attention should be given to the question of balancing, not only of the actual propeller torque by the use of two propellers, but also of the gyrostatic couples due to both the propeller and the rotary engine. Why do not the makers try an engine rotating about a horizontal axis perpendicular to the line of flight, driving a pair of propellers rotating in opposite directions by means of bevelled cogs? The arrangement would be perfectly symmetrical, and the gyrostatic couple of the engine *might* be used to assist in lateral steering.

Another disadvantageous feature of many monoplanes, though not an essential feature of them, is that the wings are usually of considerable breadth, and, of course, are cambered. The result is that when such a machine pitches, effects may occur the nature of which will remain entirely unknown until some experimental knowledge has been obtained regarding air pressures on rotating planes. To assume that these effects are negligible, or even that they may not be the cause of accidents, is, in the circumstances, scarcely justifiable.

It will be interesting to see whether any questions of stability are considered in connection with the present inquiry. The tendency which has existed up to the present time of shelving the problem of inherent stability, and attempting to attribute accidents to other causes, is, after all, very natural. If stability could be ignored altogether, the problem of aviation would be greatly simplified, and much laborious work, both theoretical and experimental, would be saved. Those of us who have spent much time in studying the theory of stability would have been glad to give our attention to other subjects instead, had we believed that a final solution of the problem of flight was possible which should make aviation independent of stability considerations. At the present time, no experimental information exists regarding inherent stability, and a comparison of theory with practice is urgently needed. Under theoretically assumed conditions, stability, both longitudinal and lateral, is greatly affected by variations in the inclination of the flight path to the horizon, and this is a point on which experimental tests would be of particular interest. The fact that so many accidents have occurred the causes of which are unknown shows that aviators have not yet been altogether successful in their attempts to dispense with theories of, and experiments on, stability. The accounts of many accidents are strangely suggestive of what would happen under theoretical conditions if an aeroplane should be flying at an inclination to the horizon consistent with inherent instability.

As regards the monoplane and biplane, these limits are probably very different in existing machines of the two types, but there is no essential difference between the "single-" and "double-decker" in regard to stability. Many monoplanes are of the Antoinette type, and can be made laterally stable by making the tail of sufficient length; many existing biplanes do not possess sufficient auxiliary surfaces for lateral stability, though this defect is probably remedied when the planes are bent up; on the other hand, the auxiliary planes in them are as a rule more favourable to longitudinal stability. These are, however, details of construction which do not depend on whether the machine is a monoplane or biplane. It is probable that most existing aeroplanes satisfy the condition that lateral, like longitudinal, *instability* increases when rising in the air.

It is necessary to repudiate any suggestion that a so-called "theory" of stability (which is really an experimental study of the results of certain assumed hypotheses, the apparatus for which are the methods of mathematical analysis) should be applied to actual aeroplanes without first being subjected to a second experimental test performed with the actual aeroplanes or models of them. But would not even this course be better than continuing to use aeroplanes about the stability of which nothing is known? And admitting that most flights have to be performed in gusty winds, is this any reason for being satisfied with a flying machine which would not fly straight in still air? Some people appear to think so. But is it not probable that the problem of stability presented by an actual aeroplane is more complex and not less complex than that presented by a system of narrow planes moving at small angles through a resisting medium? If this be so, the complexities of the simpler problem may afford some clue to those existing in the more difficult and at present unsolved problem.

It is hoped that no suggestions made in the present article will be regarded as authoritative statements except so far as they may be confirmed by experiments conducted with the aid of mathematical or physical apparatus. If any conclusions are to be drawn from these remarks, they should be to the effect that it is far less important to try to decide whether a biplane is better than a monoplane than to investigate the relative merits of flying machines on a perfectly broad basis. It is, therefore, to be hoped that the staff of the National Physical Laboratory will not only be given a very free hand in the investigations that are placed in their hands, but that they will produce a powerful and thorough report, and—if a small criticism is permissible—give a little more attention to formulating broad general principles, and confine themselves a little less exclusively to the tabulation of minute experimental details than they have done on some previous occasions.

G. H. B.

THE INTERNATIONAL METEOROLOGICAL COMMITTEE.

WEATHER TELEGRAPHY AND MARITIME METEOROLOGY.

MEETINGS were held in London during the week ending on Friday, September 20, of two Commissions constituted by the International Meteorological Committee to deal with questions concerning international weather telegraphy on the one hand, and with those concerning mari-

time meteorology and storm warnings on the other. The Commissions were first provisionally appointed at the meeting of the International Committee held in Paris in 1907; they held meetings in London in June, 1909, and upon their report to the meeting of the International Committee held at Berlin in 1910, it was decided to recommend to the meteorological institutes of Europe to substitute a reading of the "barometric tendency" (the change of pressure in the three hours preceding the morning observation) for the reading of the wet-bulb thermometer in the international code. A scheme of storm signals for daylight, using two cones, was also recommended as an international system.

In the telegraphic reports of the morning of May 1, 1911, the change of code recommended was introduced simultaneously by all the countries of Europe, and the "barometric tendency" has now become an important feature of the daily weather message. The recommendation as to storm warnings was hampered by the fact that no agreement could be reached as to the signals that were to take the place of the cones at night.

Having regard to the various incidental questions which remained unsettled, the International Committee at Berlin decided that the two Commissions, which had consisted of only few persons, should be enlarged and become permanent. All the members of the International Committee had therefore been invited to join these Commissions, and also to nominate other persons interested in weather telegraphy and maritime meteorology respectively.

In accordance with the tradition of the International Meteorological Organisation, the administrative work of a commission rests entirely with its president; both the Commissions mentioned are under the presidency of the Director of the Meteorological Office, London, who is also president of the International Meteorological Committee, by which they were appointed. Meetings of the Commissioners were accordingly arranged to be held in London on Tuesday, Wednesday, Thursday, and Friday of the third week in September.

The Board of Education kindly lent the committee-room of the Science Museum for the meetings. The members present were:—For the Commission for weather telegraphy, General Rykatcheff, Director of the Meteorological Service of Russia; Geheimrat Hellmann, Director of the Prussian Meteorological Service, secretary of the International Committee; Prof. Grossmann, representing the Deutsche Seewarte; Prof. Palazzo, Director of the Meteorological and Geodynamic Institute of Rome; M. Angot, Director of the Central Meteorological Bureau of France; Prof. Mohn, Director of the Meteorological Service of Norway; Prof. Van Everdingen, Director of the Meteorological Service of the Netherlands; Captain Ryder, Director of the Meteorological Service of Denmark; Mr. R. G. K. Lempfert, Superintendent of the forecast division of the Meteorological Office. For the Commission for Maritime Meteorology and Storm Warnings there were, in addition, Comandatore Santi, Director of the Hydrographic Bureau of the Royal Italian Marine at Genoa; Dr. van der Stok, Superintendent of Marine Meteorology at de Bilt; and Commander Hepworth, Superintendent of the Marine Division of the Meteorological Office. His Highness the Raj Rana of Jhalawar, and Señor Duarte, chef de service of the Brazilian Meteorological Service, now being reorganised, were invited to attend the meetings of the Commissions.

The representatives of Japan, Dr. Nakamura and Dr. Okada, were prevented from coming by the death of the Emperor. Letters of regret were also received from Prof. Willis Moore, of the United States Weather Bureau; Mr. H. A. Hunt, Commonwealth meteorologist of Australia; Rev. L. Froc, of Zikawei Observatory; Mr. T. F. Claxton, of Hong Kong Observatory; and others.

As regards weather-telegraphy, the questions for discussion grouped themselves into four subjects, which may be mentioned in turn:—

(1) The first was the revision of the international code, incidental to the substitution last year of the "barometric tendency" for the reading to the wet bulb.

After a long discussion agreement was reached whereby two consecutive figure-places can be obtained in the morning groups by using only two figures for the barometric tendency, and also for the air temperature. It is suggested that for ordinary stations one of these places be assigned to the characteristic of the barometric variation in the past three hours, and the other to the direction of motion of the upper clouds; but, in order to encourage the preparation of a daily map of the circulation of the upper air over Europe, it is proposed that for those few international stations where observations of the direction and apparent velocity of clouds can be obtained, the two figures shall be assigned to those elements. For a figure-place incidentally available in the evening groups, the "characteristic of the weather in the past twenty-four hours" is suggested. Figure codes for the four new meteorological "elements" here mentioned were drawn up.

(2) Secondly, the question of the extension and proper organisation of the evening telegraphic weather service was brought forward by the Seewarte, and General Rykatcheff brought before the meeting a project of the Russian service for synchronous observations twice a day over the whole of the Russian Empire, covering 150° of longitude, in cooperation with the service of middle and western Europe.

A schedule of the present hours of observation in all parts of the globe was put forward; and in order to assist these projects it was agreed to recommend 7 a.m., 1 p.m., and 6 p.m. (G.M.T.) as "international hours" for the region between the longitude 30° W. and 30° E., and 6 a.m., 12 noon, and 6 p.m., G.M.T. (8h., 2h., 8h. of St. Petersburg time), as international hours between the longitudes 30° E. and 180° E.

(3) The form of the Iceland telegrams was the third general subject of consideration; and, with reference to that, the Director of the Danish service undertook to give effect as far as possible to any modification that was generally acceptable and that might be regarded as permanent. The opinion of the institutes upon the question will therefore be invited.

(4) The last subject of discussion, mooted by Prof. Willis Moore as a sequel to the deliberations of the recent conference on radiotelegraphy in London, was the notification, to certain centres, of observations at Greenwich noon by all vessels at sea carrying radio-telegraphic apparatus, and the issue of forecasts from the centres to the vessels. The suggestion of organising the distribution of reports by radio-telegraphy on an international plan was welcomed. Some doubt was expressed as to Greenwich noon being the most suitable international hour for the observations, as it would not fit in well with the European system, and some provision for the more general distribution of the information was mentioned as desirable. As the scheme implied legislative action by the various countries, it was decided as a first step to invite the opinions of the various institutes upon the scheme.

The Commission for Maritime Meteorology and Storm Warnings was chiefly concerned with the question of the signals to be used at night to replace the day signals already agreed upon.

Copies of a third edition of the provisional summary of the maritime weather signals at present in use in the various countries of the globe had been prepared for distribution at the meeting.

The various schemes, either at present in operation or advocated on various grounds, group themselves into (1) schemes of three lanterns in the vertical, (2) two lanterns in the vertical, and (3) one lantern only. The scheme of three lanterns was proposed by the Bureau Central Météorologique of France on behalf of the French Ministry of Marine, on the ground that a combination of two lanterns might be confused with signals already adopted in the "regulations for avoiding collisions at sea" or with harbour lights. The Board of Trade approved of these proposals, and undertook to use its good offices to get the harbour lights at two ports where confusion might arise so arranged as to obviate that difficulty. On the other hand, a scheme of two lanterns for gales in the four quadrants, with three lanterns for a hurricane, originally proposed by the Commission in 1909, and objected to first by the Seewarte, and subsequently by others, on account of the liability to confusion, had been tried by the Seewarte on the German coast, and no confusion had arisen; whereas the alternative scheme of three lanterns was pronounced unmanageable, and the hurricane signal was accordingly replaced by one red lamp for an "atmospheric disturbance."

Prof. Willis Moore, to whose initiative the work of the Commission is due, also expressed the opinion that a scheme of three lanterns is unmanageable, and therefore modified the original proposal by proposing two red lamps for a hurricane (instead of one white between two red) and one white lamp for a gale in the north-west quadrant. One red lamp is at present used in some countries to replace any day signal.

In these circumstances it was evident that there was no general agreement in favour of a single scheme of signals, and it was therefore necessary to place the recommendations for the present on the lower plane of agreeing that any combination of lamps forming a storm signal shall have the same significance in whatever country it is used.

The propositions to be submitted to the various institutes will therefore be—that, in countries which use three lanterns in the vertical for storm warnings at night, the lanterns shall not be less than two metres apart, and shall be arranged according to the approved scheme of three lanterns; that in countries which use two lanterns, the lanterns shall be not less than two metres apart, generally four metres or fifteen feet, and shall be arranged in accordance with the original proposal of the Commission, with one red lamp to signify an atmospherical disturbance without indication of the direction of the winds instead of three lamps to signify a hurricane; that in countries which use only one lamp for night signals, one red lamp shall replace any of the day signals.

It was agreed to take the opinion of the institutes on a proposal to indicate at a signal-station by a green flag or a green lamp, or otherwise, the information that no warning can be hoisted on account of telegraphic communication being interrupted or for some other cause, as is now done at Thorshavn.

It was also agreed to take the opinion of the institutes upon the desirability of adopting a scheme of international "non-local signals" indicating the position of an atmospheric disturbance, on the lines of the code used at Zikawei and elsewhere on the China coast. Another scheme of day and night signals for a similar purpose, using three cones or three lanterns to indicate the position of a tropical revolving storm, was submitted by Commander Hepworth, and will be circulated also for comments with the report.

Finally the Commission agreed, on the motion of Dr. van der Stok, to recommend the collection of extracts of data from the meteorological logs of ships of all nations for certain ocean squares on the trade routes, with a view to their publication as a contribution to the meteorology of the globe.

The proceedings of the week commenced with a reception by Mrs. Shaw at 10 Moreton Gardens on Monday, September 16. Tuesday, Wednesday, and Friday morning and afternoon, and Thursday morning, were occupied with meetings. Thursday afternoon was set free to enable the reports of proceedings to be prepared in the Meteorological Office. Instead of meeting, the delegates visited Kew Observatory by motor, and took tea in Kew Gardens. In the evening they dined together on the invitation of Dr. Shaw, the President of the International Committee, who was

honoured by the presence of the Raj Rana of Jhalawar, and was supported by Sir Norman Lockyer, Sir Charles Watson, Sir George Gibb, the Deputy-Master of Trinity House, the President of the Royal Meteorological Society, Captain Loring, R.N., Captain Sueter, R.N., Captain Clarke, Captain Thomson, C.B., Captain Lyons, R.E., Captain Henrici, R.E., and other representatives of various public offices.

The Raj Rana entertained the members of the Commission at dinner at Bailey's Hotel on Friday, September 20. Some of the delegates remaining in England were entertained for the week-end by Mr. and Mrs. Cave at Ditcham Park, Petersfield.

The reports of the proceedings at the meetings, which were read and signed at the final meetings on Friday, September 20, will now be printed and circulated to the various meteorological institutes for comments. These will be taken into consideration at the next meeting of the International Meteorological Committee, which, it is hoped, may be held in Rome in the week after Easter Week in the year 1913. The meeting will have to consider not only the reports of the Commissions which have already met, but also the important question of the application of meteorology to agriculture, which has been raised by a letter addressed to the president of the International Meteorological Committee by the president of the International Institute for Agriculture, which has its seat at Rome.

Besides the Commissions, the proceedings of which have been referred to here, it may be noted that the Commission for Radiation, under the presidency of Prof. J. Maurer, of Zürich, met in Switzerland in the first week of September; and, earlier in the year—May 27 to June 1—a largely attended meeting of the Commission for Scientific Aëronautics was held at Vienna, under the presidency of Prof. Hergesell. The Commission passed a number of resolutions, one of which, in favour of the establishment of a network of stations for daily observations with pilot balloons, has already been communicated to various Governments through diplomatic channels.

Perhaps the most noteworthy of the resolutions were those passed on the initiative of Prof. Bjerknes, formerly of Christiana, and now of Leipzig, proposing that the results of upper air observations shall be arranged according to definite steps of pressure instead of steps of height; that the heights shall be given in "dynamic" meters—that is, a step corresponding to a certain difference of gravity potential, not of geometrical height; and, thirdly, that pressures shall be recorded in millibars (C.G.S. units) instead of millimetres or inches. These important steps in the direction of arranging the material obtained from the investigation of the upper air in a form suitable for dynamical calculation are to come into effect with January, 1913, but the resolution as to pressure units is to be subject to the approval of the International Meteorological Committee. The forthcoming meeting proposed for Rome is therefore likely to be one of great importance.

SCIENTIFIC COLLECTIONS OF THE GERMAN CENTRAL AFRICA EXPEDITION OF 1907–1908.[1]

IN 1902 the Duke Adolf Friedrich visited East Africa. In 1904 he returned there and explored the region immediately to the south-east of Lake Victoria Nyanza. In 1907 he started again, this time at the head of a well-equipped scientific expedition charged with the special task of examining the volcanic regions west of the Victoria Nyanza and north of Tanganyika. The general results of this 1907–8 expedition have already been published, both in German and in English, the English version having been brought out by Cassell and Co. in 1910. The Duke, after leading his expedition through the countries of Karagwe, Ruanda (including the Kivu district), and the Virunga volcanoes, travelled past Lake Edward Nyanza to the Semliki, the Albert Nyanza, the gold-mines of Kilo, and then westwards through the Ituri Forest and down the Aruwimi to the main Congo, and so back to Germany by the Atlantic Ocean.

The volume before us is the third issued as the result of a careful examination of the immense collections made by this scientific expedition. The two previous volumes have dealt with the topography, geology, and meteorology, and with botany. Vol. iii. gives us, first, a remarkably interesting dissertation on the earth-worms or Oligochæta; on the Serphidæ, Cynipidæ, Chalcididæ, Evaniidæ, and Stephanidæ of hymenopterous insects; on the decapod crustaceans (the land-crabs, shrimps, prawns, &c.) of equatorial Africa; on the bees, the Cladocera, the molluscs (especially land-snails), the bivalves, the burrowing Hymenoptera, and wasps; the birds of the Central African lake region; the ants; the Braconidæ and beetles; the copepods of the East African lake region; the cockroaches and butterflies of Ruwenzori and the Congo Forest. The separate articles have evidently been inserted in the order in which they were written, and have thus been cited here. It would have been more convenient to the zoologist, however, if they had been arranged systematically, so that one passed on, for example, from bees and wasps to ants, or from one group of crustaceans to another, without some intervening description of a totally different group of animals.

Probably the most valuable part of the present compilation will be that on the earth-worms and the birds. Earth-worms—it has long been realised, even by those who do not specialise in any way in that study—are amongst the most interesting and certain means of estimating the relationship between the existing distribution of land and water on the earth's surface and that of past times. The article on the Oligochæta collected by the Adolf-Friedrich Scientific Expedition is accompanied by a well-written summary of the

[1] "Wissenschaftliche Ergebnisse der Deutschen Zentral-Afrika-Expedition, 1907–8," unter Führung Adolf Friedrichs, Herzogs zu Mecklenburg. Band iii., Zoologie i., herausgegeben von Dr. H. Schubotz. Pp. xxiii+560+plates xi–xiv. (Leipzig: Klinkhart and Biermann, 1912.) Price 24 marks.