PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 501st meeting of the Philosophical Society of Washington was held at the Cosmos Club on April 29th. An informal communication was first made by the Secretary on Recent Geodetic Operations in Spain, special attention being given to the Base of Madridejos and to the Triangulation connecting Spain and Algiers. The results from the Base Measurement showed it to be one of extreme accuracy. The manner in which the work was carried out threw new light on the most desirable lengths of Base Lines in general, inasmuch as it was shown that greater economy with equal accuracy can be attained by measuring short lines and expanding them by careful triangulation. The geodetic connection across the Mediterranean was made the occasion to demonstrate that longitudes may be determined by means of optical signals quite as accurately as by the electric telegraph.

The first regular paper of the evening was by Mr. J. F. Hayford. The author made a statement of a new treatment of refraction in trigonometric-height computations recently used by the Coast and Geodetic Survey in connection with triangulation in Colorado, Utah and Nevada, involving lines of sight from 100 to 182 miles long. The term of the strict formula (See Wright's Adjustments, p. 387), which involves the square of the distance and the difference of the refraction coefficients at the two ends of the line, and which is usually neglected, was here retained with marked improvement in the results. It was assumed that the refraction coefficient is a linear function of the height of a station above sea level and of the air temperature at the station.

The second paper was by Dr. H. S. Pritchett, on 'An estimate of the population of the United States in 1900 derived from an empirical formula.' Dr. Pritchett first called attention to the general form of the curve defining the relation between the population and the time. The data now at hand enabled the author to write eleven conditional equations of the form

$$p = A + Bt + Ct^2 + Dt^3$$

where p represents the population (the unit being one million), t is the time counted from 1840 the epoch of the sixth census results and A B C and D are constants to be determined. The solution of the normal equations led to the following empirical formula

$$p = 17.4841 + 5.102t + 0.63t^2 + 0.030t^3.$$

Attention was called to the very close agreement between the curve and the actual population at the time of taking the census, the two largest discrepancies being in 1860 and 1870. Both these values were abnormal, partly because of the exceptional conditions then existing, the Civil War, lack of immigration, etc., and partly on account of inaccurate census results in one or both cases.

The differentiation of the formula brought out the fact that the rate of increase is continually growing less, having fallen off from 32% per decade in 1790 to 24% in 1890.

The result of the investigation was that the best value for the population of the United States in 1900, based on its growth since 1790 is 77,472,000 with a probable error of about 250,000. As a matter of curiosity the author added that if the same law holds good in the future we would have in 1990 a population of 339 billions, in the year 2500 nearly 12 trillions and at the epoch 2900 this already appalling figure will have grown to such an extent that there will, on the average, be 11,000 inhabitants to the square mile.

The third paper by Professor J. H. Gore, on 'Geodetic Work in Spitsbergen,' was not given on account of lack of time. Professor Gore, however, showed a number of interesting lantern slides illustrating his recent visit and scientific work in that country. The paper will be given at a subsequent meeting of the Society.

E. D. PRESTON,
Secretary.

DISCUSSION AND CORRESPONDENCE.

PROFESSOR JAMES ON TELEPATHY.

TO THE EDITOR OF SCIENCE: It is evident that Professor James and I have been writing at cross purposes. On the point that Lehmann has not 'established' his explanation of the Sidgwick results I am heartily at one with James, Sidgwick, Parish and Lehmann himself. But Professor James need not have awaited the return mail from Copenhagen to wrest this

admission either from Lehmann or from me. Lehmann wrote in his original paper: "Ein exacter Beweis hierfür (*i. e.*, for his explanation) kann wohl im Augenblicke nicht geführt werden." Nor, I take it, in any future Augenblick.

On the other hand, I have never regarded this point as the point at issue. Lehmann set out to examine telepathy at large. He chose the Sidgwick experiments simply as typical series, considering the authors' names a guarantee of serious intent and careful work. In his inquiry he laid hold of a condition which had never been thoroughly investigated before, and traced its effects in experiments that were both ingeniously devised and rigidly controlled; no one can neglect the unconscious whisper in future telepathic work. His paper is a model of scientific method; he has shown us how borderland questions are to be attacked, and proved that the 'ordinary channels of sense' have unexplored resources. His suggestions will be fruitful, for the next stage of advance must be an exhaustive study of the 'number habits' which Sidgwick at first rejected, but now makes the headstone of the corner. Even granting all the contentions of the critics, therefore, I should assert that Lehmann's work is brilliant, and that it has done signal service to scientific psychology. But, as I hinted before, I do not know that quasi-mathematics has contributed much to psychology in any field of research.

I conclude with a word on the logic of Professor James' objection. A theory is propounded which, from the outset, lays claim to probability and to probability only. 'Exact proof' is acknowledged to be impossible. Criticism plays upon the theory, and the author again acknowledges that his hypothesis is not proven. Professor James, apparently forgetting the first acknowledgment, affirms that the criticism has 'exploded' the theory! What is not proven is, *eo ipso*, exploded! Is Professor James, then, ready to grant that his recent book on 'Human Immortality'—something which assuredly is not yet proven—is an 'exploded document'? If the alternatives before me are scientific isolation and companionship on these logical terms I prefer the isolation. E. B. TITCHENER.

NOTES ON PHYSICS.

THE COMPENSATION PYRHELIOMETER.

MOST of the measurements heretofore made upon radiant energy by means of the thermopile or bolometer are relative rather than absolute in character, and the necessity for a simple and accurate method for reducing the indications of such instruments to the usual thermal units has long been felt. On this account a paper by Knut Ångström (*Wied. Ann.*, No. 3, Band 67) in which he describes an instrument for measuring radiation in absolute units is of great interest. This instrument, to which he has given the name of Compensation Pyrheliometer, is apparently simple in construction, and the results obtained from it are very reliable, the maximum error, as the author states, not exceeding 2%.

The construction of the instrument is briefly as follows: Two equal, thin (.001 to .002 mm.), blackened strips of platinum are mounted in such a manner that either or both, by means of appropriate shutters, can be exposed to the radiation to be measured.

One of the two junctions of a small constantin-copper thermo couple is attached to each of the rear surfaces of the platinum strips, the circuit of thermo couple including a galvanometer. It is evident that if one of the platinum strips is exposed to radiation the equality of temperature at the junctions is destroyed and the galvanometer is deflected. A current of electricity is now made to traverse the unexposed strip, and the strength of the current is adjusted until the galvanometer returns to zero. Under these conditions the two junctions are receiving the same amount of energy per second, and the heat developed by the current in the unexposed strip is equal to that given to the exposed strip by the radiation. A knowledge of the strength of the current and of the resistance of the strip suffices to find the value of the radiation in gramme calories per square centimeter per second. Since the strips are alike in all respects and are subjected to identical conditions, no corrections are necessary.

An interesting result obtained by Ångström is the value of the mean horizontal radiation of a Hefner normal lamp, which comes out to be 13.2 gm.-cals. per square centimeter per minute