

list of publications dealing with smoke, its cause, effects, and prevention. In looking through the bibliography, we are struck by the extent and varied sources of the literature, a fact which clearly indicates that the smoke nuisance has no mere "local habitation," but possesses a widespread interest. English, American, German, and French volumes predominate, and if we were to estimate the extent of the nuisance in these countries by the number of publications England would stand easily first. Still, it is some consolation to think that we do not suffer alone. The question then arises, how long will the present state of apathy on the part of the public authority continue, and when will the limit to public endurance be reached? It is true that we have the smoke clauses of the Factory Acts; but a perusal of these will immediately dispel any faith in their efficacy. We have also local bylaws; but experience will teach the most casual observer that in most industrial centres atmospheric purification has undergone little change. Indeed, in some of the most notoriously bad localities average convictions do not exceed one a year. There is, we believe, a Bill to be introduced into the House of Commons, and promoted by a large and influential body of citizens connected with various industrial centres, which, it is hoped, will find its way to the statute-book. In the meantime, there is no question that demands more immediate and drastic treatment than the smoke problem owing to its effects on the health, cleanliness, and general comfort of the community.

ANTARCTIC PROBLEMS.¹

The Problem of the Antarctic Andes and the Antarctic Horst.

AS the Weddell Sea will be the objective this year of no fewer than three Antarctic expeditions, some of its features as bearing on the above problem may be discussed first.

The continuity of Coat's Land, discovered by Dr. W. S. Bruce in the *Scotia* in 1904, with Prince Regent Luitpold Land, discovered by Dr. Filchner in the *Deutschland* in 1912, has still to be traced. Filchner sighted three Nunataks of dark rock rising from the inland ice to the south of "Vahsel Bucht," thereby proving indisputably the existence of land under the inland ice. The inland ice there rose gently from its shore cliff of from 25 ft. to 65 ft. high, up to more than 3000 ft. at a distance from the shore of about thirty miles. Of far greater importance is the tracing inland of the unknown coast to the south of Luitpold Land.

This is one of the greatest of the geographical problems which the Shackleton Expedition should solve. Amundsen, on his journey to the south pole in 1911, proved that the south-easterly trend of the Queen Alexandra Range, discovered by Shackleton at the Beardmore Glacier, is not maintained in the Queen Maud Ranges, but that the latter ranges bend to the right as one follows a great circle from the Beardmore Glacier to Graham Land. So far, this favours the theory of Penck that Antarctica is divided into a West and East Antarctica respectively, by a strait connecting the Ross Sea with the Weddell Sea, for the trend of the Queen Maud Ranges, if continued farther north in the western hemisphere, would carry it to Luitpold Land.

There can be little doubt that this Queen Maud Range is bounded by heavy fractures, of the order of several thousands of feet, for geological reasons which will be stated presently; and that these trend lines

are, perhaps, as strongly pronounced as are any in the world. If, therefore, the ranges, to which they give origin, extend towards Luitpold Land, they are certain to be strongly marked, and should be capable of accurate delineation by the Transantarctic party of the new expedition. If, on the other hand, as seems more probable, the Queen Maud Ranges, when traced into the Weddell Quadrant, bend back towards Graham Land, and become continuous with Charcot Land and King Oscar II. Land, then Shackleton's other party, operating from his main base at the head of Weddell Sea, should be able to solve this all-important problem. With its length already proved of no fewer than 1400 miles, and its height of from 8000 to 15,000 ft, its stupendous fracture lines, involving displacements of 5000 to 6000 ft., and its profound influence on the meteorological conditions of Antarctica, and probably of the southern hemisphere, it is not the least important of the mountain ranges of the world, and certainly yields to none in its geological interest and the extreme difficulty of the problems which it presents.

At the Graham Land end of Antarctica, Arctowski, Nordenskjöld, Gunnar Andersson, Charcot, and Gourdon have proved that petrographically and tectonically the rocks are distinctly Andean. Granodiorites, and Andesitic rocks, in which zoned soda-lime feldspars are characteristic, are there predominant. Boulders of gneissic rocks present in Tertiary strata at Seymour Island suggest a pre-Cambrian foundation complex at no great distance. Recently Dr. W. T. Gordon has identified well-preserved Archæocyathinæ in a large block of limestone dredged up by Dr. W. S. Bruce in the *Scotia*, from lat. 62° 10' S., long. 41° 20' W., from a depth of 1775 fathoms, near the South Orkney Islands, and specimens of *Pleurograptus ceratiocaris* and *discinocaris*, previously described by Pirie, from the collections by Bruce in the South Orkneys, proves the existence there of Ordovician rocks. The sedimentary rocks are largely formed of Jurassic plant-bearing strata, with one of the richest known fossil floras of that age in the southern hemisphere. In the west and central parts of Graham Land these have been strongly folded, and mostly overfolded to the east, as has been the case with the greater part of the formations developed in the South American Andes. Farther east in James Ross Island, Snow Hill, and Seymour Islands, &c., there is a gently inclined series of marine Cretaceous rocks, followed by Middle Tertiary rocks (Upper Oligocene to Older Miocene) with fossil leaves of *Fagus*, *Araucaria*, &c., a geological structure recalling that of East Patagonia and southern Argentina, as compared with the folded highlands of west Patagonia and southern Chile.

Then the zone of active or dormant volcanoes, which intermittently characterises the Andean Chain, is met with on both sides of Graham Land, in Bridgman, Paulet, and Deception Islands, on the west, and in Lindenberg, Christensen, Sarsee, and the Seal Island volcanoes on the east side. If now a comparison of the broad structural features of West Antarctica be made with those of East Antarctica in the Ross region it will be noticed that a great volcanic zone stretches along the western shore of Ross Sea from at least so far south as Mounts Erebus, Morning, and Discovery, to so far north as Cape Adare. This main volcanic zone of the Ross Sea region is crossed by lesser zones trending more or less east and west, like the Mounts Terror, Terra Nova, Erebus, and Dry Valley zone, the zone of the Balleny Islands, &c. If, however, this Ross Sea volcanic zone with the adjacent mountains be compared with the ranges and volcanic zones of West Antarctica, the fact at once becomes obvious that the ranges of the Ross area are entirely devoid of folding, and are of a block-faulted plateau type,

¹ Summary of a paper read before the Royal Geographical Society on February 9 by Prof. Edgeworth David, C.M.G., F.R.S.

whereas the lavas and tuffs of the Ross region are very distinct from those of West Antarctica, being strongly alkaline, of the nature of trachytes, phonolites, kenytes, &c., and of as distinctly Atlantic type as the West Antarctic rocks are of Pacific type.

The problem is further complicated by the fact that, meagre as it is, our knowledge of the geology of the King Edward Land area shows the eruptive rocks there, in which granodiorites are conspicuous, to be more nearly allied to Andean rocks than are those of Ross Sea. There, too, in the Ross Sea region, a vast coalfield with nearly horizontal strata sheets over all the older rocks from near the south pole itself to near Dr. Mawson's base in Adélie Land, a distance of more than 1600 miles. According to the preliminary report published in "Scott's Last Expedition," vol. ii., Mr. F. Debenham considers these Coal Measures to be of Upper Palæozoic age. Like the Coal Measures of Santa Catharina in southern Brazil and the northern Argentine, lying far to the east of the Andean fold area, they are but very little disturbed. Moreover, the structure of the mountains to the west of Ross Sea resembles in some respects that of the Falkland Islands, which again lie a little to the north-east of the Andean fold lines.

In the Falkland Islands undulating Devonian sandstones and quartzites lie with strong unconformity on a pre-Cambrian (?) crystalline complex, and are themselves succeeded by a nearly conformable group of Permo-Carboniferous strata with a well-marked glacial bed at its base which links it up at once with the Orleans glacial conglomerate of the Santa Catharina Coal Measure system. In his recent paper to this society, Mr. T. Griffith Taylor mentioned that the fossil fish-scales recently discovered by Mr. F. Debenham and himself at Granite Harbour, were considered by Dr. A. Smith Woodward to be of Devonian age, and the fossil tracks figured respectively by H. T. Ferrar from the lower Beacon Sandstone of East Antarctica, and by Nordenskjöld from the Devonian rocks of the Falkland Islands, show such a remarkable similarity to one another as to suggest that they are both of Devonian age. Now these late Palæozoic Coal Measures and Devonian rocks, more or less horizontally stratified, are far more characteristic of the outer foreland of the Andes, that is, the vast lower plateau or plain country lying to the east of the Andes, than they are of the Andes themselves. Sections are exhibited across typical portions of the Andes and their foreland massifs, together with type sections showing the probable geological structure of West as compared with East Antarctica, and a comparison is made between the structure of the Antarctic Horst with the "ice divide" on the lower plateau to the west, and that of the main divide between southern Chile and southern Patagonia, as described by H. Steffen, F. P. Moreno, and others. It is suggested very tentatively that in the Andean problem of the Antarctic a new physiographic enigma is propounded, viz.: When does a mountain range lose its identity as a definite unit, and become another range worthy of a different name?

The South American Andes are characterised and defined by both folds and faults. In West Antarctica the folds are present with the thrust directed easterly as in the Andes; the volcanic zone is present, and fractures are also present, as well as typical Andean eruptive rocks. In the Ross Sea region in the mountains along its western shore, the great fracture lines are perhaps continuous with those of Graham Land, but the Andean folding has died out, as well as the petrographical Andean province which is found rather in King Edward Land than in the mountains to the west of Ross Sea.

Provisionally it is suggested that while Arctowski's

term, the "Antarctandes," may be used for the mountains of West Antarctica, some such term as the "Antarctic Horst" may be applied to the great ranges of the Victoria Quadrant. The party to be dispatched by Shackleton from his Weddell base westwards for 400 or 500 miles, which should include someone who is both an experienced geologist and physiographer, should be able to throw a flood of light on this great Andean problem.

Then, too, a great opportunity is offered by this expedition for sending a strong party from the Ross Sea base, not only to lay out dépôts so far as to the head of the Beardmore Glacier to meet the Trans-Antarctic party on their arrival from over the great inland plateau, but also to collect systematically from the highly interesting Coal Measures, at the head of the Beardmore, with their associated fossil flora. The Shackleton expedition found wood, apparently allied to, if not identical with, coniferous wood, at the head of the Beardmore Glacier, and fossil rootlets in the adjacent shales suggest that the wood grew near where it is now found; and Captain Scott's party have brought back specimens of fossil plants scientifically of the utmost value from the same locality. There, too, at Buckley Island, or Nunatak, thick beds of Cambrian limestone with traces of Archæocyathinae underlie the Coal Measures. It is difficult to imagine any spot in the world more fascinating from the point of view of geology, palæontology, and many allied sciences.

The problem of how trees, like modern forest trees, could flourish within 300 geographical miles of the south pole itself, which now for five months of the year is in almost total darkness, is one which involves the question as to whether the south pole was in late Palæozoic time in its present position, or whether, if the position of the earth's axes of rotation have remained constant throughout geological time, the continents may not have crept horizontally over considerable distances, as suggested by Sir John Murray and G. W. Lamplugh. The presence of the rich Jurassic flora at Hope Bay in Graham Land and of the Miocene flora of Beech and Araucaria at Seymour Island presents a similar problem.

Coast Survey.—The existence or not of New South Greenland, originally reported by Morell, is of importance for study by the various expeditions which should be in that vicinity this year and next year. Soundings, currents, and meteorological conditions suggest that New South Greenland really exists.

The recent fine piece of coastal survey work by Dr. Mawson and his Captain, J. K. Davis, whereby about 1300 miles of new coast have been added to the map, greatly needs to be extended, so as to join up with Lieut. Pennell's latest surveys to the east, on the Scott expedition, and also to connect westwards with Kemp Enderby Land and Coat's Land. Obviously the Andean problem cannot be finally settled until the great unknown area between Charcot Land, King Edward VII. Land, and Carmen Land is thoroughly explored and charted.

Meteorology.—R. C. Mossman has shown that Antarctica is of vast importance in controlling weather, not only in its own immediate neighbourhood, but even so far north as the subtropics of Chile. This very important result from the establishment of Dr. Bruce's Meteorological Station at the South Orkneys, and the later system of meteorological stations in the far south, instituted and maintained continuously by the enterprise and insight of the Argentine Government, is likely to be confirmed in the case also of East Antarctica. Just as ice conditions in the Weddell Sea largely control the rainfall of subtropical Chile, so it is probable that ice conditions in the Ross Sea may control some portions of Australasian rain-

fall. Unquestionably very important results have been obtained from the establishment of Dr. Mawson's wireless meteorological station at Macquarie Island in the sub-Antarctic. The Federal Government is so much impressed with the importance of the results that it has decided to maintain this station for a time, experimentally, at its own cost.

In the coming expeditions it will be important to get meteorological data as to the location of the chief cold pole of Antarctica, and as to whether the low-pressure area of Ross Sea ever leads to air being sucked over from the Weddell Sea region, or *vice versa*. Both are low-pressure areas, so that, when their seas are ice-free, air obviously would stream into them normally from the high polar plateau. The trend of the dominant Sastrugi should be systematically mapped en route by all sledging expeditions. Measurements of the upper-air currents to supplement the work of G. C. Simpson, so admirably carried out on the Scott expedition, are much to be desired, as well as studies of evaporation and ablation generally in regard to precipitation. A meteorological observatory at the head of Weddell Sea should greatly enhance the value of the Argentine southern observatories.

Glaciology.—These problems are also interesting and important. The Weddell Barrier, as shown by the soundings, has, like the Ross Barrier, recently retreated at least 100 miles south of the position which it once occupied in late geological time.

It will be important to ascertain whether in the Weddell Sea, as at Gaussberg, at Adélie Land, at Termination Land, as well as in the Ross Barrier region, the ice has everywhere been recently retreating. The importance of the evidence of moss ice ("respirator ice") in the lids of crevasses, as indicating sea-water underlying barrier ice, should not be overlooked. The position of the Main Ice Divide on the south polar plateau should be carefully determined, as well as the directions and rate of movement of the inland ice and of the outlet glaciers. The origin and history of the outlet valleys—amongst the deepest in the world—which transect the Antarctic Horst, offers a most fascinating problem. Shafts of moderate depth should be sunk in the far inland snowfields to determine the crystallinity of the material.

Biological, physical, including magnetic, observations, as well as *chemical*, and particularly *oceanographical* investigations should, of course, not be neglected. In regard to oceanography, it may be suggested that not only should a general survey be made to develop the continental shelves, submarine ridges, and banks and deeper basins, but detailed surveys should be made in the neighbourhood of large floating piedmonts, so as to determine the existence or not of ice-scooped rock-hollows where such glaciers reach the sea floor, and of something like a terminal moraine where the barriers ended when at their maximum extension. Careful sets of serial temperatures should be taken at close vertical intervals in the sea around such floating glacier piedmonts and barriers at various seasons of the year. These should throw much light on the amount of annual loss, through melting at their base, that such floating barriers must undergo.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of the Senate has issued certain regulations relating to the directorship of the observatory. It is proposed that the director shall be appointed by the Observatory Syndicate at a stipend of 150*l.* a year. He will be expected to reside at the residence attached to the observatory, which will be free of rent, rates, and taxes. It is assumed that

NO. 2312, VOL. 92]

the director will in future, as in the past, be one of the professors of the University.

Mr. R. A. Peters has been re-elected to the Benn W. Levy studentship for one year.

The master and fellows of Sidney Sussex College have offered 50*l.* a year for five years toward the stipend of a University lecturer in forestry. The General Board of Studies is of opinion that the offer should be gratefully accepted, and that the lecturer should be appointed for a period of five years. The General Board has consented to a request from the forestry committee that it should have power to appoint Mr. H. Jackson as University teacher in Indian forestry.

DR. E. E. FOURNIER D'ALBE, assistant lecturer in physics in Birmingham University, has been appointed special lecturer in physics in the University of the Panjab, Lahore.

THE following advanced lectures, to which admission is free without ticket, are announced in the *London University Gazette*. A course of four lectures on the theory of wave-motion, with special reference to earthquake waves, will be given at the University by Prof. Horace Lamb, on Fridays, beginning on February 20. A course of four lectures on the Assouan Dam will be given at the Institution of Civil Engineers, Great George Street, Westminster, by Mr. J. S. Wilson, on Wednesdays, beginning on March 4.

It is announced in *Science* that the General Education Board of the United States has given 150,000*l.* toward an endowment of 300,000*l.* for the medical department of Washington University, St. Louis, to create full-time teaching and research departments in medicine, surgery, and pediatrics. The conditions of the gift provide that all teachers in these departments, while free to render any medical or surgical service, must not derive therefrom any personal gain. Their entire time must be devoted to hospital work, to teaching and research, as it is believed that medical education in the past has suffered from the fact that the teachers have had to rely on private work for the greater part of their income. The General Education Board has also made conditional grants of 20,000*l.* each to Knox College, Galesburg, Ill., and to Washburn College, Topeka, Kan.

IN the issue of *Science* for January 23 last Prof. Rudolf Tombo, jun., of Columbia University, publishes another of his useful articles on American university statistics. On this occasion he deals with the registration returns for November 1 of last year of thirty of the leading universities in the United States. Prof. Tombo points out that these universities are neither the thirty largest universities in the country, nor necessarily the leading institutions. The only universities which show a decrease in the grand total attendance (including the summer courses) are Harvard, Western Reserve, and Yale, the attendance of the two institutions last named having remained practically stationary. The largest gains, including the summer attendance, but making due allowance by deduction for the summer course students who returned for instruction in the autumn, were registered by New York University (965), Illinois (944), and Columbia (927). This year twelve institutions exhibited an increase of more than 200 students in the autumn term attendance, as against eight in 1912. According to the figures for 1913, the institutions with an attendance of more than 5000 students, inclusive of the summer courses, rank as follows:—Columbia (9,929), California (7,071), Chicago (6,834), Michigan (6,008), Pennsylvania (5,968), Wisconsin (5,890), Har-