in the world, and the section sent by American scientific men last year sufficiently demonstrated the place held by this country in applied photography. It is very desirable that American scientific photography should be equally well represented in 1915, and, in order to enable this to be done with as little difficulty as possible, I have again arranged to collect and forward American work intended for the scientific section.

This work should consist of prints showing the use of photography for scientific purposes and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than Thursday, July 1. They should be mounted but not framed.

I should be glad if any worker who is able to send photographs will communicate with me as soon as possible so that I might arrange for the receiving and entry of the exhibit.

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## SCIENTIFIC BOOKS

*Report on Gyroscopic Theory.* By SIR GEORGE GREENHILL. Reports and Memoranda, No. 146, Advisory Committee for Aeronautics. London, T. Fisher Unwin, 1914. Pp. iv + 278, with 49 illustrations. Price 10 shillings.

Many people wonder at the expenditure of time and energy given by the mathematician to subjects like the theory of groups and differential equations. Others can not understand why men of the ability of Klein, Perry and Crabtree should lecture upon the theory of the top. Still others fail to see in the studies made by Maxwell of his spinning top in an agate cup, or of Sommerfield and Noether on the gyroscope, anything to justify a student in following in their footsteps. And yet, when we reflect that the spinning top illustrates a group of motions, that its theory involves the differential equation at the very outset, that the earth is merely a moderate-sized top spinning in space, that the solar system is a somewhat larger one, and that many nebulæ are solar systems in formation, the subject assumes a different aspect, even to the man in the street. And when he further reflects that the stabilizing gyroscope, now made in large numbers by Sperry's company, is used on the aeroplanes above the firing lines in the great war, and acts as a literal balance wheel on the super-dreadnoughts of the warring powers and can be bought in the offices of the makers in any of the large capitals of the world, this same man in the street begins to see that the theorist may touch upon the very practical and that the practical man may well afford to look to the man of theory for help in the affairs of the real life of the present day.

It is such popular considerations as these that may well lead the man of dollars to welcome, even if he can not understand, a monumental treatise like this which Sir George Greenhill, with his usual modesty, has called a simple report. To the general man of science the work will mean much more, even if he too shall fail to read 278 large quarto pages devoted chiefly to mathematics. But to students of analytical mechanics, and particularly to those who look for applications of modern mathematics to dynamics, the work will stand as a monument of patient research on the part of a man who works *con amore* and with an extended vision in a field of rapidly increasing importance.

Sir George Greenhill always writes as he talks, and he never talks like the man whom he delights to refer to as "a mere mathematician." As he sits at the head of a work table in his quaint room in Staple Inn—the room in which Dr. Johnson may have written Rasselas—and talks of his labors on the gyroscope, he is a mathematician for about a minute, a man with the zeal of a boy for another minute, a charming raconteur of stories of his master, Maxwell, the minute later, and an appreciative student of his friends Klein and Sommerfield in the next unit of time. And this description characterizes his addresses, his books, his memoirs and his reports—they are all human, the product not merely of the mathematician, not merely of the student of dynamics, not merely of the experimenter in the laboratory, but always of the big-hearted man.

And so it is with this report. It is filled with mathematics in which elliptic functions, long a favorite study of Sir George's, plays an important rôle; but the reader is continually running across such homely illustrations as those a teacher might use in the classroom—the illustrations of bicycle wheels, stepladders, clock hands, reflections in a mirror, plumb lines, balancing on a knife edge, tops, children's hoops, race wheels, motor cars, the motor omnibus, spinning cards through the air, Whitehead torpedoes, the monorail carriage, and the like—just the sort of things that those who have used the problems in the author's calculus have delighted to find for interesting a class.

The report is divided into nine chapters. Chapter I. relates to steady gyroscopic motion, with applications to the problem of the precession of the equinox and to the gyroscope as a stabilizer. Chapter II. continues the applications of the gyroscope, in particular with reference to ships, the Brennan monorail carriage and the Bessemer saloon. Chapter III. relates to the general unsteady motion of the gyroscope, and to the figures resulting therefrom—for example, to the rosette curve described by Klein. Chapter IV. deals with the geometrical representation of the motion of a top, and in particular with the work of Darboux. Chapter V. treats of the algebraic cases of top motion, and in particular of the section problems, a subject continued in Chapter VI. Chapter VII. relates to the spherical pendulum and related topics, Chapter VIII. to such topics as the gyroscope on a whirling arm, and Chapter IX. to the dynamical problems of steady motion and small oscillation.

It is not intended in this brief review to do more than call attention to the general nature of the work. The practical value of the subject has come to be recognized in this war as never before, and it is well that we have in one place the body of theory which students of the subject would otherwise have to search for in many pamphlets, books and periodicals. The report lays no claim to any important discovery, but it may fairly claim to bring together in convenient form the mathematical theory of the gyroscope as far as it has been developed up to the present time.

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*Monographs on Biochemistry. Soil Conditions and Plant Growth.* By Edward J. Russell, D.Sc. (Lond.), Director of the Rothamsted Experimental Station, Harpenden; with diagrams. New Edition. Longmans, Green and Co., 1915. Pp. 150.

This is the third edition called for within three years of the best book on the soil which has yet been written. A new chapter has been added on "The Relationship between the Microorganic Population of the Soil and the Growth of Plants." A number of minor changes and a few of considerable importance have been made in the original text, usually because of recognition of literature nonexistent when the text was prepared originally. The versatility of Dr. Russell is astonishing and the wealth of his information is prodigious. And yet he has told his story in some 170 pages without an undue crowding. In fact the book has "charm" and is easily read. The professional chemist, physicist and bacteriologist will find it a mine of information most interestingly woven together, but with frequent references to original authorities. And at the same time the layman can get a purview of the complex system involved in plant production in an understandable story.

Not only is the book the best in its field relatively, but it is very good absolutely. But it is not ideal, and probably most of the experts will feel that its accents should be altered and even that some of the statements should not have been made as they are. For instance, the reviewer should prefer to see the relation between moisture content and the measurable physical properties of the soil given more prominence; and the dynamic as contrasted with the static properties of the soil developed more definitely. One is left with a too hazy idea of the colloidal properties of clay and their importance to the soil, and the purely hypothetical calcium bicarbonate is called upon rather frequently to explain things without