A valuable paper describing the factors influencing the sex ratio in poultry was read by Dr. Raymond Pearl, of the Maine Agricultural Station. In the present war conditions any information which would make it possible for the poultryman or farmer to produce a larger number of pullets to lay eggs, with out producing so many cockerels to eat up costly food, would be of very great value. This study, which is based on eight years' experiments and more than 22,000 individuals, demonstrates, first, that the determination of sex in poultry is primarily a matter of a definite, hereditary mechanism, just as it is in insects and other forms which have been studied. At the same time, it is demonstrated, however, that in certain physiological circumstances the operation of this mechanism may be modified in such a way as to lead to the production of more females in proportion to the number of males. The chief factor in bringing about the modification in the direction of a larger production of females is the fecundity of laying ability of the hens used as breeders. The larger the number of eggs which a hen lays before being put into the breeding pen, the larger will be the proportion of females and the smaller the proportion of males produced by her eggs. Some years ago it was shown by the speaker that the ability to lay eggs (fecundity) in poultry is a matter of definite Mendelian inheritance. As a result of this knowledge, it is possible to breed strains of hens in which productivity is a definitely fixed characteristic. The present results, taken in connection with the earlier ones, show that when the poultryman breeds along the right lines for increased egg production, he will at the same time be producing a strain in which profit-making pullets preponderate in place of the less profitable cockerels.

The session on Saturday afternoon (April 14) was set apart for a special symposium on aeronautics, the speakers including Dr. A. G. Webster, of Clark University, a member of the Naval Advisory Board, and Dr. W. F. Durand, chairman of the National Advisory Committee for Aeronautics.

On Friday evening (April 13) a reception was held in the hall of the Historical Society of Pennsylvania, when Prof. G. E. Hale, director of the Solar Observatory at Mount Wilson, California, gave a most interesting address on "The Work of the Mount Wilson Observatory."

A very pleasant feature of the Saturday afternoon session was the presentation of a portrait of Dr. J. Minis Hays, dean of the Wistar Association, by Joseph G. Rosengarten, LL.D., on behalf of the association. on the centennial anniversary of its organisation, and in the twenty-first year of Dr. Hays's secretaryship of the American Philosophical Society.

ARTHUR W. GOODSPEED.

EXPERIMENTAL WORK IN AERONAUTICS.[1]

THE report to Parliament of the Advisory Committee for Aeronautics for 1916–17 has just been issued, and is a further vindication of the foresight shown when this committee was inaugurated in 1909 under the presidency of Lord Rayleigh. Since that time funds have been continuously placed at the disposal of the Royal Society for the development of the experimental investigations at the National Physical Laboratory, the aeronautical work of which in all its branches is controlled by the Advisory Committee for Aeronautics.

Although less directly responsible to the Advisory Committee than the National Physical Laboratory, the Royal Aircraft Factory carries on its experimental work in close co-operation, as does also the Meteorological Office in its aeronautical work. Other institutions and private bodies find the Advisory Committee for Aeronautics a suitable body to receive and review their communications.

In normal times approved reports and papers are collected annually into a technical report issued for sale, but for obvious reasons publication has not taken place since the opening of hostilities. The volume of material collected is now very large, and special arrangements have been made to render it available to British designers, to whom it is of incalculable value. As the brief report now issued appears to have been framed to give as much information as is permissible and is of very general interest, it is reproduced below almost in full.

The experimental investigations carried out under the control of the Advisory Committee for Aeronautics into the many problems affecting the development of aircraft have been continued and extended during the past year.

Owing to the growth of the work of the committee in certain directions, sub-committees have been formed to advise in regard to special matters. An Internal-Combustion Engine Sub-Committee has been appointed under the chairmanship of Dr. Dugald Clerk, while Mr. H. Fowler is chairman of a Light Alloys Sub-Committee. Other sub-committees have been constituted from time to time to investigate particular problems.

Many changes and developments in the design and construction of aircraft have taken place as the result of the continued and varied experience gained from their use in warfare under modern conditions. An increasing number of special problems is thus constantly presented for investigation, and these have very closely occupied throughout the year the attention of the staffs engaged in experimental work, both at the National Physical Laboratory and at the Royal Aircraft Factory. In addition to aerodynamical research, much attention has been given to questions relating to engines, materials of construction, strength of construction and design, instruments and accessories, as well as to methods of attack from aircraft, and other matters.

Equipment for Experimental Work at the National Physical Laboratory.—Reference was made in the report for last year to the additional equipment provided for experimental work. The wind channels now available comprise two 7-ft. channels, two 4-ft., and one 3-ft. The new 7-ft. channel was completed and brought into use early in the year 1916–17. No important departure has been made in its design from that of the earlier 7-ft. channel, but some minor modifications have been introduced which experience had indicated as tending to greater convenience in working. An air-speed of 85 ft. per second can be reached in this channel with an expenditure of 160 h.p. It is doubtful whether further increase in size of channel or in speed of air-current would advance existing knowledge to an extent sufficient to outweigh the greatly increased cost and other disadvantages involved. If it should prove necessary, for certain purposes, to conduct experiments on a larger scale and at higher speeds, it would appear, therefore, to be necessary to employ a method in which the model is moved through the air. As is well known, this procedure presents various difficulties, and the securing of even moderately accurate data in this manner is, at the best, extremely laborious. Probably the least troublesome way of applying this method is by installing measuring apparatus on the aeroplane itself, and it seems probable that only in this way can an

[1] Report of the Advisory Committee for Aeronautics for the Year 1916–17. (Cd. 8629.) (London: H.M. Stationery Office.) Price 1*d*. net.

accurate comparison be obtained between model and full-scale conditions. The matter is of importance, and attention is being given, so far as existing circumstances permit, to the devising of suitable measuring apparatus.

Improved methods of supporting the models under test in the channel have been devised for use in special cases. The effect on the measured resistance of the method of holding the model is often surprisingly large, and without the necessary care and experience in avoiding effects due to interference with the air-flow, very large errors may result. The difficulty is, of course, in general greatest in measurements on forms of small head-resistance, *e.g.* aeroplane bodies and airship envelopes. Earlier measurements on airship models of stream-line shape were made to determine the form of least resistance, and were, in the main, comparative; from the cause mentioned, it is probable that little reliance can be placed on the absolute values then obtained. With the new methods of support the possible error has been greatly reduced, and when full-scale values have been determined with accuracy, the prediction of full-scale resistance from the model experiments will be established on a satisfactory basis. The new method of support is employed also in tests of models of complete aeroplanes.

Experimental Work in Aerodynamics.—It is not proposed at present to enter in detail into the consideration of questions on which experiment has been in progress. Flyers and designers have, of course, given close attention to matters in which improvement would be of value, and this has led to the repetition and re-examination, from a somewhat modified aspect, of many earlier investigations. The experiments have been of very varied character, and have included tests of models of, probably, all types of aircraft at present employed. A large part of the work has arisen from specific inquiries proceeding from the service departments, but progress has been made with some investigations of more general character.

A number of experiments have been carried out relative to the resistance of airship shapes, and further observations on the distribution of pressure in such cases have been made.

The investigation into the stability of the aeroplane has been continued. A number of special cases have been examined, and results of importance have been reached. The theory of airship stability has also been investigated.

Research into the nature of the flow of fluids round obstacles has been continued.

A number of investigations relating to airscrews have been carried out with the view of increasing the accuracy of prediction of performance, and thus facilitating the design of airscrews for special purposes. Tests on screws to be used as windmills for the production of power have also been made.

The work has included a complete series of tests on more than one complete aeroplane model. The information thus derived is of considerable importance for practical purposes in aeroplane design.

Strength of Construction.—A number of questions relating to strength of construction have been investigated, and some general conclusions have been reached tending to simplification of strength calculations. The basis to be adopted in design to secure adequate strength in high-speed machines, with the power of rapid manœuvring essential in aerial fighting, is a matter demanding the most careful consideration. To secure the highest possible speed it is necessary to keep down the weight to a minimum, and the best compromise between these two opposed conditions does not admit of precise determination. This question has received attention, and the manner in which strength varies with increase of dimensions has also been made the subject of investigation. Cases in which vibration has been set up have been examined, and calculations relating to the strength of the body structure have been made.

Engines.—A number of questions relating to engines and engine design have been submitted by the Air Board for consideration by the Engine Sub-Committee. These have required very careful investigation, and the sub-committee has been closely occupied since its formation with the various problems which have arisen. Experimental work has been carried out, by request of the sub-committee, at the Royal Aircraft Factory; and the sub-committee has received much assistance in the examination of special questions, both from the Royal Aircraft Factory and from manufacturing firms the works of which have been visited.

An extensive series of experiments on radiators has been carried out at the National Physical Laboratory, and other investigations relative to the transfer of heat from surfaces to fluids flowing over them are in progress. These have an immediate bearing on the design of the cooling systems in aeroplane engines. Experiments relating to the performance and efficiency of magnetos have also been made.

Light Alloys.—The use of light alloys in the construction of aircraft and aircraft engines is becoming of rapidly increasing importance, and improvements in the production of light alloys will have great effect on future development. The investigations relating to light alloys which have been in progress for many years at the National Physical Laboratory have been continued, and results of special interest have been achieved during the past year. Suggestions have been made to the Air Board by the committee which may, it is hoped, help to secure the best conditions in manufacture for the development of such alloys. The formation of the Light Alloys Sub-Committee will be of great assistance in co-ordinating the work on light alloys which is being done in various quarters, and in collecting the information resulting from experimental investigation and manufacturing experience. Experimental work has been carried out for the sub-committee at the Royal Aircraft Factory, the University of Birmingham, the National Physical Laboratory, and elsewhere, and arrangements have been made for placing the information obtained at the disposal of manufacturers.

Fabrics, Dopes, etc.—A number of special questions have arisen for investigation in relation to airship and aeroplane fabrics. A large amount of attention has been given to materials for use as dopes, varnishes, etc., and the Laboratory has collaborated with the Military Air Department in an investigation into the behaviour of fabrics, dopes, and protective coatings under the conditions of tropical exposure. The results of exposure to ultra-violet radiation have been studied in relation to the effect of sunlight, and conclusions of importance have been reached. The committee is indebted to Dr. Shakespear, of the University of Birmingham, for information he has placed before them as to the methods developed by him for determining the permeability of fabrics by hydrogen; comparisons have been made with the results obtained at the National Physical Laboratory. Methods of determining the purity of hydrogen have been investigated.

Investigations Relating to Seaplanes.—Tests on models of seaplane floats in the William Froude National Tank have been continued and extended. The provision made last year for an increase in the staff available for carrying out this work has enabled more rapid advance to be made, and a number of important questions have received attention. The methods employed have been improved and elaborated, and new apparatus has been designed whereby addi-

tional measurements can be obtained and further information secured relative to special conditions arising in practice.

Special Matters.—As usual, a large number of special questions have been referred to the committee for advice or investigation. The experiments relating to bombs have been continued, and valuable communications relative to the flight of bombs have been received from the Air Department of the Admiralty and from the Central Flying School. The committee is indebted to Prof. Karl Pearson, F.R.S., for communicating to it the results of his calculations of bomb trajectories. This question has also been the subject of investigation at the National Physical Laboratory.

Questions relating to the attack of aircraft from aircraft have been examined. Problems in connection with the aeroplane compass have been further considered. Other instruments and apparatus for use on aircraft have been investigated.

As previously, a number of inquiries have been received from the Board of Invention and Research and the Munitions Inventions Department, and investigations have been carried out at their request at the National Physical Laboratory and at the Royal Aircraft Factory.

Reports from the Experimental Stations of the Air Services.—A number of communications have been received during the year relating to experimental work carried out by the R.N.A.S., and by the Testing Squadron of the Royal Flying Corps. Many of these have been of great interest and value, and of much assistance in the application of the results obtained from the model experiments and in the estimation of aeroplane performance.

The committee visited on various occasions during the year military and naval air stations, as well as the Royal Aircraft Factory and the National Physical Laboratory, and witnessed many interesting experiments and trial flights.

EXPERIMENTAL WORK AT THE ROYAL AIRCRAFT FACTORY.—*Engine Experiments.*—Much research has been made into various methods for improving the output and the trustworthiness of aeroplane engines. A large number of radiators of various types have been tested, and an efficient type has been standardised. Great progress has been made in the development of the air-cooled engine. Work has been done on the compensation of carburettors for variation of air density, and a device for improving the performance of engines at great heights has been tested on several engines.

Full-Scale Aeroplane Experiments.—The measurement of the resistance of aeroplanes in flight has been continued with the object of confirming the model experiments, and an instrument for measuring the resistance directly has been developed. The distribution of air-pressure over the surface of the wing of an aeroplane in flight has been measured, and further experiments on these lines are in progress. Experiments have been made on longitudinal and lateral stability of aeroplanes in flight, and much theoretical work on the same subjects has been done. Measurements have also been made of the disturbance of the air behind a propeller to obtain data which are required in the design of new machines.

Instruments.—The behaviour of various types of magnetic compass in an aeroplane in flight has been investigated. Two new types of bombsight have been developed, and are now being tested. The improvement of the standard aeroplane instruments has been continued, and a number of special instruments have been devised for use in connection with full-scale experiments on aeroplanes. The means of communication between pilot and observer have been improved.

Fabrics, Dopes, etc.—Weathering tests on fabrics and experiments on the influence of humidity on their strength have been made. The development of a calendered fabric has received attention. The deteriorating effect of various agents (bacteria, light, etc.) has formed the subject of considerable research. The experiments on the composition of dopes, varnishes, and pigments, and on fluxes, paints, and oils have been continued.

Light Alloys.—Much experimental work has been done to arrive at the most suitable aluminium alloys for engine parts. Experiments have also been carried out in the application of the alloys which have been developed at the National Physical Laboratory.

METEOROLOGICAL WORK.—Experimental work in meteorology has been mainly in connection with the inquiry into the location of distant thunderstorms and the tracing of their progress across the map by means of a properly organised system of observations at various stations.

On some occasions the progression of thunderstorms across the map has been satisfactorily identified, although the identification on other occasions was uncertain.

Further attention is necessary in order to develop an apparatus which is more directly suitable for the purpose than that which is at present in use, in consequence of the variability of the sensitiveness, which with the present form of apparatus is unavoidable.

In addition, an inquiry into the variation of the gustiness of wind between day and night has been provided for by the erection of an anemometer with its vane at 140 ft. above the ground.

Observations have also been made of the variation of the wind with height close to the ground; and a large number of observations of pilot-balloons have been made and duly reported.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn that Dr. W. C. M'Intosh, professor of natural history in the University of St. Andrews since 1882, is about to retire from the position, in consequence of advanced years and conditions of health.

MR. W. BREW, hitherto lecturer in electrical engineering at the Belfast Municipal Technical Institute, has been appointed head of the electrical department of the Birmingham Municipal Technical School.

ACCORDING to the *Aftonbladet*, special lectures are to be given during the coming winter at Greifswald University on "Germany's Commercial Relations with Scandinavia," and a chair of the Swedish language is to be founded in the University after the war.

THE new session of the Sir John Cass Technical Institute commences on September 24. The syllabuses of classes which have reached us show that special courses of higher technological instruction in connection with the fermentation industries have been arranged; instruction will be given in brewing and malting, and in the microbiology of the fermentation industries. The methods of differential and integral calculus and their application to chemical and physical problems will be studied in the department of physics and mathematics. Courses of an advanced character will be provided in the metallurgy department on gold, silver, and allied metals, and on the heat treatment of metals and alloys. The courses of instruction are for the most part designed to supply a technical training for persons engaged in chemical, metallurgical, and electrical industries, and in trades connected with them. A number of the more specialised courses of instruction which in former years formed a characteristic of the work of the institute have for the present been discontinued.