

represents the actual succession of temperatures, we may modify our diagram of the annual wave by substituting for it a circle (Fig. 4), on which time and temperature may be read together. The centre of the circle is at a height above the base-line proportionate to the mean temperature, the radius is proportionate to the half-range, and when we shall have marked upon the circle a date-

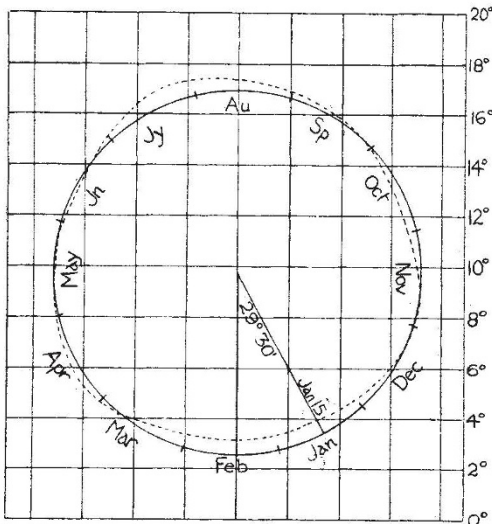


FIG. 4.

mark having reference to the phase, the temperature at a given date will be proportional to the perpendicular that falls on the base from a corresponding point of the circle. By superposing a number of such circles, or, better still perhaps, by combining them at proportionate distances in a solid model, we may represent all the various changes from point to point.

D'ARCY W. THOMPSON.

MAYA HIEROGLYPHS.<sup>1</sup>

BY way of encouraging the study of ancient documents having reference to the early history of the Mayas, the museum committee on Central American research purpose publishing translations of the more important papers that have appeared in connection with the deciphering of the Maya hieroglyphs. The most recent issue of this series is a translation of Dr. Förstemann's commentary on the Maya MS. in the Royal Library of Dresden, generally known as the Dresden Codex. The figures of the original manuscript may be known to students from the admirable reproductions due to Lord Kingsborough (London, 1831), and for the proper appreciation of the value of Förstemann's commentary, these plates or some other facsimile should be consulted. Without such assistance Dr. Förstemann admits that his description is of little value, and even with this aid, the book will scarcely be intelligible without some previous knowledge.

It is very much to be regretted that the committee has not seen its way to give some indication of the process by which the figures have been conjecturally deciphered, and to enable us to assign the degree of trustworthiness that can be placed on the suggested readings. This information is the more necessary, because research on Maya hieroglyphs is confined to a few experts, and the explanations that are now accepted cannot be regarded as final. We may confidently assert that these MSS. to some extent represent encyclopædias of astronomical or astrological lore, but, at the same time, it must be admitted that they include subjects of very diverse origin, the meaning of which is still obscure.

<sup>1</sup> Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University. Commentary on the Maya Manuscript in the Royal Public Library of Dresden, by Dr. Ernst Förstemann. Translated by Miss Selma Wesselhoft and Miss A. M. Parker. (Cambridge, Mass.: Published by the Museum, 1906.)

The key of the whole is the Tonalamatl. This is a period of time, determined by the combination of the numerals 1-13, with twenty different signs indicating as many days, consequently giving rise to a period of  $20 \times 13 = 260$  days. The number 20 was the base of the ancient Mexican numerical system, and it was natural that for the measurement of time a count of twenty days should form the first unit of a higher order. The 13 is not so easily explained. Apparently it may be compared with a period analogous to our week. Such a period was but little suited for chronological purposes, since it was neither directly based on astronomical observation nor was it the expression of any uniform recurring motion in time. Yet, by its divisions and references to natural objects, such a calendric system was destined to become a useful artifice in the hands of the priestly caste for supporting forecasts and giving force to divination. Consequently, the chronological importance of the MS. merges into the astrological, and we find mixed up with the pictures figures representing gods, one of whom is delineated no less than 141 times, and several others who recur with greater or less frequency. It seems not impossible, therefore, that hidden under these symbols we have the essential part of the religious conception of the Maya peoples in a tolerably complete form; but, unfortunately, any connection between the figure of the god and the principle it represents remains vague and undetermined. The accounts of the Spanish authors regarding the mythology of the Mayas correspond very slightly with these figures of gods, and since all other conjectures respecting their significance are very dubious, the deities can only be safely and temporarily defined by alphabetical designations. Dr. Paul Schellas suggested this method of distinguishing, without describing, any particular deity, and this plan has been wisely followed by Dr. Förstemann in his commentary.

We may now ask whether the planets have been identified with greater certainty? The first reference to a planet is made in connection with "an inverted figure of a person in a squatting attitude, the head surrounded by stars, and a sign on the back, which may be a suggestion of the Sun glyph. In this figure I see the planet Mercury, and I believe that the planet's retrogression (which lasts 17-18 days) or disappearance into the light of the Sun during this week is the subject of this passage." The evidence, to those unused in the exercise of a vivid imagination in such matters, does not seem overpoweringly strong. The retrograde motion of Mercury, though variable in length, has a longer duration than seventeen to eighteen days. There is the suggestion of forced agreement here, but if we are to understand the time during which the planet remained invisible between the evening and the morning appearance, the construction is not impossible. But if it were the intention of the scribe to record such phenomena, it is difficult to understand why such symbols do not occur with some approach to regularity.

The references seem to be a little less obscure in the case of Venus. The author exhibits a series of numbers the law of formation of which, unfortunately, is not given in this treatise, which indicate that the Mayas were aware of the approximate equality of five synodic periods of Venus to eight solar years. Assuming the length of the solar year as 365 days, and the synodic period of Venus 584 days, 2920 days include both periods. This number occurs repeatedly. The author takes a further step, which also seems warranted. In a manner comparable with that by which the cycle of 7980 Julian years is determined, he proposes to bring in the Tonalamatl of 260 days by connecting it with the number 37,960 days. This number occurs in various combinations, and is equal to  $146 \times 260$  (Tonalamatl),  $104 \times 365$  (solar year),  $65 \times 584$  (Venus, synodical period). This combination is sufficiently remarkable, and still more noticeable is the recurrence of higher numbers running into millions, in which it seems possible to trace this factor. But a very rigorous examination of the manner in which these numbers are formed is necessary before it can be concluded that they bear but one interpretation. It must also be remembered that the synodic period of Mars, taken at 780 days, is equal to precisely three Tonalamatls.

But if the instances of allusion to planetary periods are

remarkable, the omissions are not less so. The explanation that Dr. Förstemann offers for the absence of reference to Jupiter or Saturn in these hieroglyphs is that their synodic periods are too nearly equal to the solar year. This can scarcely be regarded as a satisfactory explanation. But still more curious is the small attention paid to the moon. It is true that the writer traces a reference to the synodic period of  $29\frac{1}{2}$  days, but the effort strikes one as rather forced, and the reference is by no means so prominent as in the case of Venus. There is, too, no mention of eclipses. In one passage Dr. Förstemann finds an allusion to clouds, and one need be very cautious how he disagrees with the opinion of so distinguished an expert. But it seems scarcely likely that such ordinary phenomena as clouds should be referred to, in what is evidently the production of considerable labour, intended for a permanent record. This omission is the more strange if we accept Dr. Seiler's view that the Maya documents declare an advance on the Mexican pictorial writings, and possess greater accuracy, indicating more elaborate computation. For in a Mexican MS., Codex Vaticanus, No. 3773, we have a distinct reference to the sun being devoured by a jaguar, and causing or explaining a solar eclipse (Kingsborough, iv., 22).

The commentary offers many other instances in which ingenuity and resource are exhibited in deciphering or in assigning meanings to these pictures, but here we can do no more than express our admiration of the patience and skill, which have solved so many enigmas and offered so many interesting suggestions.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Robert Boyle lecture for 1907 will be delivered by Prof. Karl Pearson, on "The Scope and Importance to the State of Physical Eugenics," on Friday, May 17, at 9 p.m., in Balliol Hall.

The Herbert Spencer lecture for 1907 will be given by Mr. Francis Galton, on "Probability, the Foundation of Eugenics," in the Sheldonian Theatre on Wednesday, June 5, at 2.30 p.m.

Mr. C. G. Douglas, formerly Demy of Magdalen College, has been elected to an official fellowship in natural science at St. John's College.

CAMBRIDGE.—During their visits to England, it is proposed to confer the degrees of Doctor of Law upon the King of Siam and Prince Fushimi.

At a congregation to be held in June, the degree of Doctor of Science, *honoris causa*, will be conferred upon Sir Clements R. Markham, Colonel Sir T. H. Holdich, and Sir T. R. Fraser, professor of materia medica and of clinical medicine in the University of Edinburgh.

Prof. Hughes has been nominated to represent the University at the celebration of the centenary of the Geological Society of London in September.

Mr. A. D. Imms, Christ's College, has been appointed professor of biology at Allahabad University.

Prof. Nuttall will deliver his inaugural lecture in the anatomical lecture theatre on Wednesday, May 22, at 4.30 p.m.

An exhibition of 50l. a year tenable for two years is offered by the governing body of Emmanuel College to an advanced student commencing residence at the college in October. Application should be sent to the Master of Emmanuel not later than October 1.

The professorship of agriculture is vacant by the resignation of Prof. Middleton. The title of the professorship will in future be "The Drapers Professorship of Agriculture." The election of a professor will take place on Saturday, June 1, at the University Offices, St. Andrew's Street. Candidates for the chair are requested to communicate with the Vice-Chancellor of the University on or before Thursday, May 23.

THE Mercers' Company lectures on "The Internal Media of the Body and their Relation to the Tissues" will be given in the physiological department of University College (University of London) by Prof. E. H. Starling, F.R.S.,

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on Fridays at 5 p.m., commencing Friday, May 10. These lectures are open to all students of the London medical schools, and to medical men on presentation of their cards.

In the course of some remarks at the annual dinner of the Institution of Mining and Metallurgy on May 3, Mr. R. McKenna, M.P., President of the Board of Education, referred to the new Imperial College of Science and Technology, and said he hopes that a year hence it will be in a state of flourishing existence. He announced that this week it will be his duty to petition the King for a charter for the new college. The Bessemer memorial fund now amounts to 13,000*l.* or 14,000*l.*, and it is hoped that the amount will rapidly be increased to 30,000*l.* or 40,000*l.* The very best equipment the world can produce is needed for the Royal School of Mines, which even without such facilities has created a world-wide reputation for itself.

In the House of Commons on Monday, Mr. Murray Macdonald asked the Prime Minister whether, in view of the recent and prospective increased expenditure upon the improvement and development of State-aided education, of the importance of connecting it more closely with the universities, and of the fact that more than twenty-six years had elapsed since the last public inquiry into the universities and colleges of Oxford and Cambridge was held, he would appoint a commission to examine into the desirability of amending the existing enactments with regard to the finances, emoluments, and government of these universities. In reply to the question, Sir H. Campbell-Bannerman said:—I am disposed to agree with my hon. friend that the conditions of the universities are ripe for a thorough and comprehensive inquiry, but I am not disposed to add, at the present moment, to the number of Royal Commissions already existing.

#### SOCIETIES AND ACADEMIES.

##### LONDON.

Royal Society, February 28.—"On the Dispersion in Artificial Double Refraction." By Dr. L. N. G. Filon. Communicated by Prof. F. T. Trouton, F.R.S.

It is well known that glass compressed unequally in different directions behaves like a temporary crystal. If  $T_1$ ,  $T_2$  be the principal stresses in the wave-front,  $\tau$  the thickness of glass traversed, then the relative retardation of the two oppositely polarised rays is  $R=C(T_1-T_2)\tau$ .  $C$  may be called the "stress-optical coefficient" of the glass.

The experiments described were undertaken in order to find out how  $C$  for borosilicate glasses varied with the colour of the light used and with the composition of the glass.

Polarised light was passed through a combination of glasses under flexure optically equivalent to a slab under uniform stress. It was then analysed by a Nicol and spectroscope. The spectrum was crossed by a dark band whenever  $R$ =integer multiple of  $\lambda$ . The measurement of  $\lambda$  then gave  $R$  and  $C$ .

It is found that, on the whole, the dependence of the stress-optical coefficient on the colour is very well expressed by the empirical formula

$$\left(\frac{C}{C_0} - 1\right)\left(\frac{\lambda}{\lambda_0} - 1\right) = 1,$$

$C_0$ ,  $\lambda_0$  being constants. This gives a hyperbolic law.

In certain glasses, however, systematic deviations from this law exist. These deviations are local in character, and their study suggests a strong analogy with the effect of absorption bands on the dispersion in single refraction.

With regard to the effect of chemical composition, it appears that an increase in the percentage of  $B_2O_3$  increases  $C_0$ ; an increased percentage of  $K_2O$  probably decreases  $C_0$ .  $\lambda_0$ , on the other hand, seems roughly independent of the composition, so that, for the glasses examined, the curves of  $C$  plotted to  $\lambda$  differ only in their scale; the dispersion increases with the stress-optical coefficient.