

PERSONALITY AND VISUAL PERCEPTION: A REVIEW.

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It has become increasingly apparent in recent years that perception may afford a valuable approach to the study of personality. In this growing awareness several converging trends may be distinguished, which have their origin in different branches of study.

In the first place, those psychophysicists, physicists and physiologists, of Fechnerian persuasion, who have done so much to advance our knowledge of the general principles that govern perception, have been forced to admit the influence of autistic and motivational factors, even at the level of "pure" sensory research. Associated with this admission has been the development of differential psychology in which, instead of dismissing individual differences as being due to experimental errors of measurement, attention was focused on these differentiating qualities *per se*. In this country and in America, as shown by the work of Galton (99) and Cattell (42), individual differences were first regarded as a means for measuring intellectual abilities, but later in both countries, and particularly on the Continent, it was realized that they might prove more effective as measures of temperamental characteristics. By studying the interrelations among different modes of perceptual response, continental writers such as Jaensch (139) and Kretschmer (167), to name but two, have attempted to develop empirical typologies.

Yet another influence may be discerned in the recent tendency for psychoanalytic theory to become more "ego-oriented," and this movement, described as one from "depth" to "surface" (95), has been accompanied in some quarters by the belief that psychoanalytic concepts, such as the various defence mechanisms, may be submitted to experimental test by deducing their consequences in the perceptual system. Finally, although few seem to be aware of this influence, ophthalmologists (8, 55, 66, 273) are paying greater attention to the effect of personality and functional disorders on the visual system; this development is, of course, associated with the establishment of psychosomatic medicine as a branch of medical science.

In the belief that a survey of existing knowledge in this new field of perception-personality relationships would be of some value to research workers, the present paper has been written. While no claim to comprehensiveness is made, it is felt that the review is broad enough in scope to serve as an introduction to the subject.

As this review has been undertaken from within the framework provided by Eysenck's (80) researches on personality, it is necessary at the outset to indicate briefly the sort of theoretical model which underlies his work. Personality is defined (following Warren (302) and MacKinnon (204)) as "the integrated totality of character, temperament, intellect and physique. In this definition character is conceived as the more or less enduring and consistent pattern of a person's conation; temperament as his more or less enduring and consistent pattern of affection; intelligence as his more or less enduring and consistent pattern of cognition" (82, p. 199). As a result of a number of experimental and statistical studies Eysenck (79) has produced a geometrical model in which the three psychological terms in this definition, character, temperament, and intellect, denote three more or less orthogonal axes of personality. The conative factor contrasts the well-adjusted individual on the one hand with the maladjusted individual on the other, the affective factor contrasts the introvert with the extravert, while the cognitive factor is identified with general intelligence. More recently, following Eysenck's (84) test of Kretschmer's theories, it appears that a further dimension should be included on the orectic side, namely "normality-psychoticism." So far, Eysenck has failed to verify Kretschmer's dimension of cyclothymia-schizothymia, but he does not regard the issue as finally settled.

This scheme results from an approach to personality which is dimensional, frankly atomistic, and has the unusual merit that it is based on experiment. It is capable of extension and development in various directions to embrace further hypotheses of personality structure as they are verified. The picture of personality organization that emerges from each fundamental dimension is a hierarchical one (see Eysenck's diagram (80, p. 29)), the essential underlying concept being, as in other hierarchical schemes, integration, while the main higher-order concepts that Eysenck makes use of are "trait" and "type," distinguishable in terms of increasing generality.

In terms of this general scheme, the present review attempts to cover most of the literature, clinical, experimental, and theoretical, that has a fairly direct bearing on the measurement of orectic factors in personality (i.e., those non-cognitive factors usually regarded as personality factors proper).

Having defined what we shall understand by personality in this paper we turn next to the other main term, perception, and here it will be noted that the review confines itself entirely to visual perception. There are two reasons for this. First, it is chiefly the correlations between vision and personality that have received attention both in clinical and experimental studies and in theoretical discussion. Secondly, it seems likely that vision provides a more direct approach to personality organization, particularly for the clinical psychologist, than other aspects of the perceptual system, for not only is the visual apparatus the most highly specialized, but it contains all the functional components that are likely to reflect orectic factors of personality. As Gillespie puts it, "The visual apparatus presents great possibilities of symptomatic reaction to psychological stress. It is a kind of homunculus, a *multum in parvo*, since it contains within itself all the varieties of functional components upon which emotional events can be reflected. All the fundamental lessons of 'psychosomatic medicine' . . . can be applied to or deduced from functional disorders of the visual apparatus.

"The functions of this apparatus comprise *sensation, voluntary movement, and involuntary movement* of unstriated muscle. We can therefore expect to find psychogenic disorders of sensation in the form of any degree of diminution of visual acuity up to complete blindness, based . . . on the psychological fact that the patient does not wish to see; or we can find inadequacy of muscular adjustment and co-ordination because the patient does not wish to look" (102, p. 41).

In restricting the review to visual behaviour the author has, at the same time, extended it beyond what some readers would regard as the legitimate province of perception, by including both sensory and motor factors. This is of no moment, for the classifications which suit the purposes of workers in separate departments will almost certainly conflict with the classifications that will eventually be arrived at by students of personality. It is, for instance, likely that much of what is now regarded as visual behaviour by sensory psychologists will eventually be subsumed under the concept of "autonomic balance" by personality science.

No attempt will be made to divide the field into many divisions and subdivisions, but the review will be presented in four main parts. The first deals with different

visual and motor functions or abilities that appear to be of value for personality study; the second part deals with perceptual attitudes (i.e., higher-order concepts, presumably organized at the trait level (see 80, p. 29)); while the third part of the review concerns recent theoretical developments. Finally, a number of general conclusions are drawn.

I. PERCEPTUAL FUNCTIONS.

(a) *Dark vision*.—Aspects of visual functioning that appear to be most promising for personality study are night visual capacity and dark adaptation for, in addition to the objective stimulus conditions (318), organic (66) and other factors with which these abilities are connected, a number of writers have noted the importance of personality factors of an orectic nature. Thus, Smith (269), Derby (59), Duke-Elder (66), Livingston and Bolton (182), Wittkower *et al.* (316), Campbell and Cross (41), Davenport (55), Ironside and Batchelor (136) and Stephenson and Cameron (271) have all distinguished a neurotic type of night-blindness.

One of the first systematic studies of the relation between dark adaptation and neuroticism was that of Wittkower *et al.* (316), who examined 52 unselected soldiers complaining of night-blindness. It was found that 42 of these subjects suffered from various types of psychological disorder, and a disturbance in dark adaptation, as determined by the Nagel adaptometer, was found in 15 cases out of 40; on the other hand, in a control group of 33 only two subjects showed defective dark vision. No evidence of vitamin A deficiency was found, and the authors concluded that "most cases of night blindness seen in . . . Britain . . . are probably of psychological origin."

A more extensive investigation of the relationship between defective dark vision and neuroticism was undertaken by Livingston and Bolton (182), using the Livingston Hexagon test. In this test, 32 separate elements, including letters and simple objects in the proportion of six to two, are presented to the subject for identification after 30 minutes' dark adaptation. The subject records his responses upon a writing board holding Braille type paper for guidance. Four tests were given at different levels of illumination (ranging from 0.00015 eq. foot candles to 0.0012 eq. foot candles), with one minute allowed in each case for recording responses. A fifth test was given to detect malingerers or individuals suffering from hysterical amblyopia. This test consists of three large capital letters exposed against a background the illumination of which enables them to be read easily except by patients with advanced pathological conditions.

Of the 50 patients who were examined, 30 suffered from anxiety states, 15 from depressions with allied anxiety state in five, two were hysterics, one was an epileptic, one was obsessional, and there was one case of psychopathic migraine. A control group of 50 normals was selected at random from the score cards of 40,000 R.A.F. personnel who had taken the test. It was found that the average score for the neurotic group was 9.6 as compared with 19 for the control group, the maximum score being 32 and the minimum 0. Of the 30 patients with anxiety states, 10 who had previously complained of night-blindness obtained scores of 4, while the remaining 20 produced an average score of 8; the 15 depressives averaged 13 marks, the two hysterics scored zero, the obsessional scored 26, the epileptic 14, and the patient suffering from psychopathic migraine obtained 8 marks.

Rees (237) gave the Livingston test to a group of 96 neurotic male patients, including 36 anxiety states, 33 depressives, and 27 hysterics. Results obtained from this group were compared with the results of 6,062 R.A.F. personnel who had taken the same test. It was found that the average score of the neurotic group was 7.1, while the average score of the normal group was 19.3 on a scale ranging from 0 to 32; the average of the neurotic group was more than three standard deviations below the average of the normal group. Turning next to the three neurotic groups themselves, the anxiety states had an average score of 4.8, the depressives of 7.9, and the hysterics of 8.7; whereas 81 per cent. of the anxiety states scored below average, only 67 per cent. of the depressives and 63 per cent. of the hysterics were below average, while for the neurotic group as a whole 72 per cent. were below average. It appears from these results that anxiety states are particularly prone to defective night vision. The correlation between scores on the Hexagon test and age, for the total neurotic group, was $-.394$, thus confirming the findings of Harman (119), Rycroft (247), and Lister and Bishop (180). The only significant difference in age between the three neurotic groups was that between the depressives and hysterics,

the former group being somewhat older than the latter. The correlation between night vision and intelligence, as measured by Progressive Matrices (1938), was $-.107$. A further interesting result from this investigation was that the Hexagon test differentiated not only between neurotics and normals, but also between the more seriously ill and the less seriously ill.

In a comparative study of four screening tests for neurotics in which a body-sway test of suggestibility, the Ranking Rorschach, the Maudsley Medical Questionnaire, and the Hexagon night vision test were used, Eysenck (80) has shown that the dark vision test was most discriminative as determined by Eysenck's Index of Screening Efficiency (80, p. 252), and also by the Selection Index proposed by Hunt *et al.* (133).

Himmelweit *et al.* (122) gave 13 tests, including a test of dark vision, to a group of 105 male service patients in an investigation of neuroticism by means of factor analysis. These patients were all returned prisoners of war who had been referred for psychiatric treatment. A control group was provided by 93 surgical cases (also returned prisoners of war), who were matched with regard to age and educational background with the experimental group. The apparatus used for the Dark Vision test was the U.S. Radium Plaque Adaptometer, and the conditions of testing were similar to those adopted in administering the Livingston Hexagon test. Following 30 minutes' dark adaptation, detailed instructions were given to the subject in a 10-minute period spent in the dark room. The subject was required to give the direction (right, left, up or down) of the letter T which appeared on a uniformly illuminated background. The position of the letter was changed 20 times in a pre-arranged random order, and one point was allotted for each position correctly described. A fixation point was provided by a faintly illuminated red cross just above the disc on which the T was shown, so that the retinal image of the letter fell outside the fovea. Intercorrelations were calculated between 17 scores from the various tests in the battery and the resulting matrix was factorized to give two factors, the first of which was identified as neuroticism while the second appeared to be a factor of introversion-extraversion. Each test score was also correlated with the psychiatric diagnosis, which served as an external criterion. It was found that the dark vision test correlated to the extent of $.25$ with the first factor, $.28$ with the second factor, and $.27$ with the psychiatric diagnosis.

In an investigation of the dark vision of normal and neurotic army personnel, Gravely (109) departed from the usual procedure of measuring sensitivity after 30 minutes' dark adaptation by taking threshold measurements during the first ten minutes in the dark, following the suggestion of Wittkower *et al.* (316) that different levels of adaptation might be used as criteria of night visual capacity. The apparatus used for the experiment was an Admiralty Research Laboratory Adaptometer, Mark 1a, which covers a wide range of illumination from 3.961×10^{-7} eq. foot candles to 7.847×10^{-3} eq. foot candles by means of a specially calibrated lamp used in conjunction with three filters and 16 graded apertures. The subject is required to determine the position of a sector which can be rotated into eight different positions against a circular viewing screen, the brightness of which can be varied. In the test procedure adopted by Gravely the brightness of the screen was first set at 10.37×10^{-4} eq. foot candles so that all subjects could give a correct answer. The illumination was then decreased by two apertures, the sector rotated to a new position, and the subject's second response recorded. This procedure was continued until the subject took 30 seconds or longer to respond, or until he was making frequent errors; the illumination was then decreased by single apertures. Readings were taken in terms of filter and aperture after 3, 6 and 10 minutes in the dark. No fixation point was provided, but the subject was encouraged to use peripheral vision when he experienced difficulty in locating the position of the sector.

The test was given to an experimental group of 62 neurotics, including 31 anxiety states and 31 hysterics, and to a control group of 94 normal subjects. Significant differences were found between the scores of neurotics and normals at three minutes, six minutes, and ten minutes but, contrary to previous findings, no significant differences were found between the anxiety states and hysterics. A particularly interesting result was that the significance of the difference between the mean scores for the controls and the neurotics increased with the length of time in the dark.

In view of the results reported in this section, it appears that dark vision may

provide a fairly effective means of assessing both conative and affective factors in personality. Complete agreement between the findings of different investigators cannot be expected at this stage, owing to the use of different types of adaptometer, experimental procedures, populations, and so on, but the agreement is sufficiently striking to provide a basis for further investigation.

One of the most urgent requirements in this field is for some hypothesis concerning underlying mechanisms. Such a hypothesis might be based, following the work of Kekcheyev (153) and Babskii (7), on autonomic influence. This would tie in well with the writer's suggestion, put forward elsewhere in this paper (p. 21), that accommodative factors probably play an important part in determining responses to some of the usual adaptometer tests.

A second important requirement is that workers in this field should pay more attention to the control of objective factors which are known to influence dark adaptation, such as the immediate past history of the subject's retina before taking the test, the retinal region which is to be tested, and so on. Consideration of such factors and their systematic manipulation in accordance with an explicitly stated hypothesis should result in a clearer definition of the visual characteristics in terms of which personality differences are revealed.

Linked with this problem is the further question of the choice of apparatus from among the many different types of adaptometer that are available. As Michaelson (212) has pointed out, while some adaptometers measure only the subject's "minimum form sense," others measure, in addition, his "minimum light sense." Here again choice should preferably be made in accordance with a definite hypothesis.

It would also be desirable to explore other aspects of scotopic vision in addition to those investigated by means of the various adaptometers. For instance, it would be worth while, following the practice of Livingston (181), to apply a perimetric test, especially as he reports a circular field contraction which may have some diagnostic value in hysteria. Some of the differences between day and night vision that Wright (318) has mentioned could also be investigated in relation to personality differences. Thus, the sensitivity of the eye to brightness contrast is drastically reduced in scotopic vision; the visual acuity or resolving power of the eye is diminished; there is considerable deterioration of stereoscopic acuity and loss of space perception, a reduced discrimination between textures, and an impaired judgment of movement.

(b) *Colour vision*.—Several studies have been undertaken in which the incidence of defective colour vision in various psychiatric groups has been compared with that of the normal population. The first investigation in this field was carried out by Hrdlicka (128), who found the prevalence of colour defect in a large group of psychotics was no greater than in the population at large. Dunlap (67), in a small-scale study, gave the Ishihara and a revised version of the Nela test to 12 mal-adjusted individuals (mainly neurotics) and found defective colour vision in 11 cases. Millard and Shakow (213) administered the Ishihara test to 839 psychotic patients, but found no significant deviation in the incidence of colour blindness from that of a normal population. Kaplan and Lynch (147) used the Ishihara test in conjunction with a few Stilling type (pseudo-isochromatic, American Optical Company) charts in order to estimate the presence and degree of colour defect in a group of 403 adult psychotics (including 371 schizophrenics and 32 manic-depressive patients); results showed a greater incidence of defective colour vision in the psychotic group than in the normal adult population. The results of this study have recently been criticized by Hardy, Rand, and Rittler (117, 118) as being based on faulty testing charts, ignorance of random errors made by psychotics, and inadequate criteria of colour defect. In their own investigation, in which the Ishihara and American Optical Company charts were administered under well-controlled conditions to 123 male and 112 female psychotics, results showed no significant deviations from the normal population.

Finally, brief reference may be made to Jaensch's work on differences in the colour discrimination of his integrate and disintegrate types. Results obtained in a colour-matching experiment (138) suggest that integrated individuals tend to show greater discrimination for colours of long wavelength than disintegrates.

Before making any final pronouncement as to the incidence of defective colour vision in various psychiatric groups, it would be advisable to undertake more extensive studies on the different neurotic and psychotic sub-categories, for the data so far relate only to the conative dimensions of personality. In view of the

claim often made in the literature that colour is in some way associated with affectivity, it may be possible to set up specific hypotheses concerning the particular aspects of colour vision that are assumed to have diagnostic value. Certainly the field should be explored in greater detail if only to attempt some explanation of the apparently contradictory findings that have already been obtained.

(c) *Visual acuity*.—In the introduction to his *Factorial Study of Perception*, in which he attempts to isolate fundamental factors of personality by means of a battery of perceptual tests, Thurstone makes the following remark about tests of visual acuity: "We have avoided those measurements that seemed likely to be restricted in significance, such as visual acuity, and we have preferred those which might reflect some parameter of more central significance or association" (281, p. 2). This rejection of acuity measurements does not seem justified in view of available facts in this field. In the first place, central factors or parameters that Thurstone would measure are known to operate in visual acuity (66), and secondly, a number of studies suggest that some of these factors may be of the non-cognitive kind in which Thurstone is particularly interested. Some of these studies will be briefly reviewed.

Michaelson (211) has found that defective visual acuity tends to be a common functional symptom, which may vary from almost complete amaurosis of one or both eyes to a reduced acuity of between $\frac{1}{4}$ and $\frac{1}{8}$. Two types of test are mentioned as being of value in the detection of this functional defect. The first depends upon the fact that the visual fields for white targets of different sizes have a definite relationship to each other and also to fields for coloured targets. In functional cases this normal relationship is upset. The second test depends on the correlation which exists between visual acuity, as determined by the number of lines that can be read on a Snellen chart, and the distance of the chart from the subject's eyes. In Michaelson's procedure acuity is taken at six to eight different distances from the chart, starting at the furthest one, and varying the order in which acuity is taken at the different distances. A graph is then plotted with distance as abscissa and Snellen acuity as ordinate. In normal cases this relationship is found to be linear, whereas in functional cases there appears to be a significant departure from linearity.

In a well-controlled experimental study E. and P. Slater (267) have shown that neurotics tend to be inferior in respect of visual acuity to a group of normal controls of the same age, intelligence and status, while amblyopia with an hysterical basis has been reported by Halpern (115) and Yasuna (319). This type of amblyopia tends to be bilateral and often associated with other symptoms complained of by neurotics, such as photophobia, blurred vision, spots before the eyes, etc. Extreme forms of visual inhibition resulting in an almost complete loss of form vision have been reported by Redslob and Brini (235), Pinho (225), Bailliart (9), Mahoney and Linhart (206), Halpern (115), Yasuna (319), Traquair (284), Berger (20) and others. That suppression or inhibition amounting to an almost complete loss of acuity is dependent on some sort of functional disturbance in the nervous system is indicated by the experiments of Janet (141, 142), McDougall (202) and Lundholm (197, 198), who had some success in producing partial amaurosis by means of hypnotic suggestion.

These studies may be considered in relation to the work of Vogt (291), and Wald and Burian (297), which seems to indicate that the site of the suppressor mechanism operating in the types of visual inhibition that have been discussed is at the cortical level. In amblyopic vision it appears that a functional separation is effected between the more primitive light sense and the more lately evolved form sense. The whole concept of "visual inhibition" and all that it implies would seem to be a fertile one for further development in relation to personality study.

(d) *Visual fields*.—One of the first writers to realize the possible significance of visual field characteristics for personality study was Charcot (43), who drew attention to the contraction of the visual fields in hysteria: this particular symptom he regarded as one of the essential "stigmata" of that condition. Later writers, in particular Babinski (6), failed to confirm this view when non-suggestive methods of perimetry were used. However, many other writers have provided evidence which suggests that a significant relationship may exist between hysteria and field contraction. Thus, Eszenyi (73), in an investigation of 200 hysterics, found only three with normal visual fields, the most frequently occurring deviation being concentric contraction resulting in a tubular field. In this respect Eszenyi's results

tend to support earlier findings by Charcot (43) and Bleuler (27). Several writers, including those already mentioned, and Yasuna (319) and Eames (69), have noted sharp edges in the typical field of hysterics, together with circular limits; apparently the size of the test object has little influence in the limiting isopter. The particular characteristic of the field limits in functional cases which seems to differentiate them from organic cases of constriction is that they are cylindrical or tubular rather than cone-shaped; this feature is regarded by such writers as Parinaud (222) and Wilbrand and Saenger (313) as analogous to certain cases of anaesthesia, and may be compared with a phenomenon described by Duke-Elder (66) as "visual extinction," or relative hemianopia. Other writers who have linked the phenomenon of tubular fields with hysteria are Ford (91), May (209), Tassman (278), and Halpern (115).

An interesting finding is that even though the fields may be extremely contracted, central vision may in many cases be good; on the other hand, Traquair (284) reports that in some cases any degree of amblyopia may be present. In regard to the extent of the contraction, this is usually considerable, and may in extreme cases produce a field of only 10° to 30° .

Another significant feature of the visual fields in hysteria is an inversion of the normal colour fields; this was found in 66 out of 200 hysterics studied by Eszenyi (73). The typical characteristic appears to be an inversion of the fields for red and blue (231), while contraction of the colour fields culminating in colour amblyopia tends to occur in the order: purple, green, blue, and red (73, 222); this order appears to differentiate functional from organic cases, where the red field is affected first instead of last.

Turning next to field characteristics in anxiety states and neurasthenia, these are, according to Traquair (284), characterized by exhaustion and general instability. At the outset of the perimetric examination the field appears slightly contracted and, as the test proceeds, it tends to shrink further. If the examination is started once again with a larger test-object the field may be somewhat wider to begin with, but soon contracts again (284), so that, if the test object is moved radially and centripetally along successive meridians, until a constant reading is obtained for each meridian, a spiral field is produced with an inward or contracting spiral, ending in a small central field.

A star-like figure may be produced if first the two opposite ends of the vertical and horizontal meridians are tested, and then the two ends of the 45° and 135° meridians, the eight resulting points being joined. Traquair (284) reports that a characteristic finding is that when one field has been tested to the limit of reduction, the field of the other eye will be found to be already contracted.

Linked with these phenomena are a further group which have been termed by perimetrists, "exhaustion" and "oscillating" fields; the latter are characterized by the successive disappearance and reappearance of the test-object along different meridians. An extreme form of this phenomenon is known as multiple concentric ring scotomata; Traquair compares this to a "stammering of perception," and he notes that it always occurs near the periphery of the field and never in the centre.

Fuchs (97, 98), Hurst and Symns (134) and von Reuss (238) claim to have demonstrated spiral fields of a contrary type, i.e., expanding rather than contracting; the last-mentioned writer found white test-objects were more effective in eliciting such spirals than were coloured objects. These data, taken in conjunction with the fact, noted earlier, that testing one field causes contraction of the field of the other eye, suggest that these phenomena have a central rather than a retinal origin, which may point to their dependence on personality characteristics of a fairly fundamental type.

Also relevant to this section is a small-scale study by Baird (10), in which he found a diminution in the colour zones of neurasthenic patients, as compared with normal controls, and Reeder's (236) more recent investigation in which changes were found both in the extent and form of colour fields in subjects suffering from psychogenic disorders.

It appears from this review that perimetric tests, which have long been recognized as having diagnostic value in neurology, may also prove to be of value in the diagnosis of functional disorders and in personality study, but owing to the absence of any systematic experimental studies in this field no definite conclusions can as yet be drawn.

(e) *Flicker-fusion*.—Critical flicker frequency (c.f.f.) is dependent on a number

of stimulus conditions, organic factors, age, and many other variables, but several studies suggest that it may also be of some value in personality study. One of the first authors to use c.f.f. for this purpose was Wiersma (312), who studied the c.f.f.s of nine normal subjects, 11 manic-depressives, and 18 melancholic patients, by means of a rotating red/green colour disc. Results showed that the average value of the c.f.f. (measured in revolutions per second) was 15.7 for the normals, 27.2 for the manic-depressives, and 12.2 for the melancholics. It was also found that the manic-depressive patients tended to have high thresholds when in the manic state, low thresholds in the depressive state, and intermediate thresholds after they had made a satisfactory recovery. The author interpreted his results in terms of the concept of *perseveration*, claiming that they were consistent with the varying degrees of ideational perseveration in the three groups studied. The experiment was repeated by Wynn Jones (145, 146), who found no significant differences between his normal, manic, and melancholic groups: the discrepancy between his own results and those of Wiersma he explained as being due to differences in psychiatric criteria. Further studies of c.f.f. as a measure of perseveration have been undertaken by Biesheuvel (23), who used an improved method of determining the threshold value, and by Lankes (171) and Shen (261), who found some positive correlation between flicker-fusion and other tests of perseveration.

Several investigations have been reported in which the c.f.f. has been used as a measure of temperament. Thus, Washburn *et al.* (303) found that extraverts tended to have a lower threshold than introverts, while Janzen (143) was able to differentiate between Jaensch's types on the basis of their threshold variability. He found that Jaensch's J_3 -type gave the most constant threshold values, the J_1S_1 -type was the most variable, and the J_2 -type assumed a median position.

Krugman (168), in one of the most systematic studies yet reported, attempted to differentiate between a group of 50 normal subjects and 50 anxiety states by means of their c.f.f.s. The apparatus used for his experiment was a General Radio Company "Strobotac," with a variable oscillating light covering a range of 600–14,500 c.p.m. After a period of light-adaptation to a standard source the subject viewed a 5° test-patch binocularly. For half the subjects in each group the average c.f.f. was determined, starting from a frequency of 3,700 flashes per minute and gradually diminishing the frequency until flicker was reported, while for the other half an initial frequency of 2,000 per minute was gradually increased until fusion was reported. Krugman found that the anxiety neurotics had a considerably higher threshold than the normals: the biserial correlation between flicker threshold and psychiatric diagnosis was .45, when thresholds were measured from flicker to fusion, and .62 when they were measured from fusion to flicker.

Ricciuti (239) has examined the c.f.f.s in schizophrenics, manics, depressives, neurotics and normals in an attempt first to differentiate between the various groups, and secondly to test Wiersma's hypothesis (312) that manics show the greatest while depressives show the least perseveration, as measured by c.f.f. His subjects included 42 neurotics, 46 schizophrenics, 15 manics, 13 depressives and 54 normals. The c.f.f. was determined by means of an electronic flicker apparatus, and monocular viewing was employed. Of the differences in mean c.f.f. between the various groups studied, only that between the normals and the manics reached significance at the 5 per cent. level, although the normals had a somewhat higher c.f.f. than each of the abnormal groups.

Gravely (109) has investigated the flicker threshold in 100 normal subjects, 28 anxiety states, and 28 hysterics, using a Dawe Strobeflash (Type 1200c), with a frequency range of 600–14,500 flashes per minute (i.e., the same range as in Krugman's experiment). The test patch was viewed binocularly in a dark room, after a period of ten minutes' dark adaptation, and thresholds were taken in ascending and descending series, from an initial setting of 2,000 flashes per minute; the score was the average of five ascending and five descending trials. None of the differences between the groups was significant, but the normal subjects had a higher average threshold than the neurotics, and the hysterics had a higher threshold than the anxiety states.

The results reported in this section present rather a confused picture. Thus, Krugman (168) found a considerable difference between the c.f.f.s of anxiety states and normals, but Gravely (109) and Ricciuti (239) failed to find any marked difference; Wynn Jones (145, 146) and Ricciuti (239) failed to confirm Wiersma's findings on normals, manics and melancholics. These discrepancies may not be

fundamental, owing to differences in experimental procedure between the various investigations. For instance, Krugman took threshold measurements after a period of light-adaptation, whereas Gravely's readings were taken after a period of dark adaptation; both Krugman and Gravely used binocular stimulation, while Ricciuti used monocular stimulation. These, and other differences in technique, make comparison difficult.

(f) *Autokinetic movement*.—The autokinetic phenomenon is a form of apparent movement which occurs when a small light source is fixated by an observer in an otherwise completely dark field. First reported by von Humboldt (131) in 1790, and later referred to as Charpentier's illusion (45), it was given its present name by Aubert. A concise history of the autokinetic effect as a scientific problem has been given by Adams (1) and Hovland (127). Several theories have been offered in explanation of the phenomenon, based on eye-movements (126, 266), the so-called "streaming phenomenon" (89, 111), and central factors (51), but none is entirely satisfactory.

The pattern of movement appears to be influenced by a number of factors, both objective and subjective. Thus, it is diminished by increasing the size (148, 181) or brightness (181) of the light source, or by introducing accessory lights into the visual field (181); it is influenced by the background (181) and varies with the area of the retina which is stimulated; it is also influenced by the subject's mental set (114) and by social factors (262). Sherif (262) has made use of this fact in his well-known experiments on the development of social norms, recently extended by Schonbar (256) and Bovard (30). These studies are cited by Eysenck (82) as bearing a close relationship to researches on suggestibility.

Voth (294) has shown, in a study of the autokinetic reactions of 600 subjects, that there are marked individual differences both in the amount and direction of movement, which makes the phenomenon of particular interest in personality study. His experimental procedure was to ask the subject to record on a rectangular graphboard the movement perceived while viewing a small light source (1 mm. in diameter) at a distance of 10–12 feet, for a test period of ten minutes in a dark room. If the light stopped moving the subject was asked to make a heavy dot on the paper and to continue from that point when movement started again; if the subject found he had reached the edge of the board, he was instructed to return to the (estimated) centre.

Voth computed an autokinetic index for each subject by combining four measures in an empirical formula; these were: total length of path, maximum distance attained from the centre, maximum expanse of the graph, and number of stops. Reliability on re-test proved to be as high as .96 for individual subjects.

In another investigation (295) the same author found autokinetic patterns characteristic of normal subjects and various psychiatric groups. Whereas movement was pronounced in schizophrenics, psychasthenics, neurasthenics, and anxiety states, it was either absent altogether or greatly reduced in manic-depressive and involuntional psychotics and in cases of conversion hysteria. Age differences appeared to exert no significant influence on the effect within the different groups studied, but there was a significant sex difference, men being on the average more susceptible to movement than women.

Sexton (258) undertook a similar investigation of 500 subjects, but using a somewhat different scoring technique. Instead of computing an autokinetic index as Voth had done, Sexton simply classified his subjects' graphs in terms of the amount of movement recorded on a circular graph-board of 60 cm. diameter. Each graph was divided into four sections by drawing concentric circles at radial distances of 5 cm., 10 cm., 20 cm. and 30 cm. from the centre of the graph, thus giving five scoring categories: no movement, a small amount of movement, a moderate amount, a large amount, and a maximum amount. On the basis of his results Sexton claims that the test provides an objective measure of introversion-extraversion, the amount of recorded movement bearing a direct relation to the degree of withdrawal from reality. Thus, patients of a schizoid type recorded more movement than the more extraverted individuals and, within the schizophrenic group itself, paranoids reported least movement, hebephrenics somewhat more, while catatonics reported maximum movement. Sexton corroborated Voth's findings concerning the high reliability of the test.

In an attempt to differentiate between groups of normal and neurotic subjects and, within the neurotic group itself, between anxiety states and hysterics, Gravely

(109) obtained autokinetic records from 146 army personnel. The light source for her test was 1 mm. in diameter, placed three feet above the subject's eye level, at a horizontal distance of seven feet from the subject. Measures were taken of autokinetic reaction time (i.e., the time taken for the subject spontaneously to report movement) and the amount of movement recorded during a period of three minutes, together with a measure of the influence of set or suggestion on the direction of movement. Records of movement were made on a square graph-board, in the centre of which was placed a luminous drawing-pin, so that the subject could find the centre of the graph without resorting to guessing, as in the researches of Voth (294, 295) and Sexton (258). No significant differences in autokinetic reactions were found either between neurotics and normals or between anxiety states and hysterics.

From the few researches that have been concerned with individual differences in autokinetic movement, it may be concluded that the phenomenon appears to be of some value in personality study. However, before the autokinetic affect can be made the basis of a satisfactory test of temperament it will be necessary to account for the apparent discrepancy between the results of Voth (295) and Sexton (258) on the one hand and of Gravely (109) on the other. It may be that the different results are due to differences in the experimental procedure (e.g., length of time for recording movement), or to different external criteria in the selection of subjects. It will also be advisable to experiment with different scoring measures. For instance, if the graphic method of recording movement is used, it might be worth while to devise some means of determining the scale adopted by the subject in representing the movement he perceives: as Thurstone (281) has pointed out, two subjects could perceive the same amount of movement and yet employ different subjective scales to record it.

It might even be desirable to eliminate the graphic method of recording altogether and, instead, to measure a person's susceptibility to autokinesis by manipulating some of the objective factors which are known to influence the effect. For instance, as the amount of movement is reduced to a minimum until it eventually disappears, by increasing the size or brightness of the light source, or by introducing accessory lights into the visual field (181), it should be possible to measure individual susceptibility to the effect by determining (a) the level of brightness at which movement ceases, (b) the size of light source which just fails to produce movement, and (c) the number of accessory lights which must be introduced before the subject no longer reports movement.

(g) *Pupillary reactions.*—The diagnostic value of pupillary reactions has long been recognized in ophthalmology and neurology and, in view of their sensitivity as an index of bodily disorder, there is some justification for regarding the pupils (following the great physiologist Schiff) as the finest aesthesiometer in the body. It would not be surprising, in view of the multiple connections of the pupillary pathways, if they were also found to be of considerable value for the study of personality and its functional disorders. Indeed, the largeness of the area which the pathways traverse, and their interconnection with many upper and lower parts of the brain, has led Behr (15) to contend that there is scarcely any nervous function which has no effect, direct or indirect, on pupillary behaviour.

Pre-eminent in this field is the work of Lowenstein (185-192), who is responsible for the development of the technique of pupillography, in which cinematographic records are taken, using a non-stimulating infra-red light. This technique allows, for all practical purposes, a condition of physiological darkness, so that pupillary behaviour may be observed both in darkness and in light. By this means it is possible to analyse both contraction and dilation of the pupil into definite stages, and to differentiate the parasympathetic and sympathetic components in the records.

As a result of this technique, Lowenstein and Levine (194) have succeeded in analysing pupillary reactions to light into four groups. The first type is characterized by rapid contraction, and rapid dilation; the second, and most common type, involves a prompt contraction and a sluggish dilation; the third type is characterized by a sluggish contraction and a prompt dilation, while the fourth type consists of a sluggish contraction and a sluggish dilation. These four types represent, according to the authors, four kinds of equilibrium between the parasympathetic and sympathetic. The reactions are apparently constitutionally conditioned. Of particular interest to this paper is the significant relationship which appears to exist between the first type of reaction and manic-depressive psychosis and between

the type 4 reaction and schizophrenia. In an earlier paper Lowenstein and Westphal (195) found the type 4 reaction to light was, in schizophrenics, often transformed into a fifth type, with a relatively long latency period, marked sluggishness, mild contraction, and a very sluggish re-dilation. In catatonics yet another type of reaction was found; this was characterized by a long latency period, a rapid reaction to light, and a long latency period for the re-dilation, followed by a full dilation. Lowenstein considers that a special type of permanently heightened tonus is responsible for these reactions, which he terms "tonohaptic." Such reactions also tend to occur in patients suffering from obsessions and phobias (189, 190).

Lowenstein and Friedman (193) mention another unusual pupillary reaction to light, known as the "cog-wheel pupil," where contraction, but more frequently re-dilation, occurs in a series of steps instead of in a single sweeping movement; this tends to be associated with hysteria and, like the other reactions already mentioned, appears to be constitutionally conditioned.

Turning next to the conditions known as mydriasis and miosis, in which the pupillary diameter shows static deviations from the average values of between about 2.5 mm. and 4 mm. (66), these also appear to have some connection with personality factors. Thus DeJong (57) claims that, "In the so-called vagotonic individuals with cold skin, bradycardia, and low blood-pressure, the pupils are contracted owing to overaction of the parasympathetic nervous system," while "in the sympathicotonic individual with warm skin, rapid pulse, and hypertension, there is mydriasis" (57, p. 161). (DeJong places anxiety states and some schizophrenics in this second group.)

Westphal (309, 310) observed a phenomenon in catatonic patients in which the pupil is usually in a condition of mid-dilation or transient mydriasis, with a variable response to light, ranging from a prompt reaction to absolute rigidity; the anomaly was also found in traumatic neurosis. The variability of the phenomenon both in regard to responses to light and in respect of size and equality led Kehr (152) to call it "spasmus mobilis." Koester (163) has observed the condition in 34 per cent. of the catatonic patients he examined over a long period; Menninger (210a) found a similar anomaly in the pupillary reaction to light in 25 per cent. of schizophrenics, and the phenomenon has since been noted by Levine and Schilder (174), who, on the basis of a series of experimental studies, advance the theory that the "catatonic pupil" is due to an imbalance of the sympathetic-parasympathetic system as a result of inhibition of the parasympathetic division.

Linked with these studies is a recent research by May (210), in which abnormalities were found in the pupillary reaction to light of a group of 343 schizophrenics as compared with 100 normal controls. The author found a connection between these disturbances and the pupillary changes that occur during muscular effort, and which are attributed to simultaneous sympathetic stimulation and parasympathetic inhibition by motor impulses having their origin in the hypothalamus. From a psychobiological viewpoint May considers that the anomalies in the pupillary reflex to light, like those resulting from pain stimuli and muscular effort, can be linked with the general hypoactivity which schizophrenics show to a variety of stimuli, and their lack of normal physical and emotional response to the environment.

A condition known as "spastic mydriasis" in which a dilated pupil is associated with marked pupillary unrest and increased pupillary reflexes has been distinguished by Behr (15) and appears to be linked with functional disorders. Thus, Hübner (130), Koester (163), Pickert (224) and Feinstein (86) have all noted its occurrence in schizophrenics.

Duke-Elder (66) notes that miosis can occur as a result of autonomic imbalance resulting from a release of the normal inhibitory activity of the sympathetic system over the constrictor centre of the hypothalamus. It can occur in schizophrenia, and may also appear in hysterics, associated with spasm of convergence.

In connection with studies of mydriasis and miosis, it is also relevant to refer to the condition known as anisocoria, in which there exists an inequality in the size of the pupils in the two eyes. DeJong (57) considers that a slight difference here may be found in neurotics and psychotics, although this would not be easy to prove in view of the very strict standards of illumination and testing conditions that are required, and the association of the phenomenon with numerous other factors.

De Jong (57) makes a further claim to the effect that a hippus pupil may indicate poorly balanced or integrated sympathetic and parasympathetic divisions of the autonomic nervous system. This periodic phenomenon is characterized by rhythmical but irregular oscillations of a deliberate temporal pattern, and of considerable excursion (2 mm. or more); it is known to occur, not only in many pathological states, but also in conditions of psychological instability (66).

A recent investigator of "autonomic imbalance," Wenger (306), included a pupillary test in a battery of tests purporting to measure an autonomic factor, but the results he obtained were most disappointing. He found very low correlations between this test and others in the battery. In view of the importance of Wenger's study in connection with the factor of neuroticism (80) and the theoretical considerations of parasympathetic and sympathetic innervation which led him to include this test in his battery it will be described in some detail, for the structure of the test may suggest a reason for the disappointing results which he obtained.

The diameter of the pupil was measured by means of a card 5 in. by 8 in. on which were drawn a pair of converging lines with the point of greatest divergence, approximately 20 mm., at the lower part of the card. Pairs of pinpoint holes were drilled at intervals along the converging lines in such a way that the centre-to-centre distance between any pair increased in steps of .5 mm.; the effective range was about 2.5 to 8.0 mm. The subject was instructed to hold the card in front of one eye with the other eye covered, and to look through different pairs of holes on the card at some object more than 30 ft. distant.

Three possible types of pattern could then be seen, depending on the subject's pupil size: (1) The images would appear to overlap; (2) the image would consist of two disparate circles of light; and (3) the circles of light would appear to be tangent. These perceptions correspond to (1) the condition where the centre-to-centre distance of a pair of holes is smaller than the subject's pupillary diameter; (2) the condition where the distance is greater than the subject's pupillary diameter; and (3) the condition where the distance between centres equals the subject's pupillary diameter.

As the surface of the card was dull black and only a relatively small amount of light could enter the pupil through the pinpoint holes, the eye in use could be regarded as being in a state of relative dark adaptation. Wenger found that variations in light in the experimental room and in the external environment appeared to have no significant effect on the results. When the subject had found the pair of holes which were just tangent the greater part of the time during fixation, the experimenter read the pupillary diameter from the opposite side of the card.

Several reasons immediately suggest themselves in explanation of Wenger's results. Firstly, the technique is a relatively crude one, in relation to the sort of subtle changes that Lowenstein's work suggests it may be necessary to detect. Secondly, although Wenger included the test of pupillary diameter on the basis of theoretical considerations concerning autonomic activity, these were of a very general type, whereas it would seem necessary to consider in more detail the particular aspects of pupillary behaviour that are likely to be most diagnostic of autonomic imbalance, on the basis of more specific hypotheses; the fairly static type of record which Wenger obtained may not be the most appropriate for his purpose, even if a more precise measuring instrument were used. Finally, it appears necessary to take into account the effect of the many factors which are known to influence mydriasis and miosis, such as sex, age, eye colour, and refractive errors (66), to mention only some of the more obvious variables. It seems likely that significant personality correlates will be found only if great care is taken in the experimental set-up, along the lines of Lowenstein's work. Certainly Wenger's results should not be regarded as closing this chapter of research which, on the basis of some of the known mechanisms of pupillary behaviour and clinical observations and experiments such as have been reviewed in this section, appears to be a profitable one for personality study.

(h) *Ocular movements.*—The mechanism of muscle balance in vision involves the co-ordination of at least twelve delicate ocular muscles, and it would not be surprising if such a highly-coordinated mechanism were readily put out of gear by general functional disturbances. In fact, the available evidence does suggest that heterophorias, anomalies in the vergence functions and other anomalies of ocular movement may in many cases have a definite psychological basis. The influence

of psychological factors is emphasized both in standard text-books of ophthalmology (66) and in manuals on orthoptics (101, 201).

This influence was shown convincingly in the second world war among air-crews undergoing orthoptic treatment for heterophoria. In a typical study of such subjects Gillespie (102) found that, out of 60 cases, 40 showed the same sort of characteristics as were found in air-crews breaking down with frank neurotic symptoms. This high percentage led the author to suggest that the reason why these individuals suffered from their ocular disability was that the latent imbalance was made manifest by their pathological emotional state: the emotional disturbance was sufficient either to cause an upset of the compensatory muscular effort made to overcome an innate heterophoria or, alternatively, caused fatigue in the muscular apparatus, resulting in a greater effort of compensation. In other words, Gillespie suggests that fatigue is intermediary between the emotional state (here anxiety) and the ocular symptoms, and this suggestion was confirmed, so Gillespie claims, by the fact that a number of his cases were of an obsessional temperament, which "... is particularly apt to favour the appearance of fatigue in its possessor."

Ironside and Batchelor (136), though not subscribing to the view that all heterophorias have a psychological basis, have also found evidence in a small experimental study of a correlation between muscle imbalance and neurotic constitution. Doggart (63) considers on the basis of his observations that heterophoria is a very common manifestation of neurosis, and goes so far as to say that "... disturbances of muscle balance are so frequently psychological in origin that many symptoms attributed to them are in reality due to the central sensory disorder—whatever its nature may be—that constitutes the psychoneurosis" (63, p. 32). This author regards the dynamic vergence-power as of greater significance than the static muscle balance, as measured by the ordinary tests of heterophoria: the depletion of duction-reserve may be one aspect of a lowered muscular tone associated with the neurosis. He cites convergence-defect as being a characteristic functional disturbance. An observation of Doggart's which may prove useful for personality measurement is that a marked discrepancy between the degree of heterophoria as measured by the Maddox rod and the Bishop Harman tests is indicative of neurotic tendencies.

In addition to deficiency in the positive fusional reserves, such as Doggart has mentioned, convergence excess, amounting in many cases to a spasm of convergence, also appears to be linked with neuroticism in certain cases. Thus Souders (270), Cords (49) and others have observed this condition in hysterics, associated with miosis and accommodative spasm. One of the mechanisms at work here may be removal of inhibition of the convergence innervation, as in the esophoria produced in normal subjects under the influence of alcohol (2, 48, 230) or under conditions of severe anoxaemia (2, 289); these facts may be of considerable importance in the experimental development of this field.

Also relevant to this section are experimental studies of eye movements in psychiatric subjects. Thus, Dodge and Diefendorf (62) examined the "angular velocity" and certain characteristics of the pursuit reaction in the ocular reactions of psychotic patients. Their technique involved the recording of eye movements on a moving photographic film with a mirror-recorder actuated by the corneal protuberance. It was found that the angular velocity for a visual angle of 25° suffered little in most of the psychotics, but was reduced for depressed patients. Greater deviations appeared in pursuit reactions: the records for depressed patients showed long sweeps which frequently passed the point to be fixated, while the schizophrenics made short, step-like movements.

Couch and Fox (50) made a similar photographic study in which they investigated the ocular pursuit of a pendulum, optic nystagmus, response to commands to look right and left, and response to peripheral stimuli in 117 patients and 16 normal controls. The records of 60 of the patients were normal apart from minor deviations due to "lapses of attention," but short, step-like interruptions of pursuit movements, considered characteristic of schizophrenics by Dodge and Diefendorf, appeared in the records of 41 patients of varying diagnosis. Eighteen of the most disordered patients (five in catatonic stupor) showed profound disturbances of ocular adjustment in both phases, with extreme variability in their records. An interesting observation was that the records of three catatonics showed their eyes moving in a direction opposite to that of the pendulum; the authors offered a

tentative interpretation in terms of the negativism supposed to characterize such patients.

White (311) studied ocular pursuit movements in 20 normals, 17 schizophrenics, 8 manic-depressives and 13 neurotic patients by means of a photographic technique. Records were taken of the eye-movements elicited by 10 oscillations of a pursuit object at each of ten velocities; this object consisted of the light from a flashlight bulb made to pass through 9° of the visual field. The author found no pattern of ocular adjustment among the patients which was not also found in the normal group. Contrary to previous findings, neither negativism nor step-like movements were found to have any diagnostic significance. Differences between the normal and psychiatric groups did appear, however, in the greater irregularity and earlier abandonment of pursuit in the latter.

Various types of nystagmus seem to have an association with emotional factors in personality. Thus, deviational nystagmus, which occurs after a latent period of 30 seconds in about 50 per cent. of normal subjects when the fixation axes are deviated beyond the limits of the binocular field and an attempt is made to keep them there, occurs occasionally in psychiatric states without the usual latency period according to Uffenorde (287) and Kestenbaum (155). Nystagmus of neurotic origin is mentioned as occurring in hysteria and in acute anxiety neurosis; this condition displays the normal features of voluntary nystagmus, but the pendular oscillations tend to be quicker (up to 1,200 a minute), and is associated with blepharospasm, convergence spasm and miosis (29, 88, 151). This rate is seen elsewhere only in miners' nystagmus, where the neurotic component also tends to be prominent in many cases (38, 39, 272). Other types of nystagmus with a functional origin have been described by Majewski (207) and Stransky (276).

A further study which indicates the relationship between eye movements and emotional factors is that of Ort (221), in which eye movements were recorded during the administration of a word-association test, containing loaded and non-loaded words, to a group of 32 subjects. It was found that loaded words were accompanied by eye reactions in about 80 per cent. of the cases, and the authors suggested that such involuntary eye movements might serve as a more sensitive indicator of emotion than any of the ordinarily-used complex indicators. Finally, mention may be made of an investigation by Lord (183), in which she found an enhancement of chronic nystagmus in a subject during a period of emotional disturbance.

(i) *Accommodation*.—It has for long been known that the mechanism of accommodation is dependent on the parasympathetic system, which causes contraction of the circular fibres of the ciliary muscle, but it has recently become more and more apparent that, while the parasympathetic may be primarily responsible for accommodation for near vision, an active accommodation for distant vision may be mediated by a contraction of the meridional fibres of the ciliary muscle, through sympathetic activity. Indeed, the present view seems to be that accommodation displays the typical antagonistic activity of parasympathetic and sympathetic divisions, which is found in other bodily systems subject to autonomic innervation. Probably the sympathetic role is inhibitory in accommodation for near, and active in accommodation for distance (66). This reciprocal innervation and mutually antagonistic activity by the two systems leads one to suppose that the mechanism of accommodation should provide valuable information concerning autonomic balance and imbalance and, via this trait, should increase our understanding of the factor of neuroticism. The available data, scanty though they are, do tend to support this view.

One of the most dramatic manifestations of the influence of personality factors in accommodation is in the ocular anomaly known as accommodative spasm. In this condition the tone of the ciliary muscle is increased, and a constant effort is required by the parasympathetic system so as to decrease the distance between the near-point and the far-point. This results in what has been termed a spurious or pseudo-myopia (175), in which the hyperope appears to become less ametropic, the normal emmetrope becomes myopic, and myopia is increased. The condition appears as an expression of excessive activity on the part of the parasympathetic nervous system, although hypoactivity in the sympathetic may also enter as a causal factor.

Two main categories of accommodative spasm may be distinguished, functional and organic, the former being of particular interest for personality study. Among the factors which determine its occurrence, the constitutional make-up of the

individual is mentioned as being of particular importance, those affected being typically of the neurotic type; this was demonstrated in the first world war when spasm of accommodation often appeared as a prominent feature of traumatic neurosis (66). Its most frequently reported personality correlate appears to be hysteria: the connection was first noted by Charcot and Galezowsky (44), and has been observed since by Borel (28), Morax (214), Plantegna (226), Shastid (259) and others, often in association with convergence spasm, myosis, contraction of the visual fields and amblyopia; this grouping may itself be of some significance as a personality syndrome or trait.

Other aspects of accommodation which appear to be of value for personality study are "insufficiency of accommodation" and "accommodative fatigue." In the former condition the accommodative power is constantly below the lower limit of what may be accepted as the normal variation for the subject's age, while the latter is characterized by the early onset of fatigue as defined and measured by the ophthalmic ergograph (18, 19); both conditions are mentioned as being related to neuroticism or other personality variables (66).

Owing to its significance as a basic ocular function, it is likely that the influence of accommodative disturbances will be shown in a number of perceptual tests used in personality study. To mention but one, the dark vision test, which is known to be a fairly good measure of neuroticism, may be affected by the inhibitory effect on accommodative activity that darkness is known to produce (149, 249).

(j) *Response time.**—One of the earliest studies of reaction time in relation to personality differences was reported by Obersteiner (217, 218), who found longer reaction times in psychotic patients than in normal persons. His results were later confirmed by Bevan-Lewis (21, 22), who also found that, among psychotics themselves, manic patients constituted the fastest group. Contrary to a generally accepted hypothesis of the day, the reaction times of manics were still appreciably longer than those of normal controls. Other early studies of a somewhat less systematic nature were carried out by Buccola (34, 35), Tschisch (285), Féré (87), Walitzky (298), Nadler (216), Toulouse and Vaschide (283), Richet (240), Raymond and Janet (233), and Pelletier (223), some of which may be of value to those who wish to experiment in this field.

Following these studies is an experiment by Franz (92), in which he measured simple and choice reaction times in a case of psychotic depression and found that his choice reactions were equal to or shorter than his simple reactions. The author considered that this anomaly might characterize depressives in general. When, however, he later undertook a similar experiment with six subjects (two manics, two depressives, and two controls), the exaggerated simple reaction times occurred in only one of the depressive patients, while the times for the manic and depressive patients were considerably longer than those of the slowest control.

Dodge and Diefendorf (62) investigated the ocular reaction times of psychotic patients to a peripheral stimulus, and found only a slight correspondence between the patient's condition and their reaction times, but the reaction times of depressives tended to be longer than those of schizophrenics and manics. Scripture (257), in an attempt to develop an objective means for diagnosing mental disorders, studied the reaction times of various clinical groups to a visual stimulus. His kymograph records yielded three measures: reaction time, variability of reaction time, and variability in "holding time," this latter depending on the way in which the subject pressed a manual response key. Several important differences were found between the groups tested: thus, hysterics tended to have extremely variable reaction times, and long "holding times" which, according to the author, exemplified their "mental inhibition," while depressive patients had considerably longer reaction times and "holding times" than any other group.

Wells and Sturgis (305) compared the choice reaction times of 12 schizophrenics with a group of normal subjects but found no evidence of any striking differences between them. The authors concluded (without justification) that their failure to find any pronounced differences indicated that the functions governing "vital adaptation" to life are dissociated from and independent of those governing the simple adaptations required in their laboratory tests. Wells and Kelly (304)

* Some of the studies referred to in this section deal with reaction-times to non-visual stimuli; it seemed advisable to include them, for they probably depend on the same factor, or closely related factors (281).

found the simple reaction times of 28 manic-depressive and schizophrenic patients were only slightly longer than for normals, thus failing to confirm the findings of earlier investigators; nor did the tendency for manics to have faster reaction times than depressives appear in the experiment. With regard to the variability of reaction times, this was greater in the manic-depressives than in the normal group, but the schizophrenics showed no deviation from the normals. Another measure, the ratio between visual and auditory reaction times, was found to be smaller for the schizophrenic group than for the manic-depressives or normals.

Lundholm (196) measured the reaction times of 12 manics, 2 schizophrenics and 2 controls twice weekly for several months, and compared the resulting distribution curves. He found that whereas the curves were "broad and loose" for the manics, they were "narrow and high" for the controls: the standard deviations of the times always increased as the patients passed into the manic state. There also appeared to be a relation between the amount of variability and the degree of the excitement. The authors concluded that variability of performance, considered as an index of the stability of attention, is the most significant symptom of disorder.

With an aim similar to that of Scripture (257), Saunders and Isaacs (250) found marked individual differences in the reaction times and variability both for normal subjects and 31 psychotic patients. Differences between the normal and psychotic groups as a whole and between the different psychotic groups themselves were barely significant. A tendency for the psychotic patients to give "anticipatory responses" was considered to have some diagnostic significance.

Huston, Shakow and Riggs (135) undertook several experiments on the reaction times of schizophrenic and normal subjects, in the first of which simple visual, auditory and visual discriminative reaction times were measured with a Cenco counter. One test was given to 25 normals and three tests were given to 38 male schizophrenic patients, and it was found that in general the patients showed slower and more variable reaction times than the normals. To account for these differences three hypotheses were put forward and tested in further experiments, in which the reaction times of 25 patients and 18 controls were measured in relation to an auditory stimulus. These experiments involved several different types of fore-period, and it was found that the schizophrenics were inferior to the normals in the height, regularity, and duration of the preparation for the reaction.

Rodnick and Shakow (244) used preparatory intervals of different lengths, with irregular warning procedures, to study differences between the set of normals and schizophrenic patients in a reaction time experiment. Results showed that the normals had significantly shorter reaction times than the patients, and shorter times with the regular than with the irregular procedures. On the other hand, the schizophrenics gave shorter reaction times with the shorter intervals in the regular procedure; at the longer intervals they gave shorter reaction times with irregular procedure. A composite reaction time index was computed which, the authors suggest, may have some practical value as a clinical device.

In an investigation of the speed and pattern of perception in schizophrenics and normal subjects, for simple letter combinations, Angyal (4) found, among other things, that the reaction times for the former group were greater than for the latter.

Other tests of response time that appear to be of promise for personality study are those involving judgments of a more complex type, such as have been used by Thurstone in his *Factorial Study of Perception* (281). In particular, Thurstone's speed of decision test, or some modification of it, seems to be of value. The original form of this test consists of a discrimination problem in which the subject is presented with pairs of circles and asked in each case to denote the larger. Some pairs of circles are of equal or nearly equal diameter, while others are of widely different diameter. The ratio of the mean response time for the easy discriminations to the mean response time for the difficult discriminations is taken as an index of the extent to which the subject tends to be retarded when asked to make a difficult judgment. Thurstone believed that this measure would be related to temperamental characteristics. In an improved form of the test no pairs of stimuli were included in which the items were exactly alike, and the use of circles as stimuli was discontinued; instead the subject was presented with pairs of squares filled with dots, and asked to judge which of the two squares contained the larger number. The squares contained from 50 to 200 dots so as to provide a wide range of difficulty. No temperamental correlates have yet been reported for the test, although research on the subject is in progress. Similar tests could be devised along the lines indicated

by Dashiell's (53), and Volkman, Hunt and McGourty's (293) researches on affective-distance as a determinant of response time in judgments of colour preference. Both studies have shown that the speed of judgment increases with the difference in affective-value between the colour stimuli. It might also be possible to make use of the relation which has been shown to exist between response time and the degree of subjective confidence with which subjects make various types of judgment (292) in the study of temperament or character.

A further result from Thurstone's *Factorial Study of Perception* (281) which is of interest to personality study is that reaction time and speed of perception appear as two different factors. Tests with the highest saturations on the first factor involved simple reaction times to light and to sound, while the tests defining the second factor were of a more complex nature: Peripheral Span (single and double), Dark Adaptation Time, Street Gestalt Completion, Social Judgment Time, etc. An incidental finding that may prove of interest in work on colour-form attitudes was that the Schmidt ratio test, a test of colour-form dominance, had a negative saturation ($- \cdot 29$) with the speed of perception factor, indicating that subjects who are form-dominant tend to have slower reaction times than those who are colour-dominant.

II. PERCEPTUAL ATTITUDES.

(a) *Colour-form attitudes*.—It has often been maintained, especially by writers on the Continent, that there are two basic attitudes in visual perception, one of which is characterized by colour-dominance and the other by form-dominance. Experimentation began comparatively early in this field with the pioneer research of Külpe (170), and was later extended to personality study by Scholl (254, 255), who suggested a connection between colour-form attitudes and Kretschmer's typology. He presented groups of similar figures in a tachistoscope to 30 subjects who were asked in each case to identify a coloured figure; identification could be either by colour or by form. When the subjects were classified as cyclothymes and schizothymes by means of a questionnaire he found a marked tendency for the former to be colour-reactive and the latter form-reactive. Scholl's results were later confirmed by Dambach (52) and Lutz (200), using similar experimental methods.

Ritter (242) investigated colour-form attitudes in children by means of Descoedres' test (60) and Scholl's sorting-box, and interpreted his results in terms of Jaensch's integrate and disintegrate types; the former tended to be colour-reactive while the latter were form-reactive. Braat (31) studied 27 schizophrenics and 10 manic-depressives by means of a tachistoscopic procedure, but failed to find any significant relationship between psychosis and colour-form reactions, as would be expected on the basis of Scholl's findings. Schmidt (252) used a very ingenious apparatus to investigate the relation between colour-form attitudes and typological diagnosis in 54 subjects. He projected coloured spots on a screen in such a way that apparent movement was seen in one of two directions, depending on the subject's spontaneous perception of either form or colour. Schmidt found agreement between typological diagnosis and colour-form attitude in 44 cases out of 54. Lüth (199) studied 156 subjects in terms of Kretschmer's typology, and found a high correlation between schizothymia and form-reaction, but a somewhat lower correlation between cyclothymia and colour-reaction. Other, small-scale studies, have been carried out by Poppinga (228), Oeser (219), Kibler (156), Enke (71, 72) and Tuompo (286), the results of which tend, in general, to confirm Scholl's hypothesis.

This hypothesis is also confirmed by Lindberg's very extensive study (177) of 424 adult psychotics, in which he found a highly significant difference between schizophrenics and manic-depressives in colour-form reactions, in the expected direction. Two tests were used in this investigation: a sorting-test, in which a set of cards could be sorted according to form or colour, and a new "Ring" test, devised by Lindberg himself. This consists of a coloured plate, divided into two parts both of which contain two figures—a circle with an arrow and a square with a smaller square inside it; the upper figures are blue in colour, while the lower ones are red. The subject is asked in what way the upper and lower figures differ. There are several differences between the two figures, such as the direction of the arrow, and the position of the circle. If the subject mentions the difference in colour in his first or second response he is regarded as having a positive attitude to colour;

if he mentions the colour difference later, or not at all, he is rated as having a negative attitude to colour.

A more recent investigation of colour-form attitude in psychotics was undertaken by Eysenck (84), who failed to find any significant differences between a group of 50 schizophrenics and 50 depressives on a colour-form sorting test; the test also failed to differentiate between the psychotic group as a whole and a control group of 100 normal subjects. There was, however, a significant difference between normals and psychotics in the time required to complete the test.

The work so far reported has been concerned primarily with measurement along the cyclothymia-schizothymia dimension, but two studies have also been made along other dimensions of personality. The first was that of Eysenck (80), who studied the colour-form reactions of 50 hysterics and 50 dysthymics, using three different tests: the "Ring" test, as previously used by Lindberg (177), a "Similarities" test, and a "Ranking" test. The "Similarities" test consisted of four cards, on each of which eight coloured shapes were arranged in a circle. The first card was for demonstration purposes, while the remaining three cards constituted the test proper. Each of these three cards contained three figures of the same colour but of different shape, and three figures of the same shape but of different colour. The three test cards differed from each other both in their choice of colours and in their choice of forms which were similar. In the demonstration card there were three figures identical in both form and colour, but in presenting this card to the subject the experimenter referred only to the similarity between the two figures, and avoided reference either to form or colour. After the demonstration the subject was presented with the three test cards in turn, and was asked to find three figures which were similar on each card.

In the "Ranking" test the subject first ranked in order of preference ten uncoloured polygons, and then ten colours. He was next presented with ten coloured polygons in which the most preferred polygon appeared in the least-liked colour, and so on, and was again asked to rank them in order of preference. This final ranking was then correlated with his ranking of the uncoloured polygons (or colours); the size and sign of the correlation coefficient indicated the strength of the influence exerted by colour or by form. Results from the three tests showed that the neurotics as a group were more colour-reactive than normals, but the hysterics and dysthymics were not differentiated with respect to their colour-form reactions.

A similar investigation was undertaken by Clarke (47), who investigated the colour-form reactions of neurotic and normal subjects by means of the Lindberg "Ring" test and the Sorting test, previously used by Eysenck in his investigation of psychotics. In administering the "Ring" test, Clarke noted certain ambiguous responses in which colour was mentioned as an indicator of differences in form (e.g., "The red ring has an arrow head a short distance from its shaft, while the blue ring has its arrow head attached to the shaft"). Finding that Lindberg's scoring procedure does not allow for such cases he introduced a third scoring category. No significant differences were found on the colour-form "Sorting" test between the groups studied, although the neurotics tended to sort more for colour than did the normals, and there was a tendency for the hysterics to be more colour-reactive than anxiety states. On the "Ring" test there was a statistically insignificant tendency for neurotics to be more colour-reactive than normals, using Lindberg's scoring categories, but hysterics were not more colour-reactive than anxiety states.

In summary, it would appear that colour-form tests may provide a means for measuring along two main dimensions of personality: first, along Kretschmer's dimension of "cyclothymia-schizothymia" and, secondly, along the normal-neurotic continuum of Eysenck (80). Several problems remain to be solved before satisfactory tests can be developed. There is first the problem of the relative generality or specificity of colour-attitude, which has been ignored by earlier writers; while assuming that colour attitude is a general trait operating in a variety of perceptual situations, little work has been done to show exactly how comprehensive this factor is. Results obtained in two investigations suggest that it may be much more specific than has been supposed. Thus, Eysenck (80) found only a small average correlation (.24) between the three tests used in his investigation, while the correlation between Clarke's tests was .152. On the other hand, Huang (129) obtained fairly high correlations between different tests of colour-form attitude, but as Eysenck (80) has pointed out, his tests were too similar to settle the issue. To

reach a decision it would be necessary to undertake a more extensive investigation ; such a study is now being carried out at the Institute of Psychiatry by Keehn, but no analysis of his data is yet available.

In the second place it would be desirable to formulate the colour-form hypothesis itself in more precise terms so that its consequences could more easily be deduced at the experimental level ; this problem of formulation is, of course, linked with the first problem of the relative generality or specificity of the hypothetical attitude. Thirdly, the possibility should be considered that colour-form attitudes may be a manifestation of a more general " analytic-synthetic " factor in perception. Indeed, two recent studies by Lindberg (178, 179) suggest that this may be so, as does Schiller's (251) finding that subjects who were " sensitive " to colour on the Rorschach gave global responses on his optical illusion tests.

In this connection the recent tendency towards a more experimental development of the Rorschach test, as seen in the work of Dubrovner, Lackum and Jost (65), Goodman (104), Lazarus (172, 173), Siipola (265), Wallen (299) and other investigators mentioned in Eysenck's (82) convenient summary of recent Rorschach research, may prove valuable for our understanding both of colour-form and analytic-synthetic attitudes. This tendency is to be welcomed and may, to some extent, reflect the growing awareness that the Rorschach deals, like any other personality test, with selected dimensions and traits (83, 282), and not with the " total personality " as some Rorschach workers have claimed. The essentially " dimensional " nature of the test is brought out in the language used by Rorschach workers to describe the personality dimensions on the one hand (anxiety, security, etc.), the objective stimulus dimensions on the other (colour, form, shading, etc.), and the postulated interrelations between the two.

(b) *Analytic-synthetic attitudes*.—One of the earliest writers to postulate a connection between different modes of perception and personality traits on the basis of experimental work was Benussi (16). In tachistoscopic experiments on what he termed *Gestaltzeit* he found two main types of response : on the one hand were subjects who experienced the Müller-Lyer illusion with short exposure times (82 to 100 ms.), while on the other hand were those subjects who required exposure times of 1,000 to 1,600 ms. Whereas the former group saw the parts of the figure, the second saw the whole figure best, with long exposures. On the basis of these results Benussi postulated two types of perception, the analytic, who react to parts first and require time to perceive the whole, and the synthetic, who perceive the whole first and require time to perceive the parts. Unlike Wertheimer and the Gestalt theorists who regarded the perception of wholes as the " natural " mode of response, Benussi regarded both types of perception as " normal " but representing two different traits of personality. Benussi made no direct attempt to develop this line of research.

Other writers, including Stout (275), Rorschach (246), Burt and Moore (37) and Bartlett (12) have, in different contexts, made the distinction between analytic and synthetic modes of perception, while Kretschmer (167) has made a similar distinction in his concept of dissociation-integration. Kretschmer's hypothesis has the great advantage over other formulations in that it forms part of a general framework of theory and empirical research in the field of personality. Kretschmer claims that dissociation characterizes the personality of the schizothyme, while integration, its opposite, is characteristic of the cyclothyme mentality. By " dissociation " Kretschmer means, " The ability to form separate and partial groupings within a single act of consciousness : from this results the ability to dissect complex material into its constituent parts." When this ability is absent, as in the cyclothyme, perceptions tend to be dealt with in a concrete, synthetic manner. The tendency towards dissociation is seen in an exaggerated form in the schizophrenic, while the integrative tendency, when exaggerated, characterizes the manic-depressive.

A number of experiments has been undertaken to test this hypothesis, many of which are of a visual nature, although of course Kretschmer's concept is not restricted to the visual system. Some of these experiments will be reviewed to show that there is considerable empirical support for the hypothesis.

In a tachistoscopic experiment Kibler (156) presented groups of coloured nonsense syllables to his subjects, with the instruction to observe either the colour or the letters. On the basis of Kretschmer's hypothesis one would expect the schizothymes, with their greater analytic and abstractive ability, to be able to observe

what is required by the instructions, and to discount other aspects of the stimuli, whereas the cyclothymes would be more influenced by field effects and would in consequence report less of what was asked for. The author found that about 30 per cent. of the leptosomatics and schizophrenics showed a complete failure to notice or remember stimulus characteristics other than the ones asked for, but only about 4 per cent. of pyknics and manic-depressives showed this extreme dissociative ability.

Enke (72) presented ten exposures of long, unfamiliar words in a tachistoscope and found that his subjects perceived the meaning of these words in two different ways: first, the analytic method, in which the whole was constructed by the combination of successively-apprehended parts, and secondly, the synthetic approach, in which an "impression" was first obtained of the whole, and this was elaborated in successive exposures. The ratio of dissociative over integrative modes of perception was $3.3/5.1$ for pyknics, $5.7/3.0$ for athletics, and $6.0/2.0$ for leptosomatics. These results are consistent with the hypothesis, the leptosomatics showing marked dissociative ability, the pyknics showing relative absence of that ability, and the athletics taking up a position intermediate between the two extremes.

Experiments in which this time pyknics and manic-depressives appeared to gain the "advantage" over leptosomatics and schizophrenics with regard to accurate performance of the task were undertaken by Kibler (156) and Van der Horst (288): the authors claimed that pyknics and manic-depressives had a greater span of apprehension in the perception of letters exposed tachistoscopically. Enke (72), however, failed to confirm these findings. Confirmation might support Kretschmer's view that in virtue of the cyclothyme's greater synthetic and integrative ability he should excel at tasks of this nature. Enke (71) carried out a further study in which he compared the number of whole vs. detailed responses given by pyknics and leptosomatics on the Rorschach test. A significant difference was found between the two groups, at the $P < .01$ level, the pyknics giving 20 per cent. of whole answers, while the leptosomatics gave 23 per cent.

Other researches which are fairly typical of German work in this field are those by Schiller, Wachter, and Syldath. Schiller (251) presented the Müller-Lyer and Sander's illusions to his subjects, with the instructions that they were to adjust about length of one line to appear equal to the other; the same subjects were also given the Rorschach test. Two main types of response were distinguished, the global and analytic, and a correlation of .73 was found between these two classes on the two illusion tests. There was no significant relationship between the illusion test results and Rorschach responses, interpreted in terms of global and analytic perception, but an interesting finding was that 90 per cent. of the subjects who were sensitive to colour on the Rorschach showed global responses to the illusion tests, while 70 per cent. of the subjects who responded to form on the Rorschach showed analytic responses to the illusions. No precise statistical treatment of the data is given.

Wachter (296) presented various optical illusions to a group of normal subjects, classified as schizothymes and cyclothymes, and a group of psychotics (including about twice as many schizophrenics as manic-depressives). Results showed that the schizothymes and schizophrenics were less susceptible to the illusions than were the cyclothymes and manic-depressives. Syldath (277) estimated the susceptibility of subjects to a number of optical illusions and was able to divide them into two types, analytical and totalizing. He found that for the latter group brightness transformation and the Aubert-Förster phenomenon were more marked, but the subjects were less susceptible to contrast effects.

One of the few studies by British investigators in this field in recent years was undertaken by Eysenck (78), who gave a battery of tests, including the Müller-Lyer illusion, eight tests of suggestibility and two tests of perseveration to 60 mental hospital patients. On the basis of clinical ratings half the subjects were classified as hysterics, while the other half were free from hysterical symptoms. Results showed that susceptibility to the Müller-Lyer illusion was unrelated to suggestibility and to hysteria, but it was positively related to perseveration, a personality correlate not previously considered in this field.

On the American side, a factorial study by Thurstone (281) seems to have some bearing on the hypothetical analytic-synthetic factor. In this investigation a number of perceptual tests was included which, on the basis of their structure, would appear to involve analytic vs. synthetic or dissociative vs. integrative

abilities. These tests were the Gottschaldt Figures (two sets), Shape Constancy, Space Perception, Brightness Contrast, and Hidden Digits. Factor analysis indicates that all these tests have fairly high saturations on Thurstone's Factor A, which he tentatively identifies as representing the "ability to form a closure in a given presentation," especially when the subject must form the closure "against some distraction." Other tests in Thurstone's battery which one might suppose to be dependent on an analytic v. synthetic factor were five tests involving optical illusions: the Müller-Lyer, Sanders, Poggendorff, Ehrenstein, and Titchener illusions. These tests did not have saturations on Factor A, but Thurstone notes that the correlation between Factor A and Factor B (which defines the illusions) is +.23; he goes on to say, "This is of some interest, because there are only four correlations among the perceptual factors identified in this study that exceed .20" (281, p. 105).

Tests which had lower saturations on Factor A than those previously considered were the Street Gestalt Completion, Dotted Outlines and Mutilated Words. On the basis of their structure one might suppose these tests would involve integrative ability to a marked extent. These results, considered in relation to Thurstone's discussion and attempted interpretation of his perceptual factors, do suggest that all the tests that have been mentioned depend to varying degrees on an underlying factor contrasting analytic with synthetic modes of perception. The nature of this factor would probably become more obvious from an independent study undertaken with the specific intention of isolating it.

Related to Thurstone's investigation and to the analytic-synthetic factor is a study by Witkin (315), in which a positive correlation was found between combined scores on three tests of spatial orientation and a Gottschaldt Figures test. Separate correlations were calculated for men and women: these were .66 and .46 respectively. Taken in conjunction with Thurstone's analysis of the Gottschaldt figures test, these results suggest that the analytic-synthetic factor may extend to the field of space perception.* A factor which underlies responses to simple geometrical figures on the one hand and our perception of the upright in space on the other would be of a fairly comprehensive kind, and likely to have a fundamental basis in personality organization. Difficult to explain at present is the sex difference which was found, in Witkin's study, where the women consistently adopted a synthetic approach to perceptual problems, as contrasted with the analytic mode of perception in the men. A similar difference (though slight) appeared in Thurstone's study between sex and susceptibility to optical illusions, women being more susceptible than men. However, results obtained in another study by Witkin, (315), on the developmental aspects of space perception, suggest that this sex difference may not be a fundamental one, for a significant difference between the two sexes in their relative dependence on visual field factors did not appear until the age of about 18 years.

Although concerned ostensibly with a different dimension, the studies of Klein and Holzman (158) on "levelling vs. sharpening" attitudes may also be mentioned as having some bearing on the analytic-synthetic factor, for subjects who showed "adaptive lag" in an experiment on "visual schematizing" obtained poor scores in a Gottschaldt Figures test and a test of Hidden Pictures: in all three situations they were apparently unable to overcome the influence of field effects.

Finally mention may be made of studies on constancy effects, such as that of Thouless (280), in which he noted that subjects of a "schizothyme" temperament showed a greater tendency to perceive the stimulus or perspective object than did "cyclothymic" subjects. A later investigation by the same author failed to confirm this relationship but, as Thouless himself points out, his selection procedure was not entirely satisfactory and may have obscured a real correlation. An interesting hypothesis that could be tested in this field has been put forward by Bruner (33, p. 142) on the basis of psychoanalytic theory. If, Bruner argues, schizophrenia is a regression to primary narcissism, a withdrawal from object relationships, might we not predict that such a withdrawal, and the increasing concern for the self, would lead to a breakdown in such phenomena as size and shape

* This correlation provides a link with Witkin's well-known series of researches on spatial orientation (314, 315 and references), which in turn appear to be related to the work of Sandstrom (248), Angyal (3), Claparède (46), and research on the Aubert phenomenon, such as that of Ogata (220).

constancy? A test of the hypothesis, which may of course depend on nothing more than a superficial analogy, would have to take into account the various factors which Thouless (280), Sheehan (260) and others have shown to be related to constancy effects.

(c) *Oscillation*.—A stimulus to research in this field was provided by McDougall's theory of introversion-extraversion (202, 203), in which he claimed that these two basic attitudes depend on the speed at which impulses travel in the central nervous system, particularly in the higher centres. This "speed of nervous action" could be studied by determining a person's rate of reversal of ambiguous figures, such as the Necker cube, Windmill illusion, Goblet figure, etc., and McDougall produced a certain amount of evidence to show that a rapid rate of reversal was characteristic of introverts while a low rate was characteristic of extraverts. (It should be noted that McDougall made no distinction between the dimensions of introversion-extraversion and schizothymia-cyclothymia.)

Guilford and Hunt (113) tested the rate of reversal of perspective in 25 college students, using a cube figure, and correlated the results with scores on three personality inventories; all three correlations were low but, as Eysenck (80) has pointed out, this result cannot be considered fatal to McDougall's theory in view of the many criticisms of self-rating questionnaires of the type used in this study. In another experiment Hunt and Guilford (132) gave two forms of a reversal of perspective test to 19 manic-depressive and 26 schizophrenic patients, first with the subject adopting a passive attitude and, secondly, an inhibitive attitude toward the reversal. Results showed that with the passive attitude normals and schizophrenics gave 18 and 17 reversals per minute respectively, while the manic-depressive patients gave only 4 reversals; with the inhibitive attitude normals gave 9 reversals, schizophrenics 13, and manic-depressives 2. Paranoid schizophrenics showed rates intermediate between those of the other schizophrenic patients and manic-depressives. These findings are in the direction predicted from McDougall's theory.

Cameron (40) reports results similar to those of Hunt and Guilford; a particularly interesting finding in his investigation was that the fluctuation rate of depressive patients tended to increase as the patients recovered, and the test results tended to become more regular. Frederiksen and Guilford (93) verified the earlier conclusions reached by Guilford and Hunt (113) that the rate of fluctuation of an ambiguous figure cannot be used as an objective test of introversion-extraversion, but their criterion suffered from defects similar to those previously pointed out by Eysenck (80).

George (100) used the Windmill Illusion, the Maltese Cross, two tests of binocular rivalry, and various rating scales to investigate, first, the relation between rate of fluctuation in binocular rivalry and reversible perspective and, secondly, the relation between these tests and introversion-extraversion, as measured by rating-scales. He found a general factor underlying the fluctuation and binocular rivalry tests, which correlated .52 with the rating scales. Johnson (144) took four samples of rate fluctuation, each lasting one minute, from subjects during both euphoric and depressed moods, and found, contrary to previous findings, a significantly greater rate of fluctuation in the depressed than in the euphoric state. Porter (229) found that subjects with a rapid reversal rate on 15 ambiguous figures tended to be more socially introverted, as measured by the Nebraska personality inventory, than subjects with a slower rate.

In an attempt to differentiate between hysterics and dysthymics by means of oscillation tests Eysenck (80) gave the Maltese Cross and Goblet tests to 34 hysterics and 38 dysthymics, each test being given twice, first with instructions to adopt a passive attitude, and second with instructions to adopt a maximizing attitude (i.e., to get as many reversals as possible). No significant differences were found between the hysterics and anxiety states, but the reversal rate for the neurotic group as a whole was significantly lower than for normals (as determined from the literature). Eysenck links this result with McDougall's theory that cerebral activity inhibits the activity of the lower centres, but notes that his results require confirmation in a properly-controlled experiment before any final attempt at explanation need be made.

In a later investigation Eysenck (84) studied the reversal rate in 50 schizophrenics, 50 depressives and 100 normal subjects, on the Necker cube test, with the following attitudes adopted: passive, maximizing, minimizing, and passive, each

for a period of 30 seconds, and in that order. The results of the first period showed no significant differences between the three groups, but the results of the maximizing period gave differences between the controls and depressives at the .05 level of significance, and between the controls and the total psychotic group at the .01 level of significance. The means were: 16.90, 11.26, and 10.74 for the controls, schizophrenics and depressives respectively. The minimizing period gave significant differences between the controls and depressives at the .001 level, and between the schizophrenics and depressives at the .05 level, the means for the control, schizophrenic and depressive groups being 2.93, 2.44 and 1.46 respectively. The final period differentiated between the controls and the total psychotic group at the .01 level; between the controls and schizophrenics at the same level of significance; and between the controls and depressives at the .05 level. The means for the three groups were 7.41, 4.56 and 4.72 for the controls, schizophrenics and depressives respectively.

Gravely (109) gave the Necker cube test to groups of normal subjects and anxiety neurotics in the same manner as in Eysenck's research on psychotics, but failed to find any significant differences between the three groups for all four periods. Working within the framework of Sjöbring's theories, Siegvold (264) found that "subvalid" subjects (i.e., individuals who, according to Sjöbring, have a fairly small supply of energy for brain processes) show a greater frequency of figure-ground reversals than "supervalid" subjects.

In addition to the above researches on the relation between reversal rate and temperament and character, mention may also be made of the work of Hoffeditz and Guilford (124), George (100), Denton (58), Thurstone (281) and Eysenck (80), who have all found fairly high positive correlations between different tests of reversal of ambiguous figures; their results suggest that there may be a group factor of "oscillation" which is relatively independent of general intelligence.

Although not concerned explicitly with oscillation as such, the recent studies by Frenkel-Brunswik (94) on "tolerance vs. intolerance of ambiguity" seem to have a bearing on the subject. This postulated attitude has its origins in the typological speculations of Jaensch (139) and in psychoanalytic theory. On the basis of research on eidetic imagery, summarized by Klüver (160, 161, 162), in which he distinguished two main types of imagery, stable and labile, Jaensch postulated two fundamentally different modes of psychological functioning, an integrate type and a non-integrate type, which are in turn related to the fundamental biotypes of W. Jaensch (140). Owing to a basic "unity of style" within the personality, characteristics in imagery may be linked with reactions to various perceptual tests (such as adjustment to prismatic lenses which distort the visual field, after-movement phenomena, reactions to visual illusions, binocular disparity, etc.), and extend to memory, thinking, and to social and political attitudes. The essential contrast in Jaensch's system is between the well-adjusted individual who is "intolerant of ambiguity" at all levels, and the unstable individual whose "tolerance of ambiguity" in his perceptions is associated with a "morbid liberalism" in the social and political sphere.

There are many non-scientific facets to Jaensch's theory and experiments, of which Frenkel-Brunswik is well aware, but she is interested in his work for two reasons: first, it centres on the concept of "ambiguity" and, secondly, a "unity of style" is postulated between the various areas of ambiguity. While she accepts the postulated interconnection between these different areas, Frenkel-Brunswik regards the relationship between "tolerance of ambiguity" and personality integration as positive rather than negative, as Jaensch supposes.

With regard to the psychoanalytic background to her hypothesis, Frenkel-Brunswik cites the concept of "ambivalence," the existence of which in a person, and that person's ability to face his or her ambivalences towards others, "must be considered an important personality variable." She points out that such a "formal" psychoanalytic factor is more amenable to experimental test than are those factors which deal more directly with "content." This variable Frenkel-Brunswik attempts to link with the more "cognitive" formulation of tolerance of ambiguity: she regards denial of emotional ambivalence and intolerance of ambiguity as but two different aspects of the same fundamental personality trait.

In working out her ideas on the experimental level, Frenkel-Brunswik makes use of Benussi's (17) concept of *Gestaltmehrdedeutigkeit*, its development by Rubin in his well-known work on figure-ground reversals, and its extension by Gestalt psycholo-

gists (164). So far, Frenkel-Brunswik's research is only in its preliminary stage, but it looks as if there may, under certain conditions, be some connection between tolerance of ambiguity in perceptual tests of figure-ground reversals, freedom from ethnic prejudice, and related personality variables. If this should prove to be the case, Frenkel-Brunswik's work may serve to link the earlier studies on oscillation, which originate in McDougall's physiological theorizing, with typological research, psychoanalytic theory, and research on primary social attitudes (81).

Closely linked with Frenkel-Brunswik's hypothesis is Klein's (157, p. 342) postulated dimension of "tolerance vs. resistance to the unstable." Experimental work by Klein and his associates suggests that "tolerance to the unstable" may be a fairly fundamental dimension, which extends from ease of perception of apparent movement (the phi phenomenon) and the autokinetic effect to "form lability" in Rorschach responses and the early recognition of distortion induced by the wearing of aniseikonic lenses.

Also related to this area of research are two studies by Gordon (105, 106), who has investigated imagery types (fluctuating and rigid) in connection with the formation of cultural stereotypes and perceptual rigidity, while the numerous studies on after-images or eidetic images by Schmülling (253), Smith (268), Liefmann (176), Fischer and Hirschberg (90), Zeman (320), Roessler (245) and other writers of typological persuasion may be of value to those who wish to experiment in this field.

(d) *Visual-aesthetic factors.*—Some readers may express surprise at the inclusion of aesthetic preferences in a paper which purports to deal with visual perception, but in view of the work of Kofka (165), and other Gestalt writers, on the "artistic" nature of perception, Helson's (121, p. 359) inclusion of affective or preferential value as a fundamental dimension of colour stimuli, along with their properties of hue, value and chroma, etc., and the experimental researches of Eysenck (77), Guilford (112), Granger (112) and others, who have shown a close connection between the perceptual dimensions of various types of stimuli and their aesthetic properties, there no longer seems any justification for isolating the aesthetic element from other aspects of perception, even though this may conflict with some of the traditional (but unverified) notions of the structure of the mind. With Dashiell (54) the author would agree that progress in both disciplines, aesthetics and perceptual research, would be hastened if they were treated together, as two aspects of the same science.

That aesthetic appreciation and personality are closely related has often been maintained; in particular, it has been supposed that a significant relationship exists between aesthetic preferences and temperament. Among modern aestheticians who have postulated this relationship Evans (74) and Read (234) are probably the best known. Both writers have attempted to relate aesthetic appreciation to Jung's typology, and their researches provide a useful introduction to the more theoretical aspects of the subject. In making his analysis Read has drawn on the work of Riegl (241), who distinguished between geometric and naturalistic types of art, Wölfflin's (317) theory of objective contrasts (linear v. painterly, surface v. depth, closed v. open form, etc.), Dvorak's (68) distinction between idealism and naturalism, and the studies of Max Verworn (290) and Herbert Kühn (169) on primitive art. He also refers to the well-known perceptive types of Bullough (36): objective, physiological, associative, and character types,* and the parallel types of Binet (24), which he identifies with Jung's four basic psychic functions.

Of the experimental researches in this field, the most relevant for personality study are those of Eysenck. In one study (75) he presented five sets, each containing 30-50 pictures, to 15 subjects who were asked to rank them in order of preference, according to a scheme of grouping. The rankings were intercorrelated, and the resulting matrix factorized to give two factors: one was the general factor of aesthetic appreciation, while the other contrasted preferences for the "simple, highly unified, vividly coloured, modern type of picture" with preferences for the "complex, less 'poster-colour,' more diversified picture". A questionnaire investigation showed that extraverts tended to prefer the former type of picture while introverts preferred the latter.

* These types may be of value in connection with Klein's recent work on the "Physiognomic vs. literal" dimension (157), in which he draws on the researches of Kouwer (166), Storch (274), Arnheim (5), Werner (307) and Hanfman (116) on physiognomic modes of experience.

In a later study, Eysenck (80) presented reproductions of 16 pairs of landscape paintings to 50 hysterics and 50 dysthymics for preference judgment. The pictures were selected so that the items in each pair depicted the same subject, were of equal artistic merit, but differed in style: one was painted in the "colourful, simple, modern manner," while the other was painted in the "more detailed, less colourful, older manner." The score on the test was the number of modern pictures preferred to the older. Results indicated that hysterics showed a greater preference for modern pictures than did dysthymics.

Other results which are relevant to this review have been obtained in the field of colour preferences. Barrett and Eaton (11) studied the preferences of women college students for colour or tint, and found that subjects preferring colours had fewer associations to words, higher annoyance scores, lower morale scores, took longer to complete an annoyance test, were more masculine, and changed their minds on social and economic issues less frequently than subjects who preferred tints: they also seemed to respond more directly and with greater interest to objects and objective events. Rakshit (232) found that subjects who tested as extraverts on the Neymann-Kohlstedt examination preferred the "deeper" colours (blue, red, and green), while introverts and "neuroverts" preferred orange and violet. Shikiba (263) investigated the colour preferences of 247 subjects, including psychiatric patients and delinquent boys, by means of six Zimmerman papers. His results are in line with those obtained in the studies of colour preferences which have been summarized by Eysenck (76) and Granger (107): these studies indicate a general order of preference to which all subjects tend to conform. Certain differences appeared between the rankings of the various psychiatric groups: for instance, manics put red first in order of preference, while depressives ranked it last. Katz (150) studied the colour preferences of psychiatric groups, and found that red, orange and yellow were more pleasing to manic-depressives than to any other diagnostic group. Dorcus (64) compared the colour preferences of a psychiatrically undifferentiated group of 19 male and female patients for a set of Munsell colours with those of several non-psychiatric groups of considerably larger size, but found no significant differences in their choices.

Thomaschewski (279) in a study of 700 children found that colour preference showed a consistent relation to social adjustment, temperament and initiative, but owing to the author's use of rather subjective procedures it is difficult to evaluate his findings. In the most systematic study yet reported in this field Warner (301) presented Munsell papers against a neutral grey background to 60 patients suffering from anxiety states, 60 manics, 60 depressives, and 120 catatonic schizophrenics; the latter group was further subdivided into equal groups of "active" and "passive" patients. In each group there was an equal representation of the sexes. Results showed that while there were marked sex differences with respect to all three attributes of colour, the only differences between the psychiatric groups were that anxiety states showed greater preference for the lighter colours, and they also expressed stronger preference for green than for yellow. Warner points out a limitation of his findings, due to the influence of extraneous variables in the criterion groups.

The most recent study of colour preferences in relation to personality differences is that of Robertson (243), in which a set of 14 colours was presented for preference ranking to 36 schizophrenics, 36 "non-schizophrenics" (a group including depressive patients and neurotics), and 18 nurses. The colours were as follows: dark red, light red, dark yellow, light yellow, dark green, light green, dark blue, light blue, purple, mauve, black, brown, grey and white. No attempt was made to specify these colours in objective terms, but fortunately this does not prevent a comparison being made between the average rankings of the three groups. Robertson shows by statistical analysis that the schizophrenics liked dark green better and white worse than did the non-schizophrenic group; the schizophrenics liked mauve better and white worse than did the nurses; and the non-schizophrenics liked dark green worse than did the nurses.

The present writer has undertaken a rather different analysis of Robertson's data with the object of determining, first, the amount of interpersonal agreement within the three groups and, secondly, the degree of association between the orders of preference for the three groups. From the set of average rankings given by Robertson in his paper it is possible to calculate the amount of agreement in terms of Kendall's (154) coefficient of concordance, W , a simple function of the average Spearman intercorrelation coefficient. When this is done, the following values of W are obtained:

schizophrenics, $W = .07$; depressives and neurotics, $W = .18$; nurses, $W = .27$. The first of these coefficients is significant at the $P < .01$ level, while the second and third are significant at the $P < .001$ level, indicating that in all three groups there is sufficient agreement from which to derive a general order of preference. This result is interesting when considered in relation to work on the general order of colour preference (76, 107), for it looks as if the interpersonal agreement which has been found elsewhere in normal groups also exists in groups of psychiatric patients. Perhaps significant, however, is the fact that agreement tends to be much less in the schizophrenic group than in the others; this cannot at present be proved satisfactorily, owing to the absence of suitable tests.

When the general order of preference for each group is derived by allotting ranks in accordance with the averaged observed ranks given by Robertson, rank 1 being allotted to the smallest average rank, rank 2 to the next largest, and so on to rank n , and the resulting rankings are submitted to analysis of variance, the result is very striking: there is evidence of a significant association at the $P < .01$ level. Further, although the writer has not made any precise calculations, examination of the ranks allotted to the blues, reds, greens, yellows and purples seems to indicate that the order of preference agrees closely with that found in normal groups.

In addition to collecting preference rankings for single colours, Robertson also presented combinations of colours for rating by the same groups of subjects. He found that the schizophrenics showed greater liking for combinations containing mauve and less for those containing white than did the depressives and neurotics; they also showed greater preference for combinations containing dark red or mauve and less for those containing white than did the nurses. The depressives and neurotics showed greater liking for combinations containing dark red and less for those containing dark yellow than did the nurses. As for the consistency shown by subjects in their preferences on different occasions, this was significantly less for the schizophrenics than for the other two groups, and the depressives and neurotics were less consistent than were the nurses.

Robertson also made an analysis of the use of colours in the paintings of a group of 176 patients, including schizophrenics, depressives, psychopaths, and neurotics, and came to the conclusion that "the central factor underlying all the peculiarities in the use of colour in painting by seriously disordered patients is a diminished feeling for colour or a weakened reactivity to it." One particularly striking result which he mentions was that the seriously disordered patients used colours of the blue-red series more than did other patients or normals. Robertson considers that his findings lend support to Kretschmer's (167, p. 240) views on the colour reactions of psychiatric patients, but they appear contrary to those of Goldstein (103), who has stated that the influence of colours is increased in psychotics. No evidence was found to support the contention made by Mosse (215), Emery (70) and Birren (25) that schizophrenics show a particular liking for yellow, nor was there evidence to support Mosse's (215) claim that depressives make great use of black. Owing to the number of variables involved, this part of Robertson's work is less easy to evaluate than his investigation of preference judgments for single colours and binary combinations. However, he has made a systematic attempt to develop a field which is still largely characterized by vague speculation and untestable hypotheses.

A further group of studies on mosaic tests may also be mentioned. Although, like the latter part of Robertson's work, they are primarily concerned with aesthetic production rather than with aesthetic appreciation, it may be supposed that the factor of aesthetic preference plays a sufficient part in these tests to warrant their inclusion in this review. In the typical mosaic test, such as that devised by Lowenfeld (184), the subject is presented with a box containing various shapes, each of which is available in several different colours, and is asked to make something. The finished pattern is then classified according to various criteria, and it is claimed that a significant relationship exists between characteristics of the pattern and the personality of the person who made it. For instance, in children and young people the use of many black pieces is supposed to be associated with depression, designs edged with projecting red pieces tend to be made by excitable and impulsive people, while edge, frame, winged and arrow designs are supposed to characterize persons suffering from functional disorders.

The few reports which are available concerning the scientific value of this test suggest that temperamental factors may be reflected to some extent in the choice of colours and shapes. Thus, Diamond and Schmale (61) found a greater insistence on

colour-balance in the designs of manic-depressives than in schizophrenics, while Wertham and Golden (308) were able to differentiate between schizophrenics, manic-depressives, mental defectives, and patients with organic brain lesions, on the basis of their mosaic patterns. Himmelweit and Eysenck (123) studied the mosaic designs of hysterics and dysthymics, but failed to find any differences between the two groups in their choice of colours. They did find significant differences in the type of pattern produced: whereas the hysterics tended to produce designs of an abstract and scattered nature, the dysthymics produced concrete and compact designs. These observed differences in the mosaic constructions of different groups, implying as they do differences in preference for form and colour, may prove of some value in the construction of visual-aesthetic tests of personality, but most of the work on mosaic tests has not yet reached a stage where its scientific significance can be evaluated.

It would appear from this review of visual-aesthetic factors that further development of the field will provide a fruitful approach to personality study. One line which such development might follow would be to identify in more precise terms than hitherto the objective stimulus properties which characterize the aesthetic preferences of different temperamental groups. This would involve preliminary analyses of the type made by the more scientifically-minded aestheticians, such as Pope (227) and Graves (110), in order to suggest hypotheses as to some of the main determinants of preference for complex pictorial compositions. At the same time, studies could be planned at a more elementary level, with simple colour-form combinations, along the lines of those undertaken in the general psychology of aesthetic appreciation by Guilford (112), Davis (56), Beebe-Center and Pratt (13), Harsh *et al.* (120), Eysenck (77), Granger (108) and others. Such researches should eventually enable some of the vague descriptive terms at present in use, such as "classical," "romantic," "compact," and so on, to be given more precise definitions; this should in turn help to throw further light on the temperamental types whose preferences are being studied.

III. THEORETICAL DEVELOPMENTS.

With the growing awareness of the relationship which exists between personality and perception, several attempts have been made in recent years to develop theories of personality "dynamics," which are based on a functionalistic view of perception. Much of the relevant literature on the subject is contained in a number of papers appearing in the September and December, 1949, issues of the *Journal of Personality*, and in the recent publication, *Perception: An Approach to Personality* (26). As reviews of these researches have already been provided by MacKinnon (205) and Blake (26, pp. 10-22) they will not be dealt with here in detail, but mention will be made of what seem to the writer to be the three most important contributions, namely those of Bruner (33), Klein (157) and Frenkel-Brunswik (95). Before discussing these contributions, it may be noted in passing that, while the large volume referred to above (26) on perception and personality has been of importance in stressing the need for integrating two fields of research that have been pursued independently of each other, its scientific content falls short of what one would have hoped for. There is an undue amount of verbiage and vague speculation to be encountered in attempting to extract the useful ideas and information which it undoubtedly contains.

Bruner's aim has been to seek a theory of perception which is "adequate both to the laboratory and to the clinic"; above all, one which will account systematically for individual differences in perception, and not assign them, in the Fechnerian tradition, to random error. On the basis of a series of experiments undertaken in collaboration with Postman, Bruner has developed an "expectancy" or "hypothesis" theory of perception. In his view perception involves a three-step cycle: it begins with an expectancy or hypothesis which is evoked "from the arousal of central cognitive and motivational processes by preceding environmental states of affairs" (33, p. 124). The second step in the process involves the input of information from the environment (both external and internal), and finally a checking procedure takes place—input information is either confirmatory to the hypothesis or it is in varying degrees infirming. Should confirmation not occur, the hypothesis shifts in a direction determined partly by internal, subjective factors and partly by feedback from the learning which occurred in the preceding information-

checking cycle. Whereas the first hypothesis is termed the "initial" hypothesis, those which follow an infirmed hypothesis are known as "consequent" hypotheses.

Bruner's development of his basic notion may be summarized in terms of three theorems which deal with the concept of "strength" of hypothesis: (1) The stronger a hypothesis, the greater its likelihood of arousal in a given situation. (2) The greater the strength of a hypothesis, the less the amount of appropriate information necessary to confirm it. (3) The greater the strength of a hypothesis, the more the amount of inappropriate or contradictory information necessary to infirm it. Having formulated his general theoretical position Bruner proceeds to translate recent perceptual research into these terms, and to suggest how personality "dynamics" can function to control the selection of information, and in this way determine the ensuing reaction. When developed in greater detail, Bruner's theory may serve to integrate some of the experimental data in this field; at present its value is not easy to determine.

Klein's (157) approach, while in its insistence on perception-personality relationships essentially similar to Bruner's, tends to lay greater emphasis on individual differences. He accepts a functionalistic view of perception, and goes on to search for those perceptual properties which fulfil an adaptive function under the control of the ego-system. Among such properties he mentions absolute and differential thresholds, constancy effects, organizing time, and schematizing. These so-called "adaptive properties," common to all individuals, are employed "idiosyncratically," and the "personal styles" or modes in using them for meeting environmental demands are called "perceptual attitudes" or *Anschaunungen*. Such attitudes, or syndromes, of adaptive properties "reflect for us the integrative principles which give character and distinctness to perceptual life" (159, p. 43), and by studying the interrelations between them Klein hopes eventually to construct an empirical typology.

The point of departure for Klein's experiments is a perceptual task involving an "adaptive property" or properties in which individual differences are shown. By examining the experience of subjects who show extreme performances on this task two opposing attitudes are then formulated to account for the difference. The third step in the procedure is to seek other perceptual tasks which will "highlight" these attitudes and, by a process of internal validation, determine if the separation of the two groups is maintained in these tasks as well. This leads to a definition of the attitude in more general terms.

Finally, having confirmed and formulated the attitude in perceptual terms, it is appropriate to extend the search to concomitant aspects of the attitude, clinical, motor, physiological, and so on.

Klein also mentions a second procedure in which the starting-point is an hypothesis regarding an ego-control principle derived from clinical experience. This principle is then translated into perceptual terms and investigated as above.

Klein's theoretical position is in certain respects similar to that of Thurstone (281), who postulates in his *Factorial Study of Perception* that peripheral functions, in the perceptual system, may in certain cases serve central mechanisms, so that by studying the "dynamics" of one of those functions some characteristics of the person as a whole might be inferred. In fact, Thurstone includes some of the "adaptive properties" referred to by Klein (thresholds, constancy effects, and organizing time) in his test battery. Thurstone also adopts a similar position with regard to the verification of an attitude inferred on the basis of observed individual differences. If he finds individual differences "in some phase of perceptual dynamics which may be centrally determined," he would then go on "to list a few subjects whose perceptual performance has some conspicuous characteristic, and to list also some subjects who do not have that characteristic or who are the opposite. Then we should ask how these subjects differ. If it should be found, for example, that the subjects who show considerable lag in the method of limits are noticeably more deliberate in movement and temperament than those who show little or no lag in the psychophysical experiments, then we should have a lead for further . . . study" (281, p. 2).

Klein's eventual aim (to build an empirical typology based on perception) also links his work with the well-known researches of Kretschmer (167) and other continental typologists. In fact, Klein's work may be regarded as traditional typology in a somewhat different guise. Unlike the typologists, however, Klein has no com-

prehensive theory embracing the various aspects of personality, conative, affective, and constitutional.

Finally, note may be made of the connection between Klein's theorizing and Eysenck's (80) picture of personality organization. Klein's approach, like Eysenck's, claims to be dimensional and also hierarchical in conception, but whereas Eysenck has provided a theoretical framework based on experimental research on many different facets of personality—perceptual, motor, autonomic, and so on—Klein's perceptual theorizing so far tends to lack such a framework, which would seem to be essential if one is to integrate perceptual attitudes with a body of experimental fact on personality structure. It also suffers to some extent from not having a clearly-formulated dimensional methodology with which to pursue an essentially dimensional aim. Klein's conception of attitudes seems to fit in fairly well, however, with Eysenck's notion of higher-order concepts organized at the trait level (see his diagram of personality organization (80, p. 29)).

A difficulty which not only Klein, but other personality-oriented theorists seem not to have mentioned is that of deducing specific perceptual consequences from the general "ego-control" and other central factors that they would utilize for their experiments. It is one thing to speculate in general terms on the sort of consequences that are likely to arise from an "intolerance of instability," on the perception of autokinetic movement or flicker-fusion, but it is quite another thing to deduce what particular aspects of those phenomena are to be selected for measurement, the objective experimental conditions under which those measurements are to be made, and the variables that must be controlled when subjects are selected for experiment. At this stage the problem becomes formidable, and must necessarily involve consideration of a network of correlations between objective and subjective factors that are known to operate in all perceptual functions. However, to say that psychological theorizing in this field is still only at the formative stage is not to say that Klein has not made a valuable advance.

Frenkel-Brunswik's (95) contribution to theory has been primarily to attempt the integration of perceptual research with psychoanalytic theory of personality "dynamics" and with developments in the social psychological field. In particular, she indicates how interest within psychoanalysis itself has tended in recent years to shift from an almost exclusive preoccupation with the id and problems of "depth" to the ego and "surface" manifestations.

Influenced by psychoanalytic writings, and undoubtedly very sympathetic towards the psychoanalytic viewpoint, Frenkel-Brunswik shows the possibility of submitting psychoanalytic concepts, such as the various defence mechanisms, to experimental test by deducing their consequences in the perceptual system. This tendency to link psychoanalysis with other branches of psychology is to be welcomed, and seems to be in line with Freud's own realization that psychoanalysis needs other departments of psychology to complement it. In his own words, psychoanalysis ". . . is seldom able to deal with a problem completely, but it seems destined to give valuable contributory help in a large number of regions of knowledge. The sphere of application of psychoanalysis extends as far as that of psychology, to which it forms a complement of the greatest moment" (96).

Of particular interest is Frenkel-Brunswik's view of the value to be derived from studying the "formal" elements in personality. She maintains that "the formal elements of personality style, since they are not as directly threatening as its content, are not subject to censorship in the same manner as its content, and that they, therefore, can be used as tools in diagnostic procedures" (95, p. 408). A study which she cites on mechanisms of self-deception seems to suggest that such formal style elements as exaggeration, easy generalization (as contrasted with salient specificity), intolerance of ambiguity, and the like, may be of greater penetrating power within the personality, more nearly alike on the surface and at greater depth, and thus of greater generality and greater diagnostic validity than such content factors as, say, sex, aggression, and the Oedipus complex. In this emphasis on the diagnostic significance of "formal" factors Frenkel-Brunswik's theoretical position bears an analogy to that of Klein's.

Not only does Frenkel-Brunswik draw on psychoanalysis for her guiding principles, but she also shows herself prepared to accept some of the ideas of continental typologists, as has been shown in her development of the concept of "intolerance of ambiguity," discussed elsewhere in this paper; altogether she shows an awareness of converging trends of thought, originating from diverse sources, a

capacity which is to be welcomed in a focal area like that of personality study. The value of her theorizing (like that of Bruner and Klein) can, however, better be judged when it has been shown to integrate existing experimental data, and to point the way to further specific experiments.

IV. GENERAL CONCLUSIONS.

Evaluation of a complex field, in which experimental studies mingle with clinical observations and theoretical speculation, is not easy. However, from this mass of data a number of trends may be discerned which invite comment.

In the first place, it looks as if visual perception in its various aspects affords a promising approach to personality organization. This view is supported not only by clinical observation, but in many parts of the field by experimental research. This current interest and research in perception-personality relationships is welcome for it may, to some extent, serve as a point of unification for approaches as different as those of psychoanalysis and psychophysics, and thus prevent undue narrowing of outlook.

With this growing awareness that personality factors operate in perception, and the emphasis on a "personality-centred" approach, there is, however, the danger that in their enthusiasm advocates of this new (?) approach will cease being aware of those factors that sensory psychologists, physicists and physiologists have shown to be important influences on our perceptions. There are already signs in many of the researches that have been reviewed of a certain relaxation of experimental controls in regard to such objective variables as quality and quantity of illumination, retinal area stimulated, pre-adaptation, and so on, and in the failure to take into account the many other variables such as age, fatigue, refractive errors that are known to influence some of the phenomena that have been considered. This lack of rigour may, to some extent, be reflected in the embarrassingly large number of zero or near-zero coefficients that often occur in our correlation tables. Associated with this general tendency for fairly slipshod experimentation in the matter of controls is a failure to consider alternative hypotheses and to attempt some explanation of contradictory findings; all too often these are merely mentioned in passing, whereas they should be regarded as an essential part of research procedure.

Thirdly, realization of the importance of perception in the study of personality must not blind us to the value of other approaches, such as the motor and autonomic. This is not, perhaps, so likely to occur in visual perception as in other parts of the field for, at every point, the influence of motor and autonomic components makes itself felt. The warning nevertheless seems necessary in view of the current tendency to make something of a fad of this newly-developed interest in perception.

This leads to a fourth point, namely the necessity for linking work on perceptual tests of personality to a general theoretical framework which embraces all aspects of personality study. Such a framework is available in Eysenck's (80) hierarchical conception of personality structure, already referred to earlier in this article. In fact, to the author's knowledge it is the only existing framework that can serve to integrate the mass of data that already exists in the scientific study of personality. Such a system lays emphasis on personality organization at different levels of generality, and into this scheme can be fitted the results of researches on such hypothetical attitudes as colour-form, analytic-synthetic, oscillation, and so on. It has the merit of being based on empirical research, and it leaves room for extension and development as it becomes necessary to add new dimensions at different levels. Indeed this scheme appears as a fairly logical outcome of the dimensional approach to personality study which is adopted, explicitly or implicitly, by most of the writers whose researches have been reviewed in this paper.

A further aspect of Eysenck's general theoretical position, which is relevant, is the greater emphasis which he puts on constitutional and hereditary factors in personality than is common at the present time, a view supported by a recent experimental study of neuroticism in twins (85). In consequence of the importance which apparently attaches to these factors, tests of the various visual functions which have been reviewed in this paper would appear to have great potential significance as measures of fundamental factors in personality, for many of them have been shown to be strongly influenced by heredity. Some of the relevant studies which bear on this topic are those of Bracken (32) on susceptibility to the Müller-Lyer illusion, Aubert's phenomenon, and the apparent size of after-images; Hofstetter (125) on accom-

modation-convergence; Malan (208) on spatial orientation; Smith (268) on eidetic imagery and response time; Lowenstein and Levine (194) on the pupillary light reflex; and Eysenck and Prell (85) on flicker-fusion and autokinetic movement. Such tests of a "formal" sensory or perceptual nature may be contrasted with those employing comparatively unstructured material, such as the various types of projective personality test, where the greater influence of "content" factors tends, perhaps, to make them more subject to diurnal variations within the personality.

One final comment on the studies covered by this review concerns their almost purely descriptive and classificatory nature. This is to be expected in a relatively undeveloped field, but such classificatory research should be supplemented as early as possible by studies designed to determine the functions and mechanisms underlying the phenomena that have been described. To some extent hypotheses about the underlying functions may be available in existing psychological or psycho-analytical theories, as investigators like Frenkel-Brunswick (95) seem to suppose, but in the writer's view the most fruitful development of this particular field will be in terms of physiological or psychophysiological hypotheses. If, as is fairly apparent, tests of the type considered in this review are dependent on fundamental factors in personality which are closely bound up with the basic structure and physiological functioning of the organism, then it seems fairly logical that theorizing should have a definite physiological bias. With such theorizing should also go a greater degree of specificity and precision than appears in most of the theoretical speculations in this field: in many cases hypotheses at present are of such a general type, and couched in such vague terms, that it is difficult to deduce their consequences under specific experimental conditions.

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