

MODERN AËRONAUTICS.<sup>1</sup>

(1) **W**ITHIN about three hundred pages Mr. Turner gives a popular account of the whole field of aerial navigation, including balloons, airships, and aëroplanes, in his survey. He first gives an account of the history and principles of each branch of the subject. In the chapter on the principles of ballooning the expansion of the gas in a balloon appears to be attributed mainly to the heating by the sun's rays, and only a sentence, by the way, refers to the expansion due to the diminished pressure at an increased height, which, of course, affects the gas in the balloon and the surrounding air equally, and also materially affects the vertical stability of the balloon's equilibrium in the air. The natural variation of the temperature of the air with altitude might also be with advantage discussed more fully. In treating of balloons of the non-rigid type, the action of the *ballonet* in preventing flabbiness might be made clearer. On p. 181, after exposing the fallacy of an airship tacking, Mr. Turner seems to say that aëroplanes are on a different footing. Of course, the speed of an aëroplane is relative to the air just as an airship's is, and an aëroplane and an airship capable of travelling at the same speed are under the same conditions as to the directions in which they can travel in a wind. The aëroplane can have the advantage only so far as its speed exceeds the airship's.

The second part of the book deals with various problems which have to be solved. Very interesting speculations are made about the aerial law of the future, and the landmarks, sign-posts, and alighting stations which will be provided for aviators. In chapters on military and naval aëronautics and strategy and aerial invasion, Mr. Turner discusses questions which interest everyone at present. A very clear account is given of the limitations which make some of the achievements that have been attributed to aerial craft impossible, and others improbable of execution, while at the same time full justice is done

to the great services they can render within their limitations. Mr. Turner's discussion of these important matters can be recommended as sane and reasonable. Other chapters deal with the possibilities of exploration and long-distance travel in general by the air, and in a chapter headed "Work to be Done" attention is directed, among other things, to the need for increased stability in aëroplanes and for a trustworthy light motor.

While those who wish to construct aëroplanes will have to have recourse to fuller and more technical treatises, this book fills a want, and a second edition is already advertised.

In a couple of places characteristically English remarks are made at the expense of mathematicians and men of science in general. These are the more uncalled for in view of the very hazy notions which the book itself shows up, regarding stability and similar questions, that are capable of exact mathematical treatment, as well as experimental tests. The

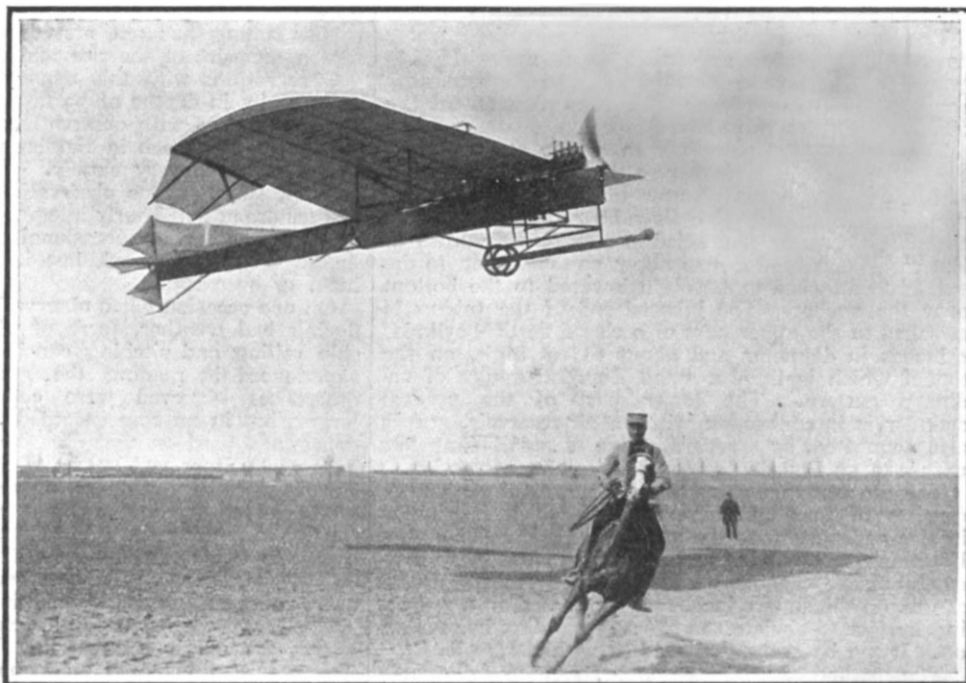


FIG. 1.—Scouts: old and new. From "Aërial Navigation of To-day."

<sup>1</sup> (1) "Aërial Navigation of To-day. A Popular Account of the Evolution of Aëronautics." By C. C. Turner. Pp. 327. (London: Seeley and Co., Ltd., 1910.) Price 5s. net.

(2) "Flight Velocity." By Arnold Samuelson. (English edition of "Fluggeschwindigkeit.") Pp. 56; 5 plates. (Hamburg: Boysen and Masch; London: E. and F. N. Spon, Ltd., 1906.)

(3) "The Conquest of the Air, or the Advent of Aërial Navigation." By Prof. A. Lawrence Rotch. Pp. x+192; 36 illustrations. (New York: Moffat, Yard and Co., 1909.)

(4) "Aërodynamik: eine Gesamtwerk über das Fliegen." Von F. W. Lanchester; übersetzt von C. und A. Runge. Erster Band. Pp. xiv+360. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 12 marks.

references to stability alone show a lack of exactness in the use of well-known mathematical and physical terms. Thus in the glossary at the end we have the following definitions:—

"*Equilibrium*.—In flying machines the term is used in the same sense as stability."

"Horizontal stability is the same as longitudinal"; while on p. 291 the author says (of dirigibles):—

"To maintain horizontal stability—that is, to enable the airship to move forward in a straight line without veering to one side or the other—fixed vertical planes at the rear of the frame are used. In addition, there is a fixed vertical plane surface at the rear of the gas-envelope."

The "useful tables" and "glossary" at the end are good features.

(2) Mr. Samuelson's pamphlet, a continuation of a previous publication of the author's, begins with a description and drawings of a model flying machine on the principle of "rowing" flight, and concludes

with a proposal to form a company to construct a full-sized machine from the author's plans. The principles on which the author relies are not those generally accepted. He maintains that the centre of pressure for a plane does not vary with its inclination to the line of flight, that the normal pressure is independent of the inclination, and that flapping wings can be constructed so as to be mechanically more efficient than a screw propeller. To establish these principles he seems to rely on rough experiments with kites and

no writer could possibly bring out a book containing the most up-to-date records in aviation. The author has, on the other hand, brought into prominence several aspects of aerial navigation which are apt to be forgotten in these days, when the breaking of records by 'planes (not to mention other breakages of a regrettable character) is the all-absorbing topic. For example, in chapter i., the ocean of air, we have an account of the results of meteorological observations in which the author has played a most

important part. It is illustrated by diagrams showing the greatest altitudes reached by mountains, balloons, and *ballons sondes*, also variations of temperature and wind velocity with the altitude, and it well shows up the efficiency of kites and *ballons sondes* in exploring regions of the atmosphere to which man can never hope to penetrate. In the second chapter—the history of aërostation—the author reproduces the letters of Benjamin Franklin to Sir Joseph Banks, P.R.S., describing the first balloon ascents made in France. The following extract from one of these letters is worth reading at the present day:—

"I am sorry this Experiment is totally neglected in England, where mechanical Genius is so strong. I wish I could see the same Emulation between the two nations as I see between the two Parties here. Your Philosophy seems to be too bashful. In this country we are not so much afraid of being laughed at. If we do a foolish thing we are the first to laugh at it ourselves, and are almost as much pleased with a *Bon Mot* or *Chanson*, that ridicules well the Disappointment of a Project, as we might have been with its Success. It does not seem to me a good reason to decline prosecuting a new Experiment which apparently increases the power of Man over Matter, till we can see to what Use that Power may be applied. When we have learnt to manage it, we may hope some time or other to find Uses for it, as men have done for Magnetism and Electricity, of which the first Experiments were mere Matters of Amusement."

How true this all sounds to-day! In England there does not, we believe, exist at the present time a single prize for any scientific investigation bearing on aerial navigation. Had such a prize existed the theory of longitudinal and

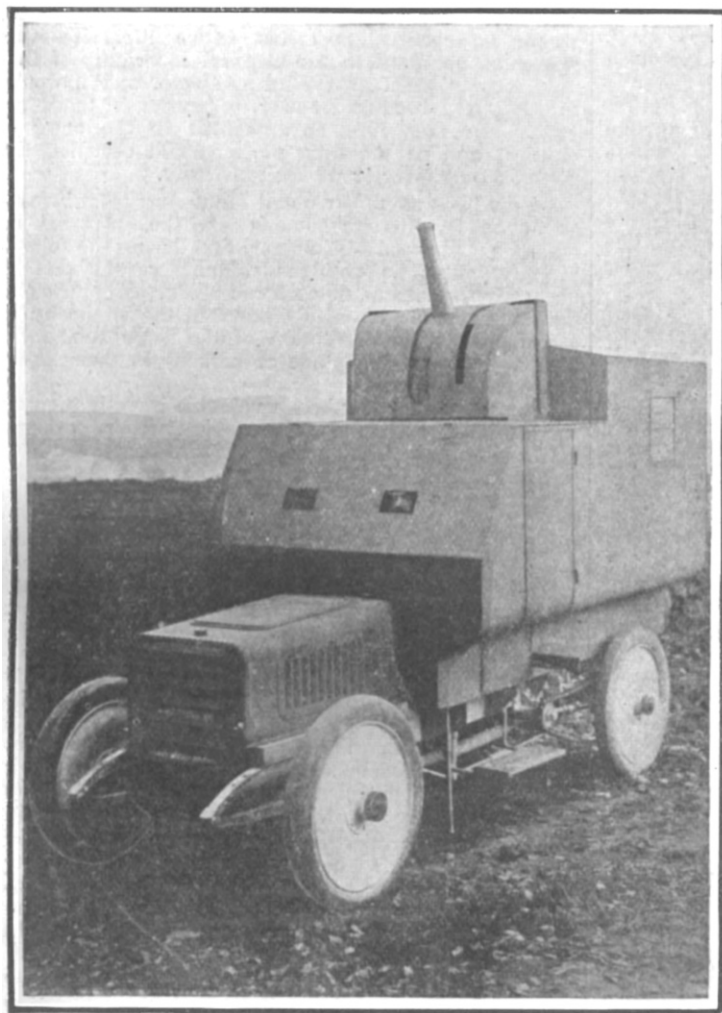


FIG. 2.—Armoured Defence against Airships. From "Aërial Navigation of To-day."

small gliders. The accuracy of the observations and the deductions made from them both seem open to question. Plotting  $v$  against  $t$ , the graph of

$$v = \frac{I}{\frac{n}{M}t + \frac{1}{v_a}}$$

is said to be a straight line, because  $v$  and  $t$  only appear in the first power. The author maintains that his observations prove Langley's to be inaccurate, and attempts to explain away the discrepancy between his principles and Langley's experiments in a way which is not convincing.

(3) The preface to Mr. Lawrence Rotch's book is dated April, 1909, and when we think of the number of flights performed since then it will be evident that

lateral stability could have been disposed of years ago, and aëroplanes could have been built with a clear understanding of their stability or lack of it. It should surely have been worth while also for those who spend such large sums on construction of dirigibles to take some steps to obtain a theory of their stability, but this has not been done. There are several other problems, including one or two in discontinuous motion, awaiting solution; and it is not the mathematician alone who is handicapped by the persistent refusal of English people to provide any adequate recognition of *original work*.

We should be greatly surprised if members of the engineering profession would not be glad to make use of a similar encouragement to carry out experiments of rather a more scientific character than would



be otherwise compatible with their business requirements. As it is, there appears to be no such inducement in England for anyone to initiate, undertake, and publish original work, whether on stability, stream lines, propellers, motors, or strength of materials. Indeed, there are very strong inducements for having such work undone, unwritten, and unpublished.<sup>1</sup>

The next two chapters deal, respectively, with the dirigible balloon and the flying machine. In the former we have an illustrated historic description, tracing the gradual progress that has been made in dirigibles since the first idea of one was suggested by Franklin in 1784; while in the latter the evolution of the power-driven machine from the mere glider is briefly but sufficiently well discussed. "The Future of Aërial Navigation" is a subject on which anyone with an imaginative mind can write something which people will read with eagerness, and this being the case, we think that Mr. Rotch has been wise in only devoting twenty pages to it, in preserving the historic order, and in giving numerous references to what has been written. The book is, of course, much smaller and less compendious than Mr. Turner's.

(4) That such English people as are able, in spite of their national disabilities, to undertake *original work* find their efforts appreciated in Germany is well shown by the publication, by the Teubner Press, of a translation of part i. of Mr. Lanchester's book within a comparatively short time of its appearance in England. The English preface is dated October, 1907, the German preface, by Prof. C. Runge, August, 1909, none too long for the work of the translators and printer. We cannot do better now than quote from Prof. C. Runge's German preface in the following terms:—

"The present book contains so many important original ideas and investigations for the development of free flight that German engineers and men of science will be grateful to the publishers for having provided a translation of it.

The author has in some places altered the text, and in others the text has been altered by the translators in consultation with the author, so that the translation may be regarded as a revised edition. A complete retrospect of existing literature was, however, not attempted; this would have altered the character of the whole book and necessitated completely re-writing it, which was not contemplated by the translator.

For men of science the principal charm of the book lies in the ideas on fluid resistance, and the expression of these by exact mathematical formulæ should be the next problem of hydrodynamics."

Does not the last sentence confirm what has been stated above as to the need of prizes for which mathematicians as well as physicists and engineers are eligible?

G. H. BRYAN.

E. H. HARPER.

#### PROF. K. J. ÅNGSTRÖM.

BY the death of Prof. Knut Johan Ångström, physical science has lost a conscientious and capable worker, in a field which requires long and continuous experience before success can be achieved. For this reason his departure will be felt more severely than that of many men, who perhaps have gained a greater

<sup>1</sup> Mr. Alexander has offered a prize of 1000*l.* to the Aërial League for the best and most trustworthy motor of 20 h.p. capable of running unattended for twenty-four hours. While fully appreciating the importance and value of such prizes, it should be pointed out that the worker who attempts to penetrate more deeply into the *thermodynamics* or *general theory* of the internal combustion engine, with the view of paving the way for future improvements, has no prospect of reward, whereas the successful competitor for such a prize *may* have other prospects of a return for his exertions in the form of patents.

reputation, but have been fortunate enough to interest others in the line of research they have been pursuing.

Knut Ångström bore an honoured name. Those who still remember the early days of spectrum analysis know how much that science owed to the pioneer work of his father, Anders Johan Ångström, whose map of the solar spectrum remained until Rowland's time the standard to which all wave-lengths were referred.

The son was born on January 12, 1857, and received his school and university education at Upsala, where he spent almost his entire life. He was appointed assistant in the physical laboratory of that university in 1882, graduated as Doctor of Philosophy in 1885, and became lecturer in physics in the same year. In 1895 he was appointed to the chair of physics, and at the time of his death occupied the position of pro-rector of the university.

So far back as 1889 we find Knut Ångström investigating absorption phenomena in the infra-red by means of the spectro-bolometer, and during the following two years he obtained valuable results on the absorption spectrum of carbonic oxide, carbonic acid, and marsh gas. He also discovered the similarity in the characteristic absorption of the same substances (ether, benzene, bisulphide of carbon) in their liquid and gaseous states.

We owe to him, further, a valuable investigation on the infra-red absorption of aqueous vapour, carbonic acid and ozone. All these gases are constituents of our atmosphere, and the effect of the two latter on the temperature of the earth may be considerable, not so much because they absorb a certain portion of the solar radiation, but chiefly on account of their much greater comparative influence in preventing the heat radiated from the earth from being dissipated into space. An interesting and instructing controversy took place in connection with the effect of carbonic acid. Arrhenius in 1896 had given a very ingenious explanation of the Glacial period by assuming that the quantity of carbonic acid in the atmosphere had increased since that time. If it be assumed that the absorption is proportional to the total quantity present, it can indeed be shown that a small variation in quantity would exercise a very considerable effect on the temperature; but, as pointed out by Knut Ångström, the proportionality between absorption and quantity only holds when the quantities are sufficiently small, and he showed that the quantity of carbonic acid in the atmosphere must be reduced to about 20 per cent. of its present value before an appreciable effect in the total absorption can take place.

In the course of the further discussion of the subject Ångström carried out important observations on the effect of pressure, and showed that by increasing the pressure, but diminishing the thickness of the layer so that the total quantity of absorbing material remains constant, a marked increase of absorption is noticed at the higher pressure. It follows that in order to find by optical means the quantity of carbonic acid in our atmosphere, it is not sufficient to determine the amount of gas necessary in our atmosphere, it is not sufficient to produce the same absorption as shown by the atmosphere, but account must be taken of the conditions of pressure. Observations on the absorption of ozone also led to the interesting result that there must be considerable quantities of that gas in the upper regions of the atmosphere.

Knut Ångström's name has become more particularly associated with recent researches in the measurement of solar radiation. He constructed an instrument, the essential portions of which consist