lying strictly within its domain. In recent years this movement has been gaining moment in a remarkable way which could hardly have been predicted ten years ago.

In order to understand properly the bearing of the author's thesis it is necessary to have in mind the exact meaning which he attributes to the term natural science. This term, he says, "is generally restricted to denote the group of those special sciences which concern themselves with the study of what we call physical phenomena, including the cases in which the phenomena are connected with living organisms." And he adds further: "In the somewhat narrow sense in which I shall employ the term, natural science excludes any direct consideration of the mental or psychical facts in living organisms from its purview." He thus restricts the term natural science to the phenomena of the apsychical physical world.

On account of the methods which he employs the conclusions of the scientist are strictly limited to a finite portion of time and a finite portion of space. They can not comprehend at once the whole of reality, or even the totality of phenomena which are capable of investigation. The possibility of natural science depends on "the fact that there is in our percepts, that is, in what we call nature, a considerable degree of regularity in the sequences of phenomena." To what extent this uniformity of nature prevails is a matter for investigation. When science comes to deal with phenomena these are treated not as individuals but as classes; natural science does not include individuality in its domain. Neither are its theories built up in terms of the percepts of phenomena nor even in terms of classes of percepts. Its scheme is a conceptual one. "An essential characteristic of every scientific theory is that it only serves to give a conceptual description of a range of phenomena which is of a limited and circumscribed character, spatially and temporally." No scientific theory is all-embracing in its character. The deterministic schemes which are set up by science are necessarily relative and partial. "The conclusion of the whole matter seems to be that the conception that the whole world of physical phenomena, or that a finite part of that world, is theoretically capable of being represented by a unified deterministic scheme is unproved and unprovable. All that natural science has established is that tracts of phenomena can be found which are sufficiently represented for certain purposes by means of deterministic schemes."

The book opens with an introductory lecture. This is followed by three lectures in which the author sets forth his main thesis concerning the conceptual character of all scientific theory and his subsidiary thesis that natural science does not enable one to conclude to a strictly deterministic scheme for natural phenomena. In the next fourteen lectures he presents the detailed argument for his general position, analyzing this with respect to mathematics, the theory of time and space, theories of matter, dynamics, electrical theory, relativity, general biology, heredity and evolution. In the two concluding lectures he treats of the relation of natural science to general thought and to theism. The volume is a very useful one for all who have to do with such questions as are raised in it.

The view set forth by Hobson "tends to limit and circumscribe the influence which natural science will have upon the wider views of the world with which philosophy and religion concern themselves. If it be admitted that natural science, when reduced to its essential elements, is independent of any opinions which may be held as regards a reality behind phenomena, and if the notions of final causes and of efficiency [in the sense of efficient causation] be regarded as extraneous to it, it would seem to follow that the existence and the special results of natural science can not be employed in any very direct manner for the purpose of throwing light upon the nature of an assumed reality, or of exercising any decisive influence in the contest between rival views as to the nature of reality."

The conclusion is thus reached that natural science can not exercise any controlling influence upon religious and philosophical thought so long as the latter leave natural science free in its own proper domain. If one adjoins to natural science certain appropriate philosophical principles and propositions, then the two together may generate conclusions of wide reach. Some possible cases are examined in the last two lectures. But there is nothing in natural science to put a categorical negative in the way of transcendental conclusions when these are reached along other paths and are sustained by considerations which lie outside the domain of natural science.

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LABORATORY APPARATUS AND METHODS

A NEW RHYTHM APPARATUS

THE instruments which have been used in experimental studies of rhythm and other time processes have, as a rule, been either too restricted in their adjustment and adaptability to varieties of patterns, or else lacking in degree of precision. As there is a wide range of usefulness in various kinds of laboratories for this type of timing device, I will describe the apparatus which has gradually developed in the Iowa psychological laboratory after experimenting with various forms of rhythm apparatus.

This rhythm apparatus is built on the principle of the piano player; *i.e.*, the pattern is cut in a stencil drawn under electric contacts which energize the time-marking instrument. The stencil is cut on a one-inch ticker tape in a continuous roll of any length by using an ordinary ticket punch and stenciling by the aid of a scale of units especially devised for the purpose, indicating halves, quarters and thirty seconds of this unit. Thus, the stencil is inexpensive, may be made of any length, and can be cut into any desirable pattern. This stencil is wound on a spool, A, Fig. 1, threaded under the guides B and C, and the contact brushes, D, E, and the end is fastened in a slit on the spool, F. This spool, F, is turned by the pulley, G, which is driven by a pulley on a phonograph. In place of the phonograph disk, an iron wheel with a pulley of suitable diameter is placed on the phonograph plate. For the study of musical rhythms this pulley should be 2 inches in diameter when G is 12 inches in diameter, in order that the phonograph may run at 78 revolutions per minute to produce the speed of 2 inches per second in the tape. In order to reduce the load and insure accuracy of the phonograph movement, it is necessary that the pulley on the phonograph shall be relatively small as compared with the pulley, G, and that the latter, together with the tape, shall operate with a minimum of friction. The spool, F, is made relatively large in order to reduce the amount of increase in speed due to accumulation of the tape in successive layers. If necessary, this error may be compensated for by the speed regulator in the phonograph. One could, of course, employ a synchronous motor for a drive, but, if kept in good condition, a phonograph motor is accurate enough for nearly all practical purposes; and, in addition to this, it is the most convenient universal timing motor that we have in the laboratory. The phonograph may stand in any part of the room, as there is no objection to a long belt.

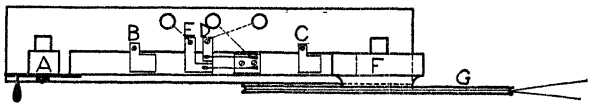

FIG. 1.

In the case of an ordinary rhythm experiment, it is necessary to have a weak and a strong sound accurately timed and alternated in patterns. This is done by having two rows of holes in the stencil, one for the accented and one for the unaccented sounds, with an electric contact brush running over each line of holes, so that when a hole passes a brush, the latter impinges upon a silver plate exposed through the hole and completes an electric circuit. For most rhythm experiments, the telegraph sounder produces a satisfactory sound. This may be energized by a storage battery or dry cells, and any desired relation of the intensity of the sound may be produced by varying the current through one of the brushes. Thus, six dry cells through one brush, and two of these through the other, makes a very satisfactory differentiation between accented and unaccented sounds.

If the apparatus is to be used for any other stimuli, the electric circuits can be used to energize these on the same principle. If more than two stimuli are needed, as many as five rows of holes may be cut on the one-inch tape; and if more than that is needed, a wider tape may be used. Thus, this apparatus can be made to operate any kind of acoustic, visual, or tactual stimuli for timed rhythmic or tachystoscopic stimulation.

At the present time we are using this apparatus in the measurement of the sense of rhythm (Kwalwasser, "The measurement of the sense of rhythm," ready for publication) and for training in the appreciation of rhythms. Kwalwasser has standardized a block of rhythms by the method of right and wrong cases and established norms for various conditions, so that the instrument is available at the present time in the musical laboratory for a ready measure of the sense of musical rhythm. This particular stencil has been put on a phonograph record and added to Seashore's "Measures of musical talent" (Columbia Graphophone Company, New York City).

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AMERICAN MATHEMATICAL SOCIETY

THE thirteenth annual meeting of the American Mathematical Society was held at Columbia University, Thursday and Friday, December 27 and 28, 1923. Dormitory accommodations were furnished by Columbia University and Barnard College, and attending members were introduced at the University Faculty Club. At the dinner on Thursday, at which about 75 members were present, Professor J. L. Coolidge spoke on the progress of the Endowment Fund.

The attendance at this meeting included 95 members of the society. The secretary announced the election of 65 persons to membership. At the annual election, which closed on Thursday afternoon, the following trustees and officers and other members of the council were elected: *Trustees,* G. A. Bliss, W. B. Fite, Robert Henderson, R. G. D. Richardson, Oswald Veblen; *vice-presidents,* E. V. Huntington, T. H. Hildebrandt, J. H. M. Wedderburn; *secretary,* R. G. D. Richardson; *assistant secretary,* Arnold Dresden; *treasurer,* W. B. Fite; *librarian,* R. C. Archibald; *member of the editorial committee of the Bulletin,* Arnold Dresden; *member of the editorial committee of the Transactions,* Edward Kasner; *members of the council,* H. W.