ON THE METHODS OF LATER PSYCHIATRY.

By CLARENCE B. FARRAR, M. D.,

Assistant Physician and Director of Laboratory, Sheppard and Enoch Pratt Hospital.

That the doctrine of diseases of the mind is the most backward child of medical science is an observation as commonplace as true, and the causes are not far to seek.

The innate difficulty of rightly judging pathologic states of mind has furnished room from the beginning of history for the human proneness to attribute to the supernatural, to divine or diabolic agency, that which is not readily explained or understood, a proneness which the leaders among primitive peoples, namely, the priests, were quick to take advantage of, whether consciously or unconsciously, in establishing the authority of their own cult, and which in later times has still been encouraged by *spiritual leaders*, even among numberless pious communities of our own day. Among such, insanity as a disease of the mind did not exist. Individuals tainted in their wits were rather victims of the powers of darkness, sinners possessed of demons; the etiology of their misfortune was unrighteousness, the course chronic, the only therapy the heroic exorcism of the priest. In the presence of doctrines such as these, scientific inquiry found no place. The axiom that reason is never more reasonable than when she leaves alone the things which are above reason, is evidently capable of misinterpretation, and when so misinterpreted, of causing untold mischief.

But the ideas of demoniacal influence are by no means limited to ancient profane or biblical history, as the following recent case in one of the German clinics will illustrate. A young girl of the uneducated class, belonging to that religious persuasion in which the authority of the priest is absolute, was one night startled by hearing the word "swine" pronounced distinctly close to her ear, although no one was near her at the time. Considerably shocked and alarmed, she at once made the priest her confidant and he as

promptly told her that the voice was that of the devil, and that she must needs be guilty of some very heinous offence to be thus visited. Up to this time the girl had been apparently well. What the result would have been had she come under influence somewhat more healthy and enlightened than that of this spiritual guide it is useless to speculate. The fact simply remains that following his words she was plunged into a state of terror and excitement which speedily necessitated her transfer to the clinic for insane.

The observation of cases of mental alienation was of course coexistent with human history, but of the night of ignorance when the priests were at once religious guides, lawgivers and medical advisers to the cult, nothing but evil is to be recorded. From Hippocrates came the first ray of light, with the denial of the priestly authority in the affairs of medicine and the snatching from their hands of all that which pertains to the study and treatment of diseases of the body, among which he included diseases of the mind. Insanity was thus for the first time looked at from the physician's viewpoint and recognized as a disease of the brain. Conditions of excitement, depression and psychic enfeeblement were distinguished, certain features in the course, prognosis and treatment indicated, and the curability of many forms demonstrated.

But these beginnings of wisdom were lost. The history of dæmonology throughout the dark ages and of witchcraft reaching almost to our own day¹ furnishes the saddest index to human credulity and gullibility.

From the ruins of centuries, psychiatry, the most baffling department of knowledge was the latest to revive, kept down by the weight of superstition which was fostered by the teaching of New Testament times that insanity is possession of the devil. No less a man than Heinroth, the first professor of psychiatry in Germany, taught at the beginning of the last century that mental diseases were primary diseases of the soul, independent of the body, that their cause was a misuse of the moral freedom entrusted by the Divinity to each individual, in other words sin,

¹ In the present month (December, 1904), a case of alleged witchcraft was brought before a local court in Thuringia.

their cure a return to virtue, and their prophylaxis a pious life. With the combating and overthrow of the teaching of Heinroth, the latest survival of the naïve system which had its origin in the imagination of the priestly cult, modern psychiatry in the true sense may be said to date. It is, therefore, scarcely more than half a century old.

One of the causes of the slow advance in this field, which has even to-day to be reckoned with, is the fact that too often the choice of men to whom the observation of the insane is entrusted has been, to say the least, unfortunate. Psychiatry as a science, loved and cultivated, exists in but a few living centers in each country. In multitudes of hospitals and asylums it is a dead letter; the number of staff physicians is small and composed perhaps largely of men who have no aptitude or liking for laborious research. A meagre routine examination recorded possibly on a stereotyped printed sheet, together with the subsequent treatment of symptoms which arise, may constitute the entire history of the case. Under such circumstances it is useless to expect illuminating scientific investigations to be carried through. We have thus to do with the lamentable situation of *the most difficult problems which science has to present being left in the hands of men the least able to solve them.*

The old school classification of mental diseases, still widely current, illustrates the naïveté with which the subject has been approached. The most obvious modifications of the normal personality from day to day are those of the affect. An individual not considered of unsound mind may be observed on one occasion to be in high spirits, on another in the dumps, and it is assumed that if these two conditions be exaggerated to a pathological degree we have, roughly speaking, the diseases known as mania and melancholia, symptomatic diagnoses pure and simple, equivalent to saying that a patient whose chief objective symptom may be labored breathing is suffering from dyspnœa, and letting the diagnosis rest there.

Krafft-Ebing one of the early exponents of the symptomatic classification admits in the seventh edition of his text-book, published posthumously in 1903, that psychiatry (from this point of view) is still little more than a descriptive science.

Only recently in one of the great European centers of learning,

a new interne in a private mental clinic of considerable estimation, on coming before his chief for preliminary directions, received the following instructions, which are here repeated approximately in the words of the interne himself: "You are about to take up a difficult science, one in which the beginner is apt to find only utter confusion. If I give you, therefore, at the outset the key to the labyrinth you will be able to find your way with comparative ease. A patient is presented to you. He is elated or excited, talks about everything in the world, makes ill-timed jests, is constantly active, perhaps violent and destructive. This, in a word, is the picture of *mania*.

"A second patient is introduced. She is sad and self-reproachful, too wicked to associate with others, sits in silence and gloom, or bewails her pitiable condition. As likely as not she is suicidal. The picture is one of *melancholia*.

"Still a third patient. He is quiet and orderly and converses with you about what you will. At some given subject, however, he leaves the track and indulges in vagaries entirely out of keeping with his previously expressed ideas. He believes some one to be plotting against him, his idea of his own personality and position is distorted, he is an impossible member of the family. Such is the picture of *monomania*.

"Finally you have a patient whose mental activity is atrophied. His ideas are few. He is silly, forgetful, complacent, has no volitional impulses. He has become a negative quantity. The picture is that of *dementia*.

"Voilà la psychiatrie!"

The interne who received this instruction felt, however, that there was something beyond and outside of such a short and convenient scheme. Many another might not, and it is just this unquestioning readiness with which diverse mental anomalies are sorted and cast into a few spacious vessels of generalities, which has blocked the progress of psychiatry and contributed not a little to bring it into ill repute as a very subordinate department of medicine, meriting but brief attention, sufficiently mastered by every practitioner, and in many instances left to the tender mercies of asylum men of indifferent qualifications or slender interest in their work, thus leaving the brilliant minds to devote themselves to the more *live* problems of medicine and surgery.

Turning now to the other side of the question, we shall have in the following pages to consider briefly some of the achievements through which psychiatry is coming to honor among the daughters of science, and to review some of the chief means by which, during the modern period, the study of mental disease has accomplished whatever of good it now has at the beginning of the twentieth century to present. We shall have, therefore, to refer in succession to the three chief methods of observation, clinical, anatomic-pathologic, and psychologic, and to inquire what each has contributed.

I.

The clinical method yielded naturally the earliest results. In its fuller value it served first in France where Bayle in 1822 separated from psychiatric chaos the disease picture of dementia paralytica, which by virtue of innumerable clinical and anatomical studies since, has become the best known type of mental disease. The clinical method was later that of Hecker in differentiating hebephrenia, of Kahlbaum in appreciating the nature of katatonia, of Meynert in his description of amentia, of Falret in recognising cases of circular insanity, and of Kraepelin in the conception of maniac-depressive insanity and dementia præcox.

The clinical method in its fullest application implies an inquiry into the history of a case reaching back, not merely to the point at which Tristram Shandy affirms his woes began, but as far remote in the family history as it is possible to obtain trustworthy details, which must be given careful consideration in their possible bearing upon the case in hand. It must, however, be borne in mind that as present day society is made up, a certain amount of eccentricity, alcoholism, of degeneracy in sum, is to be regarded as the norm, and that practically no family history is complete without some stray psychopathic facts. The clinical history embraces therefore the time from an indeterminate point in the past up to the moment of the patient's death, when the pathological history begins, and its carrying out necessitates keeping the patient under observation after his hospital period, whether discharged cured or not, the careful comparison, in cases of so-called cure, of his condition at varying lengths of time after recovery with that before the illness, the comparative study of any subse-

quent attacks of mental disease, and the determination if possible whether they constitute independent symptom-complexes or are to be regarded as episodic manifestations of the original disease. Beyond the assumption of a special constitution or native predisposition, nothing can be more erroneous than to maintain that in a patient who has been once insane, all later aberrations must be part of the original condition, exacerbations of a primary psychosis, although to be sure, this is often enough the case.

In the clinical valuation of cases the attempt at classification of forms of insanity comparable to that which obtains in internal medicine has thus far proved to be futile. In the first place for the investigation and appreciation of a patient's mental condition it is not only unnecessary but often directly mischievous, to force his symptoms into some cut and dried disease pattern and designate it by a single definite name. In this way the presence of certain more or less well defined symptoms is assumed to indicate an equally definite disease entity, while other perhaps equally numerous or important phenomena are either disregarded or necessarily misinterpreted. An exact psychological classification which shall take into account all the members of human society is impossible. To be complete, we should have as many categories as individuals. It is even impossible to draw an accurate universally applicable line between normal and pathological in the human mind. How then in the manifestly more complex phases of disease shall we be able to assign each case forcibly to some fixed psychiatric pigeon-hole, the entire number of which, as most text-books bear witness, is so incredibly small?

Not diseases but individuals should be the prime object of study, not the ability to discover symptoms sought which shall go to make up an external pathological entity, but rather to appreciate in its nature the diseased personality by establishing its variations, fine and coarse, in all the phases of mental life, not from an arbitrary norm, but *from the norm of the individual himself*, which may depart widely from any given average and which must be determined anew in each succeeding case.

Provisional diagnoses are indeed unavoidable, and their chief value lies in facilitating the recording of cases and the comparative study of symptom groups as well as in favoring statistical work. The dangers, however, of metamorphosing symptom-com-

plex into disease entity, are shown no better than by following the part which the *amentia* of Meynert has played in the history of insanity.

During the first decade after it was described in 1881 the diagnosis of *amentia* found astoundingly increasing favor until in numerous clinics it came to cover perhaps half the cases. It was a convenient diagnosis covering a multitude of conditions, and obscure cases fell easily into the *amentia* reservoir, thus reducing materially that troublesome quantity, the undiagnosed group.

Meynert recognised but three acute psychoses, mania, melancholia and *amentia*, and of these *amentia* held the chief place. In his classical *Klinische Vorlesungen* (1890) melancholia occupies thirty-two pages, mania covers fourteen and *amentia* ninety-four. As synonyms of *amentia* (*Verwirrtheit*) Meynert enumerates at the head of his chapter: "Acuter Wahnsinn, allgemeiner Wahnsinn, Manie, Tobsucht, Melancholie mit Aufregung, Melancholie mit Stumpfsinn der Autoren." In the clinical description he includes cases of stuporous mania, delirium acutum, Kahlbaum's katatonia, and petit mal, and he mentions periodic as well as simple forms.

Besides his primary idiopathic *amentia*, Meynert recognised a limited symptomatic group in which the symptoms of *amentia* represented a stage or complication of other conditions, and it is this group which has since steadily grown at the expense of the former until to-day the very existence of idiopathic *amentia* is almost controversial. While many of Meynert's followers and particularly the Vienna School, still look upon it as a distinct form of alienation of not uncommon occurrence, it is by other observers considered for the most part episodic in other more clearly defined diseases. Kraepelin who perhaps represents the extreme in this direction allows at most $\frac{1}{2}\%$ to 1% of the total admissions under the heading *amentia*. Many cases formerly so diagnosed are now assigned to the katatonic group, or the motility psychoses of Wernicke, others to the maniac-depressive, circular, and recurrent psychoses, while but a small percentage of cases, belonging to the asthenic or exhaustion psychoses remain under the original name.

Again, the variety of opinion which exists concerning the nature and frequency of occurrence of hysteria as a disease

entity, and the relation to it and the significance of hysteriform symptoms which are known to occur in practically every form of mental disease, illustrates the dangers of hard and fast diagnoses.

Just as on the anatomical side there is no single structural change which is certainly pathognomonic of a definite clinical type, so in the symptomatology it is fatal to nail one's faith to isolated phenomena. The symptom of random reply (*Vorbeireden*) which Ganser and Raecke consider one of the distinguishing features of hysteria, Nissl as stoutly claims as a manifestation of katatonia, while Meyer concludes that it is a symptom of relative value only and bound up neither in katatonia or hysteria.

The diagnosis of dementia *præcox* which may reasonably be called Kraepelin's disease is extremely frequent in many of the German clinics and is gaining ground in France and England, and more slowly on this side. By Kraepelin himself it is regarded rather as a provisional diagnosis, admitting that the 15% of total admissions which in its present form it includes, is probably too high a figure, and that future investigation will perhaps separate the great group of dementia *præcox* into several more sharply circumscribed and possibly independent diseases.

Wernicke who strenuously opposed the teaching of Kraepelin in regard to dementia *præcox*, early pointed out that it was an error to cast a universally bad prognosis in the cases described by Kraepelin, affirming that a considerable proportion of the patients entirely recovered, a statement to which Kraepelin now also gives provisional approval.

Moreover the phenomena of motility out of which Kahlbaum constructed katatonia in 1874, and which Kraepelin makes a sub-type of dementia *præcox* including a third or more of the cases, occur in such a variety of conditions and present such differing outcomes, that the question—disease entity or symptom-picture—cannot be regarded as settled. Aschaffenburg is inclined to believe that every case of katatonia shows lasting defects, while Meyer is of the opinion that one-fifth to one-fourth of the cases completely recover.

The metamorphosis of disease into symptom is again illustrated in Korsakoff's syndrome. Described originally as an alcoholic psychosis in 1887, to which two years later Korsakoff

gave the name "*Cerebropathia psychica toxæmica*," it was found to have such varying etiology and symptomatology that Jolly proposed that "*Korsakoff's psychosis*" give place to "*Korsakoff's symptom complex*," and this is now a widely accepted usage. Kraepelin urges retaining the name *Korsakoff's psychosis* for the alcoholic form alone, placing in other categories the cases which develop on the ground of other intoxications or infections, and in arterio-sclerotic and senile conditions.

As another instance of the lack of fixity in mental diagnosis may be mentioned Kraepelin's *involutional* or *true melancholia*. Up to the present, Kraepelin has looked upon this form as a distinct well-characterised disease, to be sharply differentiated from depressive attacks in earlier life, most of which are phases of *maniac-depressive insanity*. There is, however, some evidence to show that the *involutional depression* may indeed form part and parcel of the larger group of *maniac-depressive insanity*.

This possibility has been given consideration by Kraepelin in certain illustrative cases, although he still holds to his original classification. The prominent symptom for which Kraepelin always looks in cases of *involutional melancholia* lies in well developed religious delusions, particularly deep-rooted ideas of sin committed, which with a fairly uniform affect-tone, a slowly progressive onset and long duration constitute the chief features of the disease. The description while persuasive is not entirely convincing. It seems at least questionable whether *sin-delusions* should be allowed to count as differential characters in separating an *involutional insanity* from one occurring earlier in life. It is a trite observation that man thinks and acts differently and is indeed a different being with each succeeding decade. The insistent object of thought in youth is replaced by another in manhood often inconsistent with the first, and the supreme object of the prime of life gradually loses warmth and reality with declining years. By this simple psychologic metamorphosis to which Haeckel has called attention in several learned men, who with advancing years, ceased to be scientific and became pious, the mental furniture is being constantly altered. It is well known that elderly persons are often occupied by religious ideas which never came conspicuously to the surface

during their more active and healthy years. It is, therefore, easy to see how insanity attacking individuals of different ages will be expressed in delusions of varying content dependent upon the changing ideas, ambitions, and activities which may be considered normal for the respective periods of life; and it is natural to assume that an attack of depression in the senium would be characterised by preference by ideas of sin and personal unworthiness and delusions in general associated with what may be a perfectly sane appreciation of the fact by the individual that he is mentally and physically on the downward path, and that he is losing grasp on life and its activities, while such manifestations might be absent entirely during a depressive attack in a younger individual.

Moreover the personal equation and the results of environment have here their part to play. Cowper who had been educated in a hyper-religious atmosphere gave expression in numerous recurring depressive attacks almost exclusively to delusions of strongly religious coloring.

It would seem, then, that the existence of a distinct melancholia of old age to be separated from periods of depression at other times of life, such as occur in maniac-depressive insanity, except in so far as the psychic expression of any psychosis may be influenced by the time of life, is at least open to question.

As has been said, the paramount object does not lie in making the observed phenomena in a given case fit snugly into the rubric of some disease-pattern. The practical object is rather to learn the value of individual symptoms and symptom groups as affecting prognosis, to be able to judge whether the patient will recover or become demented; whether the present illness is likely to be long protracted; in case of recovery, or improvement, what social and business relations will he be capable of; what are the probabilities of recurrence; what are the dangers of suicide and crime.

Aside from this, the scientific interest sees in the modern development of *individual psychology* a leading which must be followed by those who appreciate that a hundred diseased human minds cannot profitably be tossed into a half-dozen text-book categories.

Indeed with the facts at present accumulated, and with

pathologic anatomy, in spite of the great significance of its actual contributions, still in an embryonic state, when we consider the fields yet unexplored, one feels the force of Ziehen's observation that a single ideal classification of the psychoses may be impossible.

A few well defined clinical types exist, it is true, and it is those forms among them which are recognised as dependent upon demonstrable pathologic alterations in the brain tissue which will form the basis of the psychiatry of the future. That the so-called "functional psychoses" will ever entirely disappear from the classifications is perhaps hardly to be hoped, and while they exist they make up the pre-eminently fluctuating portion of our material. A purely symptomatologic diagnosis, or even an elaborate "clinical" one, which is after all only the *n*th power of the symptomatologic, if unsupported by laboratory facts will never become binding for observers of subsequent times. Thus fell one by one into disuse the various systems which taught that insanity was a primary and independent disease of the mind or soul, without reference to its physical basis.

If one were to assemble all the conditions which various authors have described under the single designation "melancholia," one would have a tolerably complete list of known and unknown mental anomalies.

In its earliest usage melancholia meant simply madness. Hippocrates refers to it as a variety of mania associated with gloom. Most writers up to the time of Esquirol use the term to denote all cases of so-called partial derangement of the intellect, on the assumption that depression is usually an accompanying feature.

Chiarugi³ toward the close of the eighteenth century insisted that in the disease commonly known as melancholia, which he also described as a partial insanity in contradistinction to mania which represented a general insanity, the important and characteristic symptoms were the *fixed ideas*. The nature of the affect-tone Chiarugi looked upon as of secondary importance. A patient suffering with melancholia was not necessarily depressed, anxious or fearful; he might even show the symptoms of mental exalta-

³ Beiträge zur psychiatr. Klinik. Sommer., Bd. I, H. 4, 1903.

tion. Cullen's *partial disturbance* of the understanding, and the *mania* of Haller are brought together by Chiarurgi under melancholia, the insanity of fixed ideas; and the *insania hilaris* of Celsus, while included in the same general category is denominated melancholia spuria.

Chiarurgi indeed recognised the inconsistency of applying the term melancholia to patients who had no symptoms of depression and suggested that were it not for the general acceptance and understanding of the word in its perverted sense he should advise replacing it by the denomination, *insanity of fixed ideas*. It remained, however, for Esquirol to separate these cases described by Chiarurgi and place them together in a distinct group for which he originated the name *monomania*.

Pritchard, in his treatise on insanity (1835) did not recognise melancholia as a separate disease, but made it one of the varieties of his all-embracing *moral insanity*.

Such are some of the phases in the history of melancholia, the modern type of the functional psychoses, and originally the generic term for all forms of madness.

In view of the facts that no system of classification has yet been found which will without forcing account for *all* the cases which present themselves, and that the founders of systems the most widely adopted in their time, admit that in a fourth to a third of their cases an absolutely certain diagnosis is impossible, it is evident that a sufficiently extensive field still remains unconquered.

The best that is often possible is to describe the phenomena which present, and then to watch and wait, with note-book in hand. In this way material will be accumulated which will have more value for the men who come after than if the details of description had been left out and their place taken by diagnostic phrases.

The zeal for finding, as soon as possible, a diagnosis, after which through the arbitrary satisfaction of having "catalogued the case," searching observation of the patient relaxes, cannot but be pernicious. Better the seeking through the study of the actual conditions at the various stations along the incoming, central, and outgoing tracts of the patient's higher reflex arcs to ascertain in just what manner and degree he varies from his personal norm, substituting for the simple diagnosis which in

many cases is impossible, the composite mental picture thus obtained.

II.

The second method of investigation in mental disease, that of post-mortem section and the microscope, although its results may appear relatively small when we consider the definite relations which have long been recognised between structural change and clinical manifestations in other organs of the body, has nevertheless contributed in no small measure to the solution of many of the problems with which we have to do. It is, moreover, a method big with promise for the future, although in some quarters unfortunately, the enthusiasm with which pathological researches in the cortex were greeted following the discovery of improved methods of observation, has been allowed to cool as a result of the inevitable slowness with which the facts of cerebral pathology must accumulate.

Diseases of the mind must be regarded as diseases of the brain, and it is here that we must look, particularly in the elements of the cerebral cortex, for those alterations which underly the clinical symptoms which constitute the psychoses. Under ideal conditions both clinical and anatomical diagnoses should be possible, independent of each other, and upon comparison should be found to fit to the last detail. This is the distant goal which, from the facts at present available, may be considered doubtful of attainment, although it is slowly but steadily being approached.

The morbid anatomy of the individual psychoses began with the observations of Bayle in 1822 on dementia paralytica in which he described changes in the central organs, more particularly in their enclosing membranes, which he looked upon as characteristic of the disease.

Esquirol^{*} had pointed out that in certain patients the symptoms of dementia were complicated by disturbances of articulation and progression and sphincter paralysis, occurring in succession, and had shown that the discovery of such paralytic symptoms in speech and gait, in however mild a form, greatly increased the gravity of the prognosis. The two manifestations, however, of paralysis and dementia, he regarded as expressions of separate and

^{*} Dictionnaire des sciences médicales, t. viii.

independent disease conditions, associated as it were by accident. The paralytic phenomena represented a second affection complicating the dementia but not to be confused with it, "pas plus que les signes du scorbut qui complique souvent cette maladie ne peuvent être pris pour elle."

Bayle was the first to recognise that the various mental and physical symptoms which had so often been observed in association by Esquirol and his followers, were in truth all manifestations of one and the same disease, which he believed to be dependent upon a chronic inflammatory process in the meninges. "On ne saurait donc se refuser d'admettre que ces deux ordres de phénomènes sont les symptômes d'une même maladie, c'est-à-dire d'une *arachnitis chronique*."

At a time when the oil immersion had not yet been turned on the cortex, and when even its coarser internal structure was still a sealed volume, the alterations in the membranes, usually so pronounced, were naturally the first to attract attention.

Calmeil,⁴ in his report of sixty-four cases of paresis, likewise insisted upon the meningeal lesions as the chief characteristic of the disease. Patients which died from accidental causes and came to section during the early stages, and those which had presented the symptoms of paresis in but moderate degrees of intensity, showed only an inconsiderable but varying increase in the intracranial fluid, which remained clear, a corresponding dilatation of the ventricles, and a slight *apparent* thickening of the inner membranes due to "serous infiltration."

In those cases which died when the disease had run its course and which had shown the various clinical signs in typical intensity, the macroscopic findings were much more pronounced. Here was to be observed above all a clouding and thickening of the pia-arachnoid with adherence to the surface of the convolutions. The adhesions were, as a rule, most extensive and firm over the anterior and superior or inferior aspects of the hemispheres, but were often general, involving the whole surface of the brain, in some cases including the cerebellum. Decortication was the consequence of the attempt to strip off the pia.

In addition to an accumulation of fluid, clear, turbid, or san-

⁴De la paralysie considérée chez les aliénés, Paris, 1826.

guinolent, in the subdural space of brain and cord, Calmeil alluded to another particularly constant and characteristic appearance due to an excess of fluid in the subarachnoid cavity. This œdema of the membranes causes a separation of their layers and accounts in part for their increase in thickness. Moreover, it follows the pia between the convolutions, distending the fossæ, and gives to the whole surface of the hemispheres a peculiar appearance of soft gelatin which quivers when touched or jarred. The dilatation of the ventricles and the amount of contained fluid stood in proportion to the accumulation within the dura. Naked eye examination showed in the cortex wide departures from the normal in general appearances, color and consistency, while the underlying white appeared healthy in the majority of cases. The dura was in most instances reported normal. Hæmorrhagic foci were, however, noted both in the membranes and brain substance, as well as cortical areas of softening, ependymal granulations in the walls of the ventricles, and even changes in the calvarium itself.

Such were the beginnings of the pathology of paresis. They had to do only with macroscopic changes, but in this respect they must be regarded as tolerably complete, even to-day after a lapse of eighty years. Calmeil's capital finding, the thickened adherent pia, is the most prominent and constant naked-eye appearance in the paralytic brain. It was chiefly the adhesions to which Calmeil called attention, and both these and the actual hyperplasia and infiltration of the inner membranes often reach an extreme degree not approached in any other pathological condition.

The development of the finer microscopic technique, making possible a histologic differentiation of the psychoses, began with the introduction of elective staining methods, about twenty-five years ago. Previous to this, carmine, introduced by Gerlach in 1858, was the universal stain, and the fundamental facts of brain anatomy and pathology were worked out from carmine preparations. Inasmuch, however, as this method afforded only diffuse pictures in which everything was stained red, the only distinction being slight variations in shade, it is not surprising that finer anatomical relations, as well as the whole gamut of histopathological details as we now understand them, remained undiscovered.

The new era was ushered in by Exner, who discovered that by examining in ammoniated glycerin sections from material which

had been hardened in osmic acid, he obtained pictures in which nerve fibers, even those of the smallest caliber, such as were quite indistinguishable in carmine specimens, were stained black and stood out with great distinctness on a light background, all the other elements remaining unstained. The discovery of Exner formed the starting point in the development of the elective myelin sheath method. Its first fruits were the remarkable observations of Tuczek (1884), showing a progressive disappearance of the tangential and supraradiary fibers in the brains of paretics. This change, at first supposed to be specific in paresis, although especially characteristic of that disease, is now known to occur as well in other terminal conditions, notably senile and epileptic dementia.

As early as 1882 Weigert reported the first of a series of experiments which culminated in 1884 with his hæmatoxylin myelin sheath staining method, to which is due practically our entire knowledge of the normal fiber content of the brain, making possible the myelinogenetic studies of Flechsig and the production of the valuable atlases of Wernicke.

But fiber anatomy presents only one side of the question, and for the understanding of pathological processes going on in the cortex, by far the least important. There remained to be worked out an elective cell stain which would reveal in a constant manner the minute structure of the cytological elements of the cortex and their products, unobscured by fibers, thus supplying a picture complementary to that obtained by the Weigert method. To this subject Nissl had already turned his attention in 1880. During the ten years following he worked on his method, the development of which furnishes one of the most interesting chapters in microscopic technique, and published in 1890 his procedure in its final and perfected form.

It was now possible to institute studies which should clear up many of the questions of the anatomy and pathology of the *nervous elements* of the cortex, both cells and myelinated fibers. Another tissue, necessary to complete the picture, was still obscure, viz., the *non-nervous* intercellular substance, or neuroglia, and here again the task fell to Weigert's hand. In 1895, after seven years uninterrupted work he made public his elective glia-stain together with the results he had obtained with it in studying

the normal distribution of neuroglia elements throughout the central organs. Just as in the instance of the nerve fiber stain, so here in the case of the glia, it is the method of Weigert which has made possible the researches which have furnished the most of our knowledge of the intercellular substance, the origin, relations, and pathological changes of the glia fibers.

Such in brief has been the origin of the three most important technical procedures of which the brain histologist of to-day makes use. To them must be added among others the Marchi method for degenerated fibers, Van Gieson's method of collagenous connective tissue, and especially a third staining process of Weigert, his elective elastic tissue stain which is of so much importance in demonstrating syphilitic, arterio-sclerotic, and other vascular changes.*

The contributions of the microscope to psychiatry during the past twenty years have indeed been great, and the hopes for the future can be no less. By the combination of various elective staining methods through which definite constituents of the cortex can be isolated and studied separately as well as in their mutual relations, a collective appreciation of the character of the *disease process* has been attained in certain pathological conditions with an accuracy of detail before undreamed of.

What have been the results of the application of the new technique to the study of paresis, in furnishing the histopathologic counterpart of the excellent macroscopic pictures of Calmeil? First came the observations of Tuzek on the disappearance of the tangential fibers. Later, under the influence of the neurone doctrine, the nerve cell was kept tetanically in the center of the field until it was learned that of all the manifold alterations which the nerve cells present in cases of paresis there is none which is

* Our technical armamentarium is still deficient in two chief features. We have as yet no *fibril* method which can be relied upon for the determination of the *morbid changes* in these structures, and in the second place, in the intercellular substance, the nervous grey of Nissl, which remains after the nerve cells and their demonstrable processes, the glia nuclei, cell bodies and fibers, and the vascular elements of the cortex have all been accounted for, and whose presence has been assumed in explanation of the width of the supraradiary layers in man, particularly in the frontal convolutions. This tissue has thus far eluded every attempt at demonstration.

specific for the disease, none which is either a constant finding or which may not also be found in a variety of other conditions.

Finally the attention of histologists has been directed to the pathological process as a whole in its effect upon *all* the elements together which go to make up the central organs, and more particularly in its modes of expression in the cortex cerebri. It is largely the accumulated results of studies in the finer pathology of paresis which have made it now the best known of the mental diseases. The microscope to-day is the court of last appeal. In cases of doubt, when clinical signs fail or are inconclusive, the microscopic diagnosis is the most certain and trustworthy.

To review even summarily the various tissue alterations which taken together make up the definite pathological picture which is recognized as characteristic and specific for paresis, is hardly possible within the scope of this discussion. The disease-process is a diffuse one in two senses; first, that no region of the cortex is spared, although the widest variations in intensity may be observed, the occipital pole of the hemispheres in typical cases often showing but slight manifestations of the disease while in the frontal lobes the most advanced degenerative changes are found; and second, that it is not a lamellar condition affecting by preference certain levels of the grey, but ravages the cortex without discrimination from pia to the medulla.

In normal brains the only native constituents of the grey substance are ectodermal in origin, the blood vessels being, as Weigert pointed out, nothing more than foreign structures penetrating from without, and not representing part of the brain parenchyma, just in the sense that the alimentary tract is merely a continuation of the external surface of the body, its contents lying really without the organism. Weigert demonstrated a glia sheath bounding the adventitia of the blood vessels without, which is continuous with the subpial glia network; and the surfaces adjoining the vessels but separated from them by the glia sheath he designated collectively as the *internal surface* of the cortex. Moreover the white blood cells which have been widely stated to occur, even normally, scattered promiscuously through the grey matter and to lie often in the pericellular spaces, have been shown by the experimental work of Nissl, not to wander, as a rule, even pathologically, beyond the confines of the vascular adventitia, ex-

cept in cases where tissue relations are utterly destroyed, as in hæmorrhagic foci, abscess, etc.

While then normally, only ectodermal derivatives are to be looked for in the cortical parenchyma, in paresis, a new mesodermal element makes its appearance and is often present in astonishing numbers. These rod-shaped structures (Stäbchenzellen) are derivations of the elements in the vessel-walls, and might be assumed theoretically to occur in any condition in which vascular proliferative activity is pronounced. This is, however, by no means always true, for while in paresis they accompany a more or less marked capillary new formation, in other conditions with even greater capillary proliferation, as when tissue defects resulting from focal necroses are to be filled, rod-cells may be sparingly present or absent entirely. In healthy animals, used for experiment, rod-cells have not been found. Their presence, therefore, in such characteristic abundance in paresis suggests rather a regressive than progressive vascular change. Along with new capillary sprouts, these elements are given off prodigally from the vessel parietes, wander a certain distance and lie isolated in the surrounding tissue. They subserve no apparent function, have not been observed subsequently to contribute to the formation of new capillaries, and sometimes show degenerative changes in their cell protoplasm.

A second mesodermal form derived from the vascular walls, the *reticulated cell* (fat granule cell, epithelioid cell, corps granuleux, inflammatory cell of Friedmann, compound granular corpuscle, Gitterzelle of Boedecker, Juliusburger, and Nissl), which is the wandering phagocytic cell par excellence of the nervous system, is also an occasional appearance in paralytic brains, but is observed only in connection with necrobiotic foci, as in an area of softening following hæmorrhage, where its phagocytic function is called into service in removing the broken down ectodermal structures of the region as well as the escaped hæmatogenous elements.

In the vascular system itself, beside the progressive and regressive alterations in the various mural elements, the *infiltration of the adventitial sheath* with lymphocytes, plasma cells, first discussed in connection with paresis by Alzheimer, and an occasional mast cell, is the one phenomenon which gives to the para-

lytic cortex almost macroscopically its striking and characteristic appearance.

Among the cortical constituents proper, the ectodermal elements, ganglion cells and fibers and neuroglia, regressive changes in the former and progressive changes in the latter go hand in hand; yet in no other diffuse disease process are such luxuriant outgrowths of glia met with as in paresis. Not only are the intercellular substance of Weigert greatly increased both as to number and size of the individual fibers, and the subpial and extra-adventitial mesh markedly thickened, but the protoplasmic cell bodies themselves show often enormous hypertrophy, as well as a very considerable increase in the total number of elements. Among the proliferative forms, the peculiar type with large pale eccentric nucleus and greatly exaggerated cell body (*gemestete Zelle von Nissl*) perhaps generally known as the giant spider-cell is pre-eminently characteristic. Another increase-form among the supporting elements, the *glia clusters* and *nebulae* are also particularly common in paresis.

Taken together the various pathologic findings, the more important of which have been mentioned, make up a microscopic picture, which it is impossible to confuse with any other condition. The irregular disappearance of the ganglion cells, the overgrowth of glia, the profound alterations in the intercellular substance, the often enormous increase of smaller blood vessels, the extensive adventitial infiltration, and the invasion of the cortex by hordes of mesodermal elements, all these factors contribute to a greater or less disorganization of architectonic relations, both in the breaking up of the columns of Meynert and the confusion of lamellar boundaries, which transforms the beautiful orderliness of the normal cortex into veritable chaos.

This picture may confidently be looked for in every case of dementia paralytica, it being understood that the *degree* of the progressive and regressive processes in the several categories of native and new formed elements, and the relation between the changes in one tissue and those of another, may vary within wide limits, not only in different cortices, but even in different areas of the same hemisphere. Alzheimer⁶ has recently covered mono-

⁶ Nissl's *Histologische u. Histopathologische Arbeiten*, Bd. I.

graphically practically the entire field of the cortical pathology of paresis, furnishing illustrations of the chief types of morbid elements to be encountered.

It is readily understood why paresis was the first psychosis to which microscopists directed their attention, and also perhaps why it has been only within very recent years that the systematic histologic analysis of the cortex has been undertaken in all mental cases of whatever nature, whether presenting recognizable macroscopic abnormalities or not. In the short time, however, the foundations have been laid for an anatomical differential diagnosis which is bound to play a rôle of increasing importance in the collective study of clinical forms. In the first place the normal regressive changes which characterize the cortex in the senium have been worked out, and from these have been separated by reason of their greater intensity and the occurrence of certain peculiar appearances in glia and ganglion cells, the cortical alterations which must be assumed to underlie senile dementia. These changes are, as a rule, most pronounced in the upper layers of the cortex.

Nissl has further described in katatonia a peculiar type of proliferative glia, which in contradistinction to senile dementia is found by preference in the deep layers of the cortex below the granular zone. He does not maintain that this glia form is specific for katatonia, but he declares, that in no undoubted case of katatonia in which he has had the opportunity of examining the cortex has it been absent, while its possible presence in other conditions appears to be merely accidental, and indeed rare. This type of glia differs fundamentally in morphology from that which is typical of senile dementia, and both of these again are entirely different from the forms which characterize paresis. Alzheimer has demonstrated in Weigert glia preparations a phenomenon in which the proliferating satellite cells, two or three of which may occur normally in close proximity to the ganglion cells, give off processes which closely embrace (*umklammern*) the body of the nerve cell to its apparent damage. In elective cell-preparations this condition presents the picture of so-called *neuronophagia*.

Alzheimer has further contributed to our knowledge of the pathology of the cortex by his studies in arterio-sclerosis. In 1894 he described clinically and pathologically under the name of *arterio-sclerotic brain atrophy*, a condition formerly confused with

paresis, but which he showed to have nothing to do with that disease. At the same time Binswanger enriched the field of cerebral pathology with the picture of *chronic diffuse subcortical encephalitis*, a disease also dependent upon arterio-sclerotic changes. Later Alzheimer added two other forms, *perivascular gliosis* and *senile brainwasting* (Rindenverödung), both of these and Binswanger's subcortical encephalitis representing subforms of the general condition, cerebral arterio-sclerosis.

The differentiation of the arterio-sclerotic psychoses, characterised by rapid exhaustibility, impossibility of sustained mental effort, affective depression and apprehensiveness of wavelike intensity, defects of memory, especially of the recording faculty (Merkfähigkeit), aphasic and other focal symptoms, with intercurrent seizures varying in severity from vertiginous to apoplectic-form shocks, the symptoms appearing late in life and resting upon a definite anatomical basis, has been one of the distinct gains of later psychiatry.

Diffuse cerebral syphilis is another primarily vascular condition which can, however, usually be separated both anatomically and clinically from other forms of arterio-sclerosis, as well as from general paresis.

Along with the clinical study of cases, a diagnostic measure of considerable importance which has recently been brought into service in connection with the pathology of the psychoses is the intra-vitam examination of the cerebro-spinal fluid.¹

The simple therapeutic lumbar puncture introduced by Quincke in 1890 was first turned to cytodiagnostic purpose by Widal in 1900. As a diagnostic measure it includes the systematic investigation of the physical, chemical, cytological and bacteriological reactions of the fluid obtained by lumbar puncture. Bacteriological examination is especially called for in the differentiation of the several meningitides.

¹Widal, Sicard, Ravaut, Soc. d. Biol., 13 October, 1900; Sicard, Le liquide cephalo-rachidien, Paris; Schäfer, Allg. Ztschr. für Psych., Bd. LIX, 84; Dupré et Devaux. Bull., d. l. Soc. méd. des Hôpitaux, 13 June, 1901; Nageotte, *ibid.*, 31 January, 1901; Séglas et Nageotte, *ibid.*, 13 June, 1901; Guillaumin et Parant, Rev. Neurol., 30 April, 1903; Joffroy, Annales méd-psychologiques, Sept., 1901; Ravaut, Annales d. Dermatol. et d. Syph., January and July, 1903; Campbell, Review of Neurol. and Psychiatry, January, 1904; Nissl, Centralbl. für Nervenheilk. u. Psych., April, 1904.

Regarding the nature of the cerebro-spinal fluid itself and its alterations in disease, by use of the technique of Widal, many facts have already been accumulated, the more important of which may be thus summarised. In the normal fluid are to be found traces of serum globulin, while serum albumin is absent or present in extremely small quantities. In paresis, even in the very early stages, albumin is increased in amount, usually in considerable degree. Guillain and Parant examining sixteen cases of paresis found a constant well marked albumin reaction, while in twenty other cases of various psychoses the reaction was negative. Nissl in a series of seventeen sure cases of paresis obtained in each instance a positive reaction, and in forty-one other cases found albumin absent (except in several patients with luetic infection or definite meningeal involvement). The finding of albumin is not peculiar to paresis, but merely implies an organic meningeal lesion; it occurs in tabes, or any exudative meningitis, and may be observed following hæmorrhage (cerebral arterio-sclerosis).

Parallel with the albumin reaction is an increase in the cellular elements (lymphocytes) of the fluid. Normally one sees but one to three elements in an oil immersion fluid. In paresis a marked increase is the rule, and they may be present in such numbers that counting becomes difficult. In any mental case showing the chemical and cytological reactions, paresis is the first disease which has to be reckoned with. Albumin and lymphocytosis are usually associated, but not always and the albumin reaction is the more constant of the two.

If a suspected case gives negative results at the first examination, if it be paresis the fact is usually established at the second or third puncture, undertaken after intervals of not less than ten days to allow the subsiding of any possible reactionary lymphocytosis following the first operation.

The various involutional and senile psychoses, alcoholic insanities, the maniac-depressive and dementia-præcox groups as well as the so-called functional neuroses furnish regularly negative results; and in affording an additional means of early excluding these forms from among the differential possibilities in certain obscure cases of paresis or other chronic brain disease with meningeal involvement, cytodiagnosis fills an important place among our methods of examination.

A further chemical reaction, that of cholin, was first observed by Mott and Halliburton in the blood and cerebro-spinal fluid of patients suffering with paresis. Cholin is one of the katabolic products of the fat contained in the myelin sheath of nerve fibers, and the original supposition that its presence in the blood and cerebro-spinal fluid was limited to cases of paresis has been disproved by subsequent observations, both of the discoverers and of a number of other investigators. Mott found it in two cases of beri-beri, "where the disease had been of sufficient duration to give the Marchi reaction in the nerves; but in another case, in which the patient had died in the early stage from heart failure, there was no evidence of cholin." Gumprecht demonstrated its presence in cases of meningitis. Donath found it in nearly all cases of epilepsy, Rosenfeld showed it to occur in a variety of organic diseases of the nervous system, tumor, encephalitis, apoplexy, multiple sclerosis, epilepsy, paresis, tabes, Korsakoff's psychosis.

Representing as it does a normal product of the breaking down of nervous tissue the amount of cholin obtainable from the cerebro-spinal fluid may be taken as an index of the extent of the degenerative process. That it was first detected in paresis is easily understood, as Mott observes, from the fact that paresis of all diseases is the one which presents the most far-reaching downfall of the nervous parenchyma.

III.

The third viewpoint for the study of mental disease, that of psychological experiment, is the newest and consequently least well known and appreciated among alienists. Experimental psychology had its birth in the laboratory of Wilhelm Wundt in Leipzig in 1879, since which time similar laboratories have been founded in many of the other German universities and abroad. In no other country, however, has the growth of experimental psychology been so rapid as in America, where the pupils and disciples of Wundt have given themselves to the work with a devotedness of purpose which commands the admiration of the Germans themselves.

This work both at home and abroad had yet no direct connection with medicine, and between psychology and psychiatry there

existed a lamentably wide gulf, a gulf which still exists in the majority of institutions. On the one hand, alienists have not been trained psychologists, and on the other, the psychologists have, as a rule, had little or no knowledge of clinical psychiatry. It remained, therefore, for Kraepelin to institute the bridging of the gulf by organizing in 1890 a laboratory for experimental psychology in Heidelberg in connection with the university psychiatric clinic, in which both normal and pathologic mental conditions should be studied by the same experimental tests. In this way he hoped to arrive at a closer analysis and understanding of the symptoms which constitute the various clinical pictures than had hitherto been possible. How far he has been successful, a look through the "Psychologische Arbeiten" will show. This publication, devoted exclusively to the experimental researches of Kraepelin and his pupils was founded in 1894, and now fills four large volumes, a survey of whose contents suffices to indicate how important a place this precise mental vivisection occupies in the analysis and diagnosis of diseases of the mind.

With the removal of Kraepelin to Munich, a new psychological laboratory has been set up in the psychiatric clinic of that city from which the "Arbeiten" will continue to be published, while the one in Heidelberg has ceased to exist. A second laboratory was established by Sommer in the psychiatric clinic in Giessen, and a third is to be opened in Tübingen. These, with the laboratory at Berlin under Ziehen, are at present the chief places where psychologic experiment forms a regular and important part of the armamentarium of the alienist. The method thus inaugurated has contributed very materially to the knowledge of insanity, both in throwing light upon the pathogenesis of symptoms, and in correcting the conclusions of clinical observation.

The observer has to do in the first place with the exact measurement of various mental processes in health and disease. Studies in the *simple reaction time* (interval required for receiving a sensory impression and translating it into a motor response measured in thousandths of a second) in normal individuals, showed that there were two chief reaction-types, muscular and sensorial. In those subjects whose reaction is of the muscular or motor type, the attention during the experiment is fixed upon the execution of the movement, hence in these individuals the reaction

time is short and errors are fairly common, both from misinterpretation of the sensory impulse and from the tendency to premature reaction. On the other hand persons of the sensorial type fix the attention on an earlier point in the reaction-circuit, namely the incoming sense-impression. Their interval is, therefore, longer than that of the motorists, and their errors correspondingly fewer. The time of the simple reaction to auditory stimuli averages about 125 σ ($\sigma = .001''$).

In addition to the simple reaction, other more complex methods are made use of, such as those involving a definite act of recognition of the form of the stimulus, those involving acts of decision and choice, and finally those requiring various forms of associative activity. The value of the application of these tests in accessible mental cases is obvious. In maniacal excitement, for example, the simple reaction interval may be shortened as a result of the increased psychomotor irritability, but on the other hand, associative activity in spite of the apparent hyperfunction, is actually diminished, the assumed increased rapidity of cerebration being in reality a deception, according to Kraepelin resulting from the greater divertibility of the attention and the increased facility of motor discharge.

Normal and abnormal *phenomena of association* have been the object of a special series of observations by Aschaffenburg who defines four great groups as follows:—(1). Inner associations, (2). Outer associations, (3). Sound associations, (4). Indirect associations.

Inner associations are those which stand in the relation of cause or effect, coordination, subordination, or predication to the original word used as stimulus.

Outer associations are those whose relation to the original word is merely one of co-existence in time or space, of speech reminiscence or of similarity or identity.

Sound associations are such as depend not upon the sense of the stimulus-word but upon its sound-image, and may consist in the addition of syllables to the original word to make a new one, the meaning of which has no connection with the first. In this group also belong the rhyming associations both senseless and meaning.

The fourth great group of *indirect associations* are those in

which the relation of the response to the stimulus must be sought in an unuttered usually subconscious intermediate association.

Aschaffenburg showed that in experimental fatigue resulting from a night's watching the number of sound associations was greatly increased at the expense chiefly of the inner associations, the latter representing the highest type of associative activity, the sound associations the lowest. Studies such as these are of great significance in the consideration of the pathogenesis of symptoms in actual alienation, in which conditions of exhaustion are so often the underlying factor.

Aschaffenburg found that in alcoholism, as well as in mania the sound associations were increased in frequency and the inner associations decreased, just as in his experimental fatigue, and he associated this altered ratio with the increased motor excitability which is characteristic of all three conditions. The group of conditions belonging to Kraepelin's exhaustion psychoses present in their general characters merely the symptoms of the experimental fatigue writ large.

Gross in an extensive series of observations on the *handwriting* determined in detail the character of this method of psychomotor expression in health, and followed its variations representing changes in the personality in various psychoses. He described particularly the character of the writing-curve in various forms of maniac-depressive insanity and in katatonia.

The work of Michelson on the *depth of sleep* demonstrated the nature of the two great sleep-types, characterising respectively the morning worker and the night worker. In the first type, sleep is profound in the early part of the night, or within the first half-hour after going to sleep, and becomes shallow during the early morning hours. The individual awakens early, feels refreshed and is capable of doing his best work before noon.

In the second type profound sleep is reached only after several hours, and there is no such marked decrease in depth with the approach of morning as in the first type. Persons belonging to this class are usually unfit in the morning and their working capacity gradually develops during the day, so that they are capable of their best effort during the afternoon or at night. The great body of neuropathic individuals of our generation belongs mostly to the night-worker type.

To review the four volumes of the "psychologic studies" is entirely beyond our present purpose. For this the reader is referred to Weygandt's⁸ comprehensive résumé, also to Hoch's⁹ briefer review.

The researches themselves furnish the groundwork for a scientifically accurate conception of insanity, embodying as they do the application of the exact laws of the psychological laboratory to the clinical consideration of mental cases. Particularly suggestive are the studies on the psychological effects of drugs and poisons; and the demonstration of the relation between anatomical changes in various forms of intoxication (as revealed by post-mortem section and by animal experiment), and abnormal mental function furnishes one of the most immediate and fruitful problems in cerebral pathology.

In the estimation of the psychic condition of an individual the chief criteria furnished by the studies of the Kraepelin school are these:¹⁰

(1) Determination of the mental *functioning-capacity* (Leistungsfähigkeit), represented by the rapidity with which simple mental processes take place. The three chief points here to be taken into account are, (a), perception of sensory impressions, (b), association of mental images, (c), execution of voluntary movements.

(2) Measurement of the effect of *practice*, or the increased functioning-capacity through exercise (Uebungsfähigkeit).

(3) Quality of *general memory* or the *permanency* of increased functioning-capacity through exercise, measured after considerable intervals of time (Uebungsfestigkeit).

(4) Estimation of the functioning-capacity of the various forms of *specialised memory* as shown by the fixity of sensory impressions, associations and motor sensations.

(5) Effect on the functioning-capacity of the stimulus developed through a period of uninterrupted work, in other words the capacity for *warming up* to a task (Anregbarkeit).

(6) Measurement of the degree of *fatigue* (Ermüdbarkeit) after long continued work.

⁸ Centralbl. f. Psych. u. Nervenheilk, Jan.-März, 1903.

⁹ Psychol. Bulletin, June 15, 1904.

¹⁰ Psychol. Arbeiten, Bd. I, H. i., pp. 63 ff.

(7) Measurement of the capacity for *recuperation* from fatigue or exhaustion (Erholungsfähigkeit).

(8) Determination of the *depth of sleep* at successive intervals during the night.

(9) Measurement of the capacity for resistance to disturbing influences, or of the amount of diminution of the functioning-capacity under the influence of irrelevant sensory impressions, in other words the degree of *divertibility of the attention* (Ablenkbarkeit).

(10) Estimation of the ability to disregard continued disturbing influences through *habituation* to them (Gewöhnungsfähigkeit).

The researches of the Heidelberg School are important not only in the analysis of the factors which bring about abnormal mental states, and in supplying new diagnostic and therapeutic indications to clinical psychiatry; in addition, it is a part of the original plan of Kraepelin that each piece of experimental work should include a discussion of the value of the *personal equation* in influencing the results. With this in view the test-persons in a given series of experiments are separated into groups according to their manner of reaction and the quality of their work thus determined, in short, according to their *functional-mode*, and the characters of the psychic activities of individuals and groups of individuals are defined in so far as the range of the given experiments makes possible. In this way a foundation based on laboratory methods has been laid down for a broad *individual psychology* which is not alone of such inestimable significance in the appreciation of cases of mental alienation, before all, the borderline cases, in showing that an arbitrary *norm* by which mental health or disease may be estimated does not exist; but which plays a capital rôle in the larger question of education, upon the merits and faults of which the sanity of the nation in such great part depends.

In the foregoing pages reference has been made to some of the methods, attainments, limitations and possibilities of the newer psychiatry. In like proportion as the efficiency of our methods of observation has increased, has increased the complexity of the problems to be solved. The goal is not to be reached by the clinician alone, nor by the anatomist and pathologist, nor by the chemist or psychologist alone. All laboring together will still

find before them a hundred years hence a field as limitless as that which confronts the workers of the present generation. But withal it is no mean record which the closing years of the nineteenth century have to present; they have brought it about that our science, instead of being a subordinate, little understood and little cared for branch of knowledge, has become in its many sided developments and relations one of the broadest and most important departments of medicine.