to carry only one or two, of a machine fitted with a 50 horse-power engine flying faster than one almost exactly similar having a 100 horse-power engine. It all seems to show how very little we know of the principles which underlie the matter, and how much really careful experiment and research are needed if we are to go by anything more than rule of thumb.

Now that a certain amount of experience has been gained, we can get at some idea as to which type of machine is generally pronounced the most satisfactory. It is perhaps curious that two types so different as the Farman biplane and the Blériot monoplane have performed so similarly, and there does not seem to be any decided preference among flying men between the two. The following figures of the machines on which certificates had been gained in France last year give some idea of the popularity :—

93 Blériot monoplane, 81 H. Farman biplane, 37 Antoinette monoplane, 30 Sommer biplane, 26 Voisin biplane, 16 Wright biplane, 15 Hanriot monoplane, 9 M. Farman biplane, 20 on other biplanes, 17 on other monoplanes (besides 10 others not specified), that is, 162 monoplanes and 182 biplanes.

Of British-owned machines, according to Jane's "All the World's Airships," there are (or *were* five months ago) :—

34 Blériot, 14 H. Farman, 6 Voisin, 8 Wright's, 5 Sommer, 4 Antoinette, 1 Demoiselle (besides small numbers of various English makes).

This list is, however, not very trustworthy as an indication, as many of these machines have scarcely been tried, and many others (not included) have done good service during the last four or five months.

Automatic Stability.—A great deal has been said and written on this subject. Before practical flight had been attained, it was often thought that it would be necessary to apply some controlling mechanism actuated by a pendulum or gyroscope, so that when the machine tilted over it would be automatically forced back. Practice has shown that such an arrangement is quite unnecessary. We still hear of projects of this nature, but it is evident, not only from the performances of actual machines in the hands of expert aviators, but also from uncontrolled models, that a properly designed and properly balanced machine is quite stable by itself.

Motors.—The subject of motors for aërial work is perhaps rather beyond the scope of this paper, but since so much depends upon the motive power—indeed, the advent of the successful aëroplane may be said to have been entirely due to the invention of the petrol engine—I must refer briefly to it.

The chief notable feature in this line is the very general adoption of the Gnome rotary motor. This peculiar engine, which, of course, consists of seven cylinders radiating from a central shaft, which spin round forming a fly-wheel, and very efficiently cooling themselves by their rapid motion through the air, was at first looked upon as an impracticable freak. In 1909, however, it was fitted to several machines, and at once proved itself trustworthy and superior to all other motors for the purpose. Recently quite a number of engines of somewhat similar design have been brought out, and some of them, such as the Buckman, seem likely to prove even more efficient.

Meanwhile, several British-built engines of more ordinary design have come to the fore, notably the Green, with four water-cooled vertical cylinders, the N.E.C., a two-stroke motor, and the E.N.V., and several others, but for one reason or another these do not seem to be so popular with practical aviators.

Future Developments.—It is, of course, extremely difficult to foresee in which direction aëroplanes are likely to develop. There is, however, here again one of those what I may call "reciprocal" situations such as I have referred to with regard to balloons. The tendency seems to be to make the planes smaller. By this decrease the weight is lessened as well as the resistance. By lessening the resistance the machine should travel farther, and the decrease of weight of planes should enable a heavier and more powerful engine to be carried, and thus speed again increased. By travelling faster we obtain more lift, and can therefore further cut down the size of the planes. So we go on, making the machines smaller and the speed faster; and who can say where the limit may be?

Other types of machines have often been suggested, notably those of the wing-flapping species, and those with vertically acting screws. Seeing the success which has attended the simple aëroplane, I think it is doubtful if any other form will supersede it, but I have long been of opinion that some combination may prove advantageous. For instance, it is possible to arrange for vertically thrusting screws to assist in starting the machine, and it seems quite probable that a propeller on the flapping-wing principle may prove highly efficient.

THE AUSTRALASIAN ANTARCTIC EXPEDITION.[1]

AUSTRALIA and New Zealand have always been anxious for further knowledge of the great frozen continent lying to the southward of them. Because the Ross sea area is more conveniently situated to the south geographic pole, most expeditions to the Australian quadrant have wintered there. This has led to the neglect of the great coast-line westward of Cape Adare. Our information regarding it is very fragmentary, and for the most part untrustworthy. Properly equipped, an expedition to this region should have no difficulty in achieving great geographical successes. In the words of Dr. H. R. Mill, "It is time, at any rate, that someone should revisit the lands discovered by Biscoe, Balleny, D'Urville, and Wilkes. . . ."

Lying within wireless telegraphic distance of our borders, this region has a special call upon Australians. Alive to the value of scientific data there massed waiting to be collected, I have ardently sought for an opportunity to reap the harvest. Captain Scott's programme was too full with the determined efforts in view, upon the south geographical pole and King Edward VII. Land, to accede to my request to be landed this year with a party at Cape Adare. It was then that Sir Ernest Shackleton proposed to raise the necessary funds, and, with myself in charge of the scientific work, to attack the whole coast-line between Cape Adare and Gauss Berg. The plans were published in the Press on March 19, 1910, and repeated later in the year. Eventually Sir Ernest Shackleton handed over command to me.

Until the last fifteen years, though touched upon as early as 1820, only about seven expeditions, excepting whalers in the areas south of America, have come within sight of the continent. It was not until 1898 that the first Antarctic night had been experienced; even to the present day but four expeditions have wintered on the continent, and their contributions refer only to isolated spots of the 8000 miles, more or less, of coast-line. It is gratifying to note the successes which have attended recent assaults upon the unknown, and we can confidently look forward to the complete unravelling of the broader features and secrets of Antarctica within the next three years.

The Antarctic Continent.

Conclusions of any but local value based on the data available are obviously liable to prove in error, but will always serve a useful purpose in directing the attention of explorers to possible contingencies. The inadequacy of the data available is comprehended when we find, based upon them, several entirely different views regarding the geomorphology of the South Polar region. There is, nevertheless, a general agreement regarding the seaward limits of the land and the permanently attached ice. That is to say, we can now guess approximately the limits of southward navigation—where ships must be brought up either by land or barrier ice. Assuredly considerable portions of this coast-line are no more than barrier ice—marginal shelf-ice of great thickness—which in the recent past may have been of greater seaward extent, and in the future may retreat even hundreds of miles before the rocky coast-line is revealed. These barriers originated from the land glaciers, and are partly aground, partly afloat. It appears probable that the immense thickness of nearly 2000 feet is sometimes reached. In such cases the barrier ice, though afloat,

[1] From a paper read before the Royal Geographical Society, on April 10, by Dr. Douglas Mawson.

plays the *rôle* of land, and is charted as the margin of the continent.

Concerning the topography of the interior, all is speculation except in the vicinity of Captain Scott's and Sir Ernest Shackleton's exploits.

Thus it is that some hold the view of a continuous high land from Graham's Land to South Victoria Land—a continuation of the Andean chain; others regard the possibility of a great trough-subsidence, continuous from the Ross sea to the Weddell sea, isolating an eastern and a western Antarctica. Yet another view is that Enderby Land is part of a third isolated mass. There are many grounds in support of the existence of a trough between the Victoria Land massif and the Andean continuation of Graham's Land. Granted its existence, it will be still uncertain whether this depression sinks below sea-level, or is merely a topographical feature of the land. The existence of a passage below sea-level appears quite unlikely to me. Nordenskjöld and Gunnar Anderson have shown how the highlands of Graham's Land must be regarded as a continuation of the Andes. Possibly, further to the westward, this folding has been responsible for land trending towards King Edward VII. Land, the presence of which has been inferred by Charcot, and does not participate in the piling up of the mighty ranges which girdle the south geographic pole.

This may ultimately prove to be correct, for the geology of Victoria Land corresponds with that of Australia and Tasmania, whilst, in the same region, Andean types are represented further to the eastward amongst the Pacific islands.

Another point of correspondence is that South Victoria Land is elevated *en bloc*, and not subject to the contortions of folding illustrated in the Andes. I am not by any means the first to entertain this idea of an inverted South America. According to it, the highlands of Graham's Land are continuous with the mountain ranges of South Victoria Land. To the westward of this main range there is a great plateau, in part as much as about 10,000 feet in height, eventually sloping to the Indian and Atlantic oceans. Eastwards, on the Pacific side of the range, there is a precipitous scarp. We have no means, as yet, of telling whether this lower area is barrier ice with occasional islands, or is extensive undulating land.

Between Gauss Berg and Graham's Land, on the Atlantic ocean side, it is likely that most of the sea-front will be occupied by barrier ice; Enderby and Kemp lands, therefore, may be no more than islands.

The consanguinity of the lavas of Gauss Berg and the Ross sea downthrow area is suggestive of a similar downthrow in the direction of the former; it is possible, therefore, that a considerable indentation lies west of Gauss Berg.

According to present views, the Antarctic continent has an area of about five million square miles, the major part of which is a plateau of great height. Geographers are generally agreed, at any rate, that the main land mass of the Antarctic regions lies in the Australian Quadrant. This has been independently arrived at from theoretical considerations by Mr. E. A. Reeves, who has discussed the subject of distribution of land and sea as judged by the deflection of the lines of magnetic force.

Glimpses only of the past history of Antarctica are yet known—fragments gleaned from the analysis of scientific data to hand. We know that there were periods when ice was almost unknown, when great formations of water-deposited beds accumulated, associated with coal-bearing strata; these beds have their exact prototypes in Tasmania—in fact, where Tasmania leaves off South Victoria Land begins. We believe that in not long geologically remote times the intervening 1500 miles became engulfed; this conclusion is arrived at by an entirely separate line of argument proceeding from the evidence supplied by fossil and living forms of life.

Australian and New Zealand types show a remarkable affinity with those of South America and South Africa. This striking similarity in variety and range is exemplified not only in the bird life and mammalia, but also in the crustacea, amphipoda, mollusca, galaxias, and others. The similarity extends to the flora also. To the casual observer the connection is most noticeable in regard to the birds and mammals. We find parrots and struthius birds of the ostrich type common in these southern lands. Considering the marsupial mammalia, such occur at the present day in the Australian region and in Central and South America. Of the two sub-orders, Polyprotodontia and Diprotodontia, into which the marsupialia are divided, the Diprotodontia, which are the more primitive, are essentially Australian, as shown by the abundance of their fossil remains. The fact, however, that a representative of this class is now living in South America is strong evidence of a land connection, unless an independent and convergent process of evolution is regarded as possible. Further, the fossil evidence is absolutely in favour of a continuity between South America and Australia—as, for instance, may be mentioned amongst the extinct marsupial fauna of Patagonia, the Prothylacinus, which is essentially identical with the Tasmanian tiger. All this evidence confirms the theory of connection between the southern lands by way of Antarctica.

On the other hand, there is no line of argument founded on fact which can be urged to support the view of immigration by way of Asia. Suppose, for instance, that the marsupial fauna had come to Australia from Asia; then we should expect to find the types most numerous and most generalised in Northern Australia and Asia. Identically opposite is the case, and in the whole of Asia no living or fossil marsupial has ever been found.

The evidence is conclusive, therefore, in the minds of men of science, that in the not long (geologically) past there existed a habitable Antarctic continent with rays stretching up to meet with what are now Tasmania, South America, New Zealand, and South Africa. With regard to the relative dates at which these countries became severed from the southern continent, the evidence shows that with South Africa was the earliest and loosest. New Zealand, though possessing many of the features of Antarctic flora and fauna, never received a marsupial population, and its final separation is thereby allocated to the early Tertiary times. Australia, then separated by the formation of Bass strait, and more recently Tasmania and South America, have become isolated by the engulfment, due to diastrophism of the land bridges connecting both with the Antarctic continent.

Much of the strata of Southern Australia are composed of the *débris* of this lost land. To the south of Australia, where now is ocean, were highlands, providing an abundance of material shed northward into what were then lowlands and marine areas. Volcanic activity on a large scale, remaining even to the present day in isolated spots, attended the separation of these land masses. Finally, an ice age of almost unprecedented severity overwhelmed the residual Antarctic continent, and swept every trace of life into the southern ocean.

The Plans of the Australian Expedition.

We hope to have a complement of fifty men—ship and land party—and proceed south from Australia about the close of this year. Practically every member of the land party will be a specialist in a particular branch of science. Most of the recruiting will be amongst the graduates of the universities of Australia and New Zealand.

It is our intention to land several parties with stores and huts, to winter between Cape Adare and Gauss Berg, and the ship will return to Australia and New Zealand for the winter, though not remaining idle. It had been our intention of dropping a few men at Cape Adare, for that is the easiest and most accessible landing on the Antarctic continent. The facilities there afforded of coal and stores left by Borchgrevinck's expedition would have further simplified matters. In the light of recent events, of course this must be eliminated from our programme. It is our special desire to accomplish a complete coast survey between the two points mentioned, and complete the magnetic charting of the region north of the south magnetic pole. The several wintering stations will simultaneously despatch coastal sledging parties on either hand, thus dividing up the task. A special journey will be made inland from our main base on the north coast to the south magnetic pole, thus completing, in conjunction with the former journey in which I participated, the crossing of that corner of South Victoria Land. For the rest, without entering into details, I may say that no branch of science will be neglected.

Before Australian meteorology is placed on a final basis—before the causes are known which produce the effects

observed—much more requires to be known regarding the circulation of the atmosphere in high southern latitudes. There are no other portions of our globe, excepting equatorial regions themselves, which influence so greatly the climate of the southern hemisphere than the Antarctic continent. It is a vast refrigerator condensing warm moist overhead currents from the equator and speeding them back at sea-level, frequently with hurricane velocity, much to the consternation of Australian shipping. All such irregularities in the regular anticyclonic cycle can be predicted by an observing station on the coast of Antarctica, southward of Australia. That the regular phases of barometric pressure in the Antarctic regions are the dominating causes that affect the climates of the southern temperate regions cannot be denied, and by their study we shall become more capable of predicting weather for Australia.

It is very desirable that a permanent meteorological station in connection with Australia and New Zealand be erected either at Adelie Land or to the west of it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—As an outcome of the recent increase in rate aid granted by the City Council, the University has drawn up a scheme for bringing facilities for higher education within the reach of the poorest scholars who may have the requisite ability. Twelve entrance scholarships, tenable for four years, are offered for competition at the forthcoming matriculation and intermediate examinations in July and June respectively. Candidates must have been resident within the city boundaries for at least one year, and must have attended one of the schools in that area. Competitors must reach such a standard as, in the opinion of the University, offers a reasonable prospect of a successful or distinguished career. Competitors may further apply for an annual grant (not exceeding 30*l*.) towards maintenance, on the ground that they are unable to avail themselves of such scholarships without a maintenance grant in addition. It will be interesting to see to what extent the maintenance grants increase the number of suitable candidates, for hitherto the number of entrance scholarships has been in excess of the number of properly qualified applicants.

IT is officially announced that Dr. Theobald Smith will be the Harvard exchange professor at Berlin University during the academic year of 1911–12. Dr. Smith has held in succession the chairs of applied zoology and comparative pathology at Harvard, and is a member of the board of directors of the Rockefeller Institute for Medical Research.

THE Council of the City and Guilds of London Institute has elected Dr. E. Frankland Armstrong a fellow of the institute (F.C.G.I.), in recognition of his original research work and his contribution to the advancement of the industry, in which he has been engaged since he gained the associateship of the institute at the close of his regular course at the City and Guilds Central Technical College in 1903.

THE University Extension Board of the University of London has arranged a training course for lecturers to be delivered in the University buildings, South Kensington, in the Easter term. The course will consist of four lectures by Prof. John Adams on "The Art of Lecturing," four lectures by Dr. H. H. Hulbert on "The Delivery of Lectures," and six meetings for practical work. Each member of the class will have an opportunity of delivering a trial lecture, and will have the advantage of the criticism of Prof. Adams as regards material and arrangement, and by Dr. Hulbert as regards delivery.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society April 6.—Sir Archibald Geikie, K.C.B., president, in the chair.—Hon. R. J. **Strutt**: The Bakerian lecture. A chemically active modification of nitrogen produced by the electric discharge. The leading facts established are:—(1) That pure nitrogen, from whatever source, subjected at a low pressure to the jar discharge, undergoes some modification which causes it to glow for a short time after it has been sucked away from the discharge. (2) The glow which is emitted while the gas returns to its normal condition is not destroyed by the removal of ions. It is weakened by heating, intensified by cooling. This seems to favour the view that it is due to the recombination of dissociated atoms. (3) The modified nitrogen acts on ordinary phosphorus, combining with it, and at the same time forming much red phosphorus. (4) It combines with sodium and also with mercury at a gentle heat (say 150° C.), forming in the latter case an explosive compound, and in each case developing the line spectrum of the metal concerned. It also develops the line spectra of other metals, probably combining with them. (5) It develops the band spectra of compounds, when these are vaporised in it, giving in many cases spectra of substances too unstable to be examined at the temperature of the Bunsen flame. (6) It attacks acetylene, and substances like ethyl iodide or chloroform, setting the halogen free when there is one, and combining with the carbon to form cyanogen. This is proved by the brilliant cyanogen spectrum produced, and by direct chemical tests, such as formation of Prussian blue. (7) It attacks nitric oxide, with formation, strangely enough, of nitrogen peroxide, a more oxidised substance.—A. **Holmes**: The association of lead with uranium in rock-minerals, and its application to the measurement of geological time.—Prof. E. T. **Whittaker**: The dynamical value of the molecular systems which emit spectra of the banded type. It is now widely believed that when the spectrum emitted by a luminous body is of the banded type, the small vibrators which give rise to the radiation are the molecules of the substance, as distinguished from atoms or ions. This result is applied in the main body of the paper in order to suggest a dynamical system, which is formed of two members in the same way as a diatomic molecule may be supposed to be formed of two atoms, and which has free periods of vibration related to each other by the same formula as holds in the case of banded spectra. This formula presents a certain peculiarity, in that the frequency of vibration occurs in it linearly, whereas in the equation for determining the free periods of dynamical systems in general the frequency enters by its square. It is shown that from this peculiarity in the radiation of a molecule certain inferences may be drawn regarding the dynamical character of the connection between the atoms within the molecule. It is shown that a somewhat modified mechanism would emit radiations connected by the same law as that which Balmer found for the hydrogen lines.

Royal Meteorological Society, March 15.—Dr. H. N. Dickson, president, in the chair.—Prof. H. H. **Turner**: What can we learn from rainfall records? The "periodogram" method has been applied under the superintendence of Prof. Schuster and the lecturer to the rainfall records of Padua (175 years) and Greenwich (90 years), besides Klagenfurt and Oxford (50 years), all periods between 20 months and 5 months having been examined, as well as some others. The resulting indications are not very positive, but include several features well worth further study, especially in the Greenwich rainfall, where periodicities of 597 days and 150 days (possibly a quarter of the former) seem to be fairly persistent, as well as a short one of 25 days; but these are not reproduced in the Padua records, at any rate not exactly. There are doubtful periods of 591 days and 147 days, which again are possibly related by the ratio 4 to 1. (The shorter periods near 25 days have not been investigated, as daily records are required.) It is possible that the periodicities change slowly with the latitude, in a manner suggested by the cloud belts on Jupiter.

Geological Society, March 22.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. A. S. **Woodward**: Some mammalian teeth from the Wealden of Hastings. Mr. Charles Dawson has obtained two imperfect molars, apparently of Plagiaulax, from beds of grit in the Wealden near Hastings, and his associates in the work of exploration, Messrs. P. Teilhard de Chardin and Félix Pelletier, have found a well-preserved multituberculate molar of the form named Dipriodon by Marsh. These specimens are described.—A. **Wade**: Some observations on the Eastern Desert of Egypt, with considerations bearing upon the