of Great Britain and Ireland, and the commencement of the issue for Scotland and the North of England (and for Ireland ultimately) of the same revised 1-inch map with hills in brown by double printing. The progress made with coloured 1-inch maps of the South of England. The progress made with maps on scales smaller than 1 inch to a mile.

A short account was given of the nature, causes, and results of the changes made since 1887 in the system of carrying out the survey, some of which were due to the reports of committees, or suggestions from the general public, while others have been necessitated by the changes which have taken place in the character of the work done by the Department.

The Ordnance Survey Department, in 1887, published town maps at the cost of the State, on the scales of 10 feet ($\frac{1}{500}$) and 5 feet ($\frac{1}{1056}$) to a mile. It does so no longer. The reason for this change was stated. The sales of the Ordnance Survey maps were in 1887 in the hands of the Stationery Office; they are now in the hands of the Ordnance Survey Department itself. The reasons for and results of this change were stated.

Some remarks were also made as to the organisation and superintendence of the department and of its work; as to the use made of the Ordnance Survey maps by other departments of the State and by the public generally; and as to the important work which still remains to be done by the Ordnance Survey.

Mr. Vaughan Cornish described the sand-dunes bordering the delta of the Nile dealing with the ripples, sand-dunes, and dune-tracts in turn.

Ripples.—The author had previously measured twelve wind-formed ripples in the blown sea sand on the Dorset coast. The average ratio of length to height was L/H = 18·4. The least height was ·06 inch, and the greatest ·34 inch. These measurements were, for the most part, of one or two individual ripples. Mr. E. A. Floyer measured six of the largest kind of ripples on the El Arish route, and obtained L/H = 17·7 with H from 6 to 10·6 inches. The author measured thirty-seven *consecutive* ripples to leeward of a sand-dune near Ismailia. The ripples had an average height of 1·43 inches, and the average L/H was 16·57. The appearance of these was intermediate between that of ripples where accumulation is rapid (which never grow large), and the large and nearly symmetrical ripples (? analogous to sastrugi), as much as 11 feet in wave-length, the formation of which is apparently accompanied by a considerable lowering of the general level.

Dunes.—A tract of a few hundred acres of small, but true, dunes (not ripples) on a sandy foreland, exposed during the fall of the Nile, afforded an opportunity for similar measurements.

Higher and lower dunes succeeded one another, and, viewed transversely, the ridges were strongly undulating. Nevertheless, a line having been marked out in the up-and-down-wind direction, the *average* L/H for twenty-four consecutive dunes was found to be 18·04, average height 20 inches. Another set of measurements taken near the same line on the succeeding day gave L/H = 17·89 for twenty-three consecutive dunes. Apparently the ridges are formed of the nearly uniform (L/H = 18) shape, and lateral inequalities are subsequently developed in the manner explained in the *Geographical Journal*, June 1898, pp. 637-9, but these do not affect the *average* L/H. The author hopes to make similar measurements of trains of larger dunes.

The straight, slipping lee cliff of dunes is caused by the undercutting of the eddy. In the dunes near Ismailia a progressive development of the profile form was observed. At first both windward and lee slopes are very gentle, and the highest point is near the middle. The summit apparently moves to leeward, and the lee slope becomes steeper; a slipping cliff is formed on the upper part of the lee slope. This pushes back towards the summit, and the windward slope grows steeper. Finally, windward and average leeward slope become of nearly equal steepness, and the top of the cliff coincides with the summit of the dune.

Dune Tracts.—The condition for formation of a dune tract in a sandy district is that the rate of travel of the sand should be locally diminished without a corresponding diminution in the supply of sand. The persistence of such a condition may cause a stationary dune massif without fixation.

In the sandy district visited by the author the formation of a dune tract or dune massif appears to be chiefly determined by the presence of ground moisture, which gives coherence to the sand. Thus the boundaries of these massifs frequently appear inexplicable when an explanation is sought in the wind. Within the bounds of the massif, however, the modelling of the surface is explicable by the action of the winds. In the neighbourhood of Helwan, wind erosion of limestone and other rocks is very active over areas where there are no dunes. An examination of the wind-formed detritus showed a quantity of sand-sized particles sufficient for the formation of dunes; and the explanation of their non-formation seems to be that the sand-sized particles are too small a *proportion* of the whole. According to this line of reasoning, dunes will only be formed where dust formation proceeds slowly, for if dust be produced rapidly the proportion of sand-sized particles remains low.

Travel papers, for the most part accompanied by graphic illustrations, were contributed by Mrs. W. R. Rickmers on the rarely visited region of Eastern Bokhara, by Mr. W. R. Rickmers on the Karch-Chal mountains in Transcaucasia, by Dr. H. O. Forbes on the island of Sokotra, by Mr. O. H. Howarth on the province of Oaxaca in Mexico, by Dr. A. C. Haddon on some geographical results of the recent Cambridge anthropological expedition to the Malay Archipelago and New Guinea, and by Captain Wellby on a remarkable journey through the western borderlands of Abyssinia. Mr. E. Heawood contributed a paper on the date of the discovery of Australia, in which he brought forward evidence for discrediting the rumours of the discovering of Australia in the fifteenth century or the early part of the sixteenth.

The eighth report of the Committee on the Climatology of Tropical Africa was presented, giving records from forty stations.

MECHANICS AT THE BRITISH ASSOCIATION.

MEETING under the presidency of Sir William White, Chief Constructor of the Navy, naturally the papers which came before the Section dealt mainly with marine engineering, canal and harbour works, and allied subjects.

Owing to the energy of the President a very complete programme was secured; and the papers read and discussed were certainly considerably above the average. The attendance at the sectional meetings was also much better than usual.

On the opening day, after the presidential address, a paper by Messrs. Coode and Matthews on the Admiralty harbour works at Dover was submitted to the Section. It was taken early in the programme in order that the engineers present at the meeting who naturally wished to carefully inspect the