Modern Investigations of Mental Imagery.[1]

By Prof. T. H. PEAR.

IT is necessary to distinguish at the outset between several types of revived experience. First there is the *after-sensation* (sometimes called the after-image), which is probably not revived at all but a persistence of the effect of the original stimulus. In vision this phenomenon is familiar to us as the positive after-sensation which reproduces the colour and brightness of the original stimulus, and the negative after-sensation in which the colour and brightness are complementary to those of the stimulus. Equally well-known phenomena are the memory images proper; those revivals of experience which may occur in the form of visual, auditory and other images; in fact there are probably as many types of such imagery as there are types of sensation.

Intermediate between these is the type of image which is the subject of this paper. In the last century it was described by Fechner and called by him the *memory after-image*. Until recently it has been called either by this name or the *primary memory image*. Only lately, however, has it been specially studied and in rather special circumstances.

These studies have been chiefly carried on at Marburg under the direction of C. R. Jaensch. These researches claim to have found certain unique and hitherto unrecognised characteristics of imagery in children. Some of the work has been repeated and the conclusions carefully checked by G. W. Allport of Cambridge. From his article on "Eidetic Imagery" (*British Journal of Psychology*, 15, 1924, 99-120) much of the present summary has been taken.

The modern investigators call the image which they are describing an "eidetic image." It differs from an ordinary visual memory image in many ways. Most common among these is that while in the case of a visual image a former visual perception is merely imagined, in the eidetic image the original object is actually "seen" projected in space. It can be seen particularly well when the eyes are closed in a dark room.

Results show that approximately 60 per cent. of all children between the ages of 10 and 15 are able to produce eidetic images. During adolescence this ability retreats. There seems, however, a considerable probability that a large number of poets and artists are in this respect "grown-up children." If this be true, it explains several puzzling points in connexion with poets' and artists' description of their own imagery.

Characteristics of the eidetic image may be summarised thus:

It is literally and truly "seen."

Attention when observing it is directed outwards.

It is usually localised against any background and is never entirely unlocalised.

Though possessed of an outer character like a true perception, it is always recognised as a distinctly subjective phenomenon. It differs both from the memory image and the after-image by its extraordinary richness in detail. This richness in detail is much less dependent upon the structuration in its contents. (The structuration is observable in an ordinary memory image, when a detail particularly interesting to the observer, acting as a nucleus, tends to collect around itself characteristics depending upon it.) In the eidetic image details are frequently observed which do not appear to have this dependence upon the observer's interest. Children have reported details with extraordinary fidelity; *e.g.* the length and direction of the lines of shading in a stretch of roadway, details unrelated to any "nucleus" in the original picture.

The eidetic image is unusually persistent and often returns. When it does return its details are often extraordinarily accurate. It may be that the so-called hypnagogic images which appear to many normal people just before falling asleep are of the eidetic type. But apparently the exclusion of borderline and pathological phenomena from this conception of the eidetic image makes it impossible at present to discuss this connexion.

There appears to be little doubt of the importance of the study of this eidetic image both for an understanding of the mentality of the developing individual and for a better comprehension of certain questions connected with literature and art. In the realm of applied art it is not impossible that a knowledge of this type of imagery and its occurrence among adults might be of use in the work of the poster artist. For many posters are seen while the observer is in motion, and their details, therefore, are possibly apprehended after the poster has disappeared from the visual field.

The relation of this work to psychopathology, more particularly to the question of pseudo-hallucinations and the type of mentality subject to them, is of the first importance.

[1] Summary of paper read before the Manchester Literary and Philosophical Society, April 28.

Periodicity in Weather and Solar Phenomena.[1]

ALMOST any series of numbers when plotted shows indications of more or less regular sequences; meteorological statistics are no exception to this rule. These recurrences can be investigated by some method of periodogram analysis, and the result is a periodicity or cycle. There exist, however, certain mathematical criteria which can be applied to the results, and when this is done, it is found that the greater number of meteorological periodicities either vanish or at least become highly suspect. According to orthodox views, a cycle should remain constant in length; if it breaks down for a time, it should reappear at the correct phase, and meteorological periodicities do not often behave in the orthodox fashion. Even solar periodicities suffer from this defect, the well-known eleven-year sunspot cycle undergoing marked variations in length.

Mr. H. W. Clough attempts to get over the difficulty by considering the wave-length of a periodicity as itself a periodic function. In 1905 he found that the length of the sunspot cycle has a periodicity of about 36 years, the "Brückner cycle"; this 36-year periodicity, however, is itself not constant, its length varying during a longer cycle, estimated at 300 years. He has now investigated a shorter periodicity in sunspots, pressure and temperature, to which various investigators have assigned lengths ranging from 2·5 to 3·5 years, and he finds that it behaves in the same way, its length averaging 2·33 years and varying from 1·5 to 3·5 years according to its position both in the 11-year cycle and in the 36-year cycle. The material which he employs consists of composite series of temperature (1730-1924) and pressure (1743-1924) in

[1] "A Systematically Varying Period with an Average Length of 28 Months in Weather and Solar Phenomena." Washington, *Monthly Weather Review*, vol. 52, 1924, pp. 421-441.

Europe, temperature in the United States from 1780 and sunspots from 1750. From the monthly data, two 12-month means per year were formed, one centred on January 1 and the other on July 1. These means were plotted and the maxima and minima were picked out from the graphs. They were also studied statistically in various ways, and the first conclusion was reached, that there is real evidence for the recurrence of maxima and minima at an average interval of about 2·5 years.

The strongest part of this evidence is provided by the method of correlation, or rather of contingency, since the coefficients are calculated from the signs of the variations only, irrespective of their magnitude. These coefficients are theoretically the same as those calculated by the full method of correlation, but there is a larger possibility of error due to small accidental variations, and it would have been better to have adopted the full method. Each set of data was correlated with the same data 6, 12, 18, etc., months later, and the coefficients showed maxima after 2·5, 5 and 7·5 to 8 years, with intervening minima; this is clear evidence of the existence of a periodicity of about 2·5 years, and is far more convincing than the periods which are derived graphically.

This point being established, the lengths of successive intervals between maxima and between minima were regarded as "observations," and themselves examined for periodicity. It is shown that the average difference between the lengths of successive intervals is significantly less than would be expected on the basis of a chance distribution, indicating a tendency towards grouping, and other statistical evidence to the same effect is found. The lengths of the intervals were accordingly plotted and smooth curves were drawn showing the variations of length with time; these indicated that the intervals between epochs are generally least near the rainfall maxima of the Brückner cycle. The origin of these variable meteorological cycles is sought in solar conditions, especially in a 2·5-year period in the mean latitude of sunspots, which also varies in length according to its position in the eleven-year sunspot cycle and in the Brückner cycle. The author derives this period graphically (though to the present writer the graph is more bewildering than convincing), and he considers that the epochs of sunspot latitude fit in well with those of temperature in the United States.

Prof. C. F. Marvin, in a critical discussion, appears to accept the results as sound, and at first sight they appear to be so. Further consideration shows certain objections, which may or may not be valid. The graphical method leaves a certain amount to the judgment of the investigator, and however conscientiously the work may be carried out, there is always a danger that personal bias will weight the result. The method as adopted is unsound for another reason, since the combination of two simple periods of the same amplitude, treated by Clough's method, may also give the appearance of a single period which varies in length systematically. The second difficulty concerns the validity of the data. Both in Europe and the United States the length of the temperature cycle shows a secular increase from nearly two years to more than 2·5 years. This may be real, but it is what one would expect from a progressive increase in the trustworthiness of the data as the stations became more numerous and the observations better.

The author does not give his original data for Europe and North America, so that his conclusions cannot be checked directly. In a later table he gives epochs of maximum and minimum pressure at Batavia, which indicate a variable cycle with an average length of 2·6 years. C. Braak found a pressure cycle at Batavia which runs its course in three or occasionally four years, resulting in a "periodicity" of slightly more than three years. The present writer investigated the Batavia pressures by ordinary harmonic analysis and by the "difference-periodogram"; both methods gave a periodicity of 3·15 years, and he could find no trace of a 2·6-year cycle. This result throws doubt on the corresponding periods for Europe and North America.

To sum up, we know that there are frequent examples of recurrence in meteorological phenomena which suggest relationship to solar cycles, but when they are submitted to exact mathematical analysis, the results are usually negative. We infer that either the phenomena are not real, or their true nature is complex. H. W. Clough adopts the latter view, but the solution which he puts forward is not very plausible, and he does not go far enough towards proving it. C. E. P. B.

The Tactile Sensory Reflex.

THE investigation of the physiology of the special senses is fraught with difficulties which do not obtrude themselves to the same extent in the case of the other systems of the body. Whereas in the latter the end result of a stimulus is some objective phenomenon, possibly accompanied by a sensation, in the case of the special senses, the subjective sensation is the main effect produced by the stimulation and the accurate description of his sensations by the subject of an experiment requires both training and intelligence, if fallacies are to be avoided. The method of investigation also is not without importance, and should be capable of producing stimuli of known force if any accurate comparison between the degree of stimulation and the resulting sensation is to be obtained.

The method of investigating the sensation of touch by means of hairs of varying degrees of stiffness, while giving information as to the spots in a given area sensitive to this form of stimulation, is unsatisfactory, since it is difficult to estimate the actual degree of force applied. F. Allen and A. Hollenberg (*Quart. J. Exp. Physiol.*, 1924, vol. 14, p. 351) have applied a method used in investigations on visual and auditory sensations, to the elucidation of further facts relating to the tactile sensation. A blast of air at a known pressure is interrupted by means of a rotating disc with openings in it and the resulting puffs directed upon the area in which the sense of touch is to be examined, *e.g.* the palmar surface of the tip of the forefinger. Just as in the case of light, the puffs of air will be fused into a single sensation at a certain rate, which may be described as the critical frequency of percussion. Experiment has shown that there are *two* fusion points at any given pressure of the air pulsations up to a pressure of about 5·0 cm. of mercury, at which these two points coincide. It is possible that they represent the superficial and deep tactile sensations respectively. The duration of the stimulation at the critical frequency was found to be related to the pressure by the formula $D = -K \log P + C$, where D is the duration of the stimulus, P the pressure, and K and C constants. The minus sign shows that the critical frequency has a higher value, that is, the duration of the stimulus becomes shorter as the pressure rises.

It is of great interest to note that similar expressions relate the duration and intensity of stimulation in the case of both light and sound, when interrupted stimuli are used. The constants are different for the