KATATONIA.

BY MM. T. SÉGLAS AND PH. CHASLIN.

EFFORTS are always being made to group together some of the numerous scattered facts existing in the wide field of insanity, in order to constitute distinct pathological forms. General paralysis remains till now the only undisputed one, although other attempts have been made, more or less justified. We intend to examine here one of those efforts, concerning which authors are not yet agreed, and which has been described in Germany as *katatonia* or *Spannungs Irresein*.

I.

The first and principal work on *katatonia* dates from 1874 and is due to Kahlbaum¹ who tries in an important monograph to define a form of disease in which certain physical, and more particularly muscular symptoms accompany (as in general paralysis, and as frequently) certain psychical phenomena, and play a leading part in the whole morbid process.

This new form of mental derangement may be closely allied to *melancholia attonita*, which is ordinarily considered to be a distinct disease. On careful examination of cases of the latter disease we can very often according to Kahlbaum discover at the onset epileptiform seizures or other manifestations of spasmodic attacks. These conditions become permanent, attain their greatest development in the *flexibilitas circa* stage of the mental condition and merge into the final stage of *dementia*. These symptoms are by their importance placed on a line with the paralytic phenomena of general paralysis. By their side, and in ad-

¹ Kahlbaum, *Die Katatonie*, Berlin, 1874.

dition to the usual symptoms of melancholia attonita, we find other physical, and more especially psychical, phenomena, notably a particular form of exaltation, which may be termed "pathetic ecstasy," as well as a tendency to speak as if discoursing or to recite, which gives a characteristic physiognomy to the disease. All these symptoms constitute what is called Katatonia, and up to a certain point this form of disease should be considered as a counterpart to certain forms of general paralysis with or without grandiose delusions. Analogous to general paralysis as regards the succession of the different psychical phenomena in connection with the muscular symptoms, they seem to differ from it, on the contrary, by the quality of the muscular and psychical manifestations, and consequently a marked difference is to be found in the prognosis.

If we study all the psychical phenomena of katatonia, it will be found that this disease exhibits in succession the chief forms assumed by diseases of the mind, such as melancholia, mania, stupor (*attonität*), intellectual enfeeblement, and finally dementia. The intellectual enfeeblement is generally accompanied by delusional conceptions, which are active but badly arranged, and often even incoherent (*Verwirrtheit*). The duration of each state is very variable, and frequently we find alternations of depression and excitement, but on the whole, the melancholic stage is of longest duration. Melancholia with stupor either follows immediately upon the primary melancholia, or is more frequently separated from it by an attack of mania. It should be remarked that in the cases where this attack of mania is absent there has often been some such outburst of excitement at a previous period of the patient's history. In very rare cases the disease commences with a condition of stupor, and this happens chiefly where there have been violent physical or moral shocks, such as an intense fright, injuries, hanging, &c. At other times excitement succeeds on an attack of stupor of short duration; or it may be a condition of intense melancholia followed by a state of stupor with or without a period of maniacal excitement, which latter may be considered as a further development of the morbid process.

Sometimes in the midst of a long period (weeks or months) of mania there appear only a few days of stupor. In other and rarer cases the stupor alternates with a condition of speech-incoherence. The terminations may be dementia, recovery or death. There are also cases where the katatonia develops itself in the midst of a condition of nervous excitability or of general physical depression, but then the katatonia does not commence with a period of melancholia (unless a mild attack of hypochondria be so termed), but with a period of mania.

In the majority of cases the stupor lasts longer than any of the other periods, but it must be noted that the transition to dementia takes place in an imperceptible manner.

However it may be, the condition always presents a marked cyclic character. Usually it commences slowly and progressively, later on the katatonia attains to a condition of crisis, and lastly it abates, passing into a condition of dementia. In many cases a state of general verbal confusion develops itself after the stage of stupor and before the complete dementia, and this stupor is preceded by a maniacal period separating it from the initial melancholia. The stupor may therefore be considered to indicate the onset of the period of decrease.

As regards the particular symptoms, they present nothing very special, except those of the stage of exaltation. As a whole there is either agitated melancholia, or the most violent excitement, or else a more regular and systematised delirium (*Wahnsinn*). We then meet certain symptoms peculiar to katatonia which enable us to make the diagnosis even antecedent to the period of stupor. First there are the *pathetic characteristics*, in the form of theatrical exaltation, and of tragico-religious ecstasy, in which the patients both speak and act. They recite and make speeches perpetually, gesticulating all the time, arriving often even to the idea that they wish to become actors, or even that they have already attained to their ambition. They utter the most commonplace remarks as if they were convinced that those expressions were of supreme interest to mankind, or they speak of most serious subjects much above their knowledge, and without express-

ing well-defined grandiose delusions, they believe at last that the world is particularly interested in the trifling events of their existence. The mania of reading, speech-making, loudly reciting (*Redesucht*), which one meets during the stage of exaltation is very different to the senseless words and cries of the ordinary maniac. Among the other characteristics peculiar to katatonia we notice a tendency to the repetition of words and phrases without any meaning, and without following each other in proper sequence, but pronounced as if the patient were holding a discourse. This "verbigeration" is a co-ordinated spasm of the muscles of speech originating in the cerebral speech centres, and is absolutely special to katatonia. It must not be confounded with the idle, senseless talk of the ordinary loquacious elements (*Verwirrten*), and mentally enfeebled, with the ordinary reciter, with the person of flighty ideas (*Ideenflucht*), or with a condition of *confabulation*.¹ In the course of the disease however the verbigeration can be transformed into any of these other forms; moreover, along with the verbigeration we must note the remarkable habit of frequently using diminutives. With regard to the dumbness of the stage of stupor, it may be absolute or relative, partial or intermittent. Sometimes it is voluntary (owing to the fear produced by a delusional idea, or a hallucination), at other times it is involuntary (from an absence of ideas and incapacity of attention), and in other cases the condition remains inexplicable. Whilst the speech-making loquacity (*Redesucht*) is attributable to a clonic convulsion, the dumbness seems on the contrary to be due to a tonic convulsion.

Frequently during the period of stupor there seems to be an entire absence of the formation of ideas, a cessation of the thinking processes; at other times one may discover, on the one hand, delusional ideas with hallucinations, such as are found in melancholia, and on the other hand ideas of grandeur, such as of illustrious birth. Again, some patients are not a prey to depressing thoughts during the stage of stupor,

¹ "Confabulation" is distinguished from "verbigeration," by its character of creative and phantastic imagination (*phantastisch-productiver Inhalt*). Kahlbaum; *loc. cit.*, p. 39.

but on the contrary, they seem to have from time to time amusing impressions, as is shown by their occasionally laughing. Ideas of a religious or erotic character are said to be very frequent.

It is likewise to be noted that in katatonic insanity there is a condition of monotonous movement and a resistance offered to any interference, especially when one attempts to give another direction to these movements. The katatonic patient likes to remain in bed and even refuses food during the stage of excitement—sometimes from a fear of any change in position or movement, but generally without reason, whether delusional or not. Further, there is a certain tendency to make stereotyped gestures, or to assume ridiculous attitudes, to make peculiar grimaces, more particularly puckering the lips (*schnauzkrampf*), even from the beginning of the disease, or during the remissions when delusions are no more apparent.

As regards the physical symptoms, they are all based upon a disturbance of the motor nerves. Very frequently, and especially during the stage of stupor, we may observe a relaxation of the limbs; we may also find, even from the beginning of the disease, choreiform convulsions, epileptiform, or tetanic spasms. These convulsions may be general or partial in their distribution. The convulsions whether clonic or tonic must be ascribed partly to the psychical state, and partly to the physical condition. We never find real motor paralysis: we may find anæsthesia, more or less complete, apparent or real; hyperæsthesia is frequent, and localised occipital cephalagia is pretty characteristic of katatonia.

Amongst the other physical phenomena let us notice the frequency with which the legs are swollen; sometimes there is œdema of the eyelids; there is abundant cutaneous desquamation, marked anorexia, the breath is foul; there is disturbance of the gastro-intestinal functions, and, finally, chlorosis is not uncommon. We must also note the importance and excessive frequency of phthisis in this disease—rare according to Kahlbaum in other mental conditions. This last fact will have to be opposed to the predominance of pneumonia in general paralysis.

According to Kahlbaum the ætiology of katatonia offers nothing very particular; heredity seems to have very little influence in its production, and sex does not influence its frequency, but the disease is most prevalent in youth and adult age. Sexual excesses and onanism in youth seem to create a serious predisposition to it. With women we might attribute the cause either to pregnancy or to the puerperal state. Overwork and excessive religiousness seem to play an important part in the causation, and we count among those subject to katatonia a large number of schoolmasters, the sons of schoolmasters and theologians. Further anæmia and a general condition of nervousness seem to occupy the first position among the predisposing causes. The occasional causes are those of the other forms of mental disease; we must not omit however to refer to certain forms of traumatism, more especially hanging, as occupying an important ætiological position. It would also seem to us that imitation plays a part in the ætiology, from Kahlbaum's point of view, for he classifies under katatonia the epidemics of the convulsionists and preachers (Suède).

The prognosis of this affection is upon the whole favourable, and in this again it differs from general paralysis: habits of antecedent self-abuse seem to aggravate the disease. Apart from tubercular complications, katatonia may cause death; if cured, a relapse never occurs, and it does not exercise any hereditary tendency in the children of persons who have suffered from it. However, let us remark in passing, the author seems to us to have little faith in degeneration in general.

With regard to the pathological anatomy, Kahlbaum reports very extensively the results of seven autopsies of persons subject to katatonia, and he institutes a comparison between the pathological conditions found in his cases and those found in general paralysis. There seems to be in the early stages of the disease a condition of general stasis in all the cerebral vessels, along with serous effusion, which produces softening of the cerebral tissue without retraction or shrinking, but with the formation of exudation both on the coverings and ventricles. This exudation affects chiefly

the arachnoid membrane, and is especially to be found at the base of the brain. In old cases one finds some shrinking of the cerebral tissue, and the exudation partially organised. Contrary to what happens in general paralysis there are ordinarily no meningitic hæmorrhages, but the arachnoid is regularly the seat of pathological changes. In the cases where death has occurred at an early stage, the arachnoid was opaque over the pons, and the opacity extended over the cerebellum to the medulla oblongata immediately behind the fourth ventricle. In the other cases the arachnoid was found to be thickened in the same regions; further, there was a remarkable tendency for serum to exudate in the neighbourhood of the base of the brain, which accounts for the marked diminution in the number of the Pæchionian granulations.

According to Kahlbaum mental diseases in general are caused by disturbances in the nourishing processes which, commencing with hyperæmia and exudation, terminate in atrophy, dropsy, and finally the formation of new tissues. Katatonia acts in the same manner but with this difference, that the stasis is essentially transitory and weak in the early stage; the shrinkage and atrophy set in much later, thus preventing due dilatation of the cerebral cavities, contrary to what takes place in general paralysis. Moreover, katatonia has a predilection for the arachnoid and for the base of the brain, the exudation extending itself to the Sylvian fissure and towards the second and third frontal convolutions. This latter fact is of great importance in explaining the dumbness as well as the verbigeration. It must be added however that the arachnoid was not in every case altered in these special regions, and besides, the pia mater was not adherent to the subjacent convolutions in the majority of the cases.

An examination by the microscope has produced no results. Kahlbaum admits himself that these data are a little insufficient, but that they form a point of departure for future researches.

Pulmonary and intestinal tuberculosis are found very frequently. These may be complications, due secondarily to

the katatonia itself, the muscular rigidity producing imperfect respiratory action which might permit tuberculosis to develop itself in lungs insufficiently distended with air.

To sum up, katatonia is a cerebral disease, the characters of which change in a cyclic manner in such a way that the psychical symptoms present successively the forms of melancholia, mania, stupor, loquacious dementia (*Verwirrtheit*), and ending finally in complete dementia. To this picture of the whole disease there may be wanting one or more symptoms, but on the other hand there may appear, as the chief phenomena, affections of the neuro-motor system presenting the general character of muscular contractions. This form of disease thus distinguished approaches general paralysis with or without grandiose delusions, especially when considered from its clinical aspects. In general paralysis there are also symptomatic indications which change in a cyclic manner and are accompanied by disturbances of the motor-nervous system; here however having the characters of paralysis.

Closely allied to these two forms of such well-marked diseases we have to arrange a third form. In this latter the symptomatic evolution is equally typical; but when we consider the neuro-motor system we find an entire absence of symptoms. This last form which is frequently met with in asylums, exists as mania and it often terminates in recovery, and when it is contrasted with some complicated maniacal forms it may be termed simple or veritable mania.

To these forms pursuing a cyclic course we must oppose all the cases in which the symptomatic whole remains unvaried (partial insanities), and those in which the symptoms are changing and the course not cyclic (ordinary sympathetic, febrile and traumatic insanities).

Katatonia is not a partial alienation, but it includes among its symptoms, more or less, all psychical manifestations. It does not develop itself after physical diseases, but rather on a predisposed ground (anæmia), and, by its cyclic and typical course it differs from idiopathic and sympathetic forms of mental alienation.

One may distinguish epileptic, tetanic, choreic, cataleptic

and indifferent forms of katatonia ; but it is better to classify them as weak or simple cases, grave or complicated. Among the first class we may place melancholia attonita, which is already isolated as a separate affection in ordinary forms of classifications of mental disease, but which according to Kahlbaum may be termed a form of mild katatonia. For, during the condition of stupor one may always recognise some neuro-motor symptoms as well as convulsive attacks previous to the admission of the patient to an asylum, and which the doctor fails to notice ; and similarly there are frequently found short periods of excitement—a sort of passing mental exaltation—interrupting the ordinary course of the melancholic condition ; but with such rapidity and in such a transitory manner, that the aspect of the melancholia does not seem to be altered by it.

A second group may comprise cases in which after a melancholic beginning, mania sets in more or less pronounced, more or less durable, and which, disappearing before the stage of stupor appears, have been mostly described as cases of simple mania. Next come the cases where one notes neuro-motor symptoms of long duration, and so well marked that the medical attendant regards them as curiosities and complications without regular character (K. gravis). Finally, in the last form (protracted katatonia) the symptoms of excitement do not appear in the first half of the disease, but in the later stage, and mostly in the form of remissions and intermissions.

The diagnosis of this disease would be after all easy, and this is what Kahlbaum says of it : An isolated case of convulsions, considered as epilepsy, eclampsia, apoplexy, meningitis, or encephalitis, which appears in a condition of complete health or of mental trouble of a certain duration, and which (without determining paralytic phenomena) is complicated by excitement or intense emotional depression, leads invariably to a condition of dumbness without motive or at the very least to a cataleptic state. Lastly, it may be complicated by symptoms of resistance. If no recovery takes place a state of stupor will supervene. Or perhaps if we find a marked pathetic expression and an attitude of peculiar

stiffness in a patient who is acutely melancholic, we may be able to predict almost certainly the commencement of stupor (attonity). Again, if a patient who used to speak leaves off doing so and that permanently, the head and limbs being in a rigid condition, this disease is certainly katatonia. In the absence of further data one might confuse the apathy with the stiff and rigid habits of infantile dementia, or the evanescent mental outbreaks following physical diseases.

Only in two cases is the diagnosis really difficult. The first case is when in the commencing half of the disease the dumbness is not continual, and the neuro-motor symptoms have not yet appeared. The pathetic attitude, and the obstinate repetition of a word are then characteristic. The second difficult example will be in a case where melancholic symptoms without neuro-motor manifestations have existed for a long time, and where dumbness develops itself without muscular stiffness at all, and without alteration in the ordinary melancholic symptoms. The important symptoms for purposes of diagnosis will then be found in the repetition of a word or discourse, gesticulations and stereotyped attitudes, obstinacy and resistance.

Since the publication of the work of Kahlbaum we find a certain number of other authors who have written on the subject, some admitting, at least in the main, the descriptions and conclusions of Kahlbaum, and others criticising them. It is with the first class of authors that we will now occupy ourselves.

Hecker¹ reports in support of the opinions of Kahlbaum two cases of katatonia, to which however serious objections might be offered, and accordingly we will have to refer to them again later on. Brosius,² with regard to katatonia, insists upon the importance of the verbigeration, the absence of sudden changes in the emotional state, and the amnesia which follows the agitated periods. There would be no real mania in katatonia during the period of stupor; there is rarely a condition of emotional depression, but frequently a

¹ Hecker, *Allg. Zeitsch. f. Psych.*, 1877, Bd. xxxiii., p. 602.

² Brosius, *Die Katatonie (Allg. Zeitschr. f. Psych.*, 1887, Bd. xxxiii. S. 770.)

kind of ecstasy or general indifference. He believes that we can already distinguish three forms of katatonia :—

(1) *A meningitic form*, the prolonged course of which is connected with the residue of meningitis.

(2) Another form connected with *cerebral anæmia*, such as one sees frequently in the clinique, when the amelioration in the symptoms of katatonia runs parallel with that of the general health. Lastly there is

(3) A third form, namely, *cerebral œdema*, which has been described by Etoc-Demazy.¹

Kiernan² in two consecutive memoirs on this subject reproduces in substance the ideas of Kahlbaum. He refers particularly to the heredity of the strumous diathesis, to the facility of simulation on account of the regularity of the symptoms of the disease. He writes much about the pathological anatomy, and confirms by his own autopsies those of Kahlbaum, which show old but cured hydropsy and some basilar meningitis. The deductions of Meynert in Kahlbaum's cases lead him to think that the disease has been preceded by a meningitic process, localised to the base of the brain or over the fissure of Sylvius. According to Kiernan, katatonia is frequently preceded in infancy by basal meningitis of a tubercular character, extending itself likewise to the Sylvian fissure and fourth ventricle. With regard to this meningitis, he refers to the opinions of some authors as to the origin of the motor symptoms, convulsive or otherwise, accompanying the basal meningitis. He notes besides in passing that Meynert described katatonia as a particular form of melancholia attonita two years before Kahlbaum, and he cites the opinions of Meynert regarding the pathology and physiology of this affection—certainly very ingenious ideas, but they are perhaps a little hypothetical. In addition, he gives details of an autopsy, followed by microscopic examination, in which he again finds the remains of the tubercular meningitis, and a condition of venous stasis of vaso-motor origin; no other alteration was found except slight sclerosis of the white matter of the

¹ Etoc-Demazy, *Th. de Paris*, 1838.

² Kiernan, *Alienist and Neurologist*, 1882; *Detroit Lancet*, 1884.

spinal cord. He finds a great analogy between the state of the brain one observes in this condition and that found in cases of typhoid fever, but the essential and characteristic pathology of the disease is, according to Kiernan, a primary disturbance in the vaso-motor centres, producing sanguineous stasis, and this he maintains is the point of departure of the whole morbid process.

Hammond¹ describes katatonia as a special form of mental disease distinguished by alternating periods presenting themselves with more or less regularity of mania, melancholia and epileptiform and cataleptiform states, with primitive delusions of an exalted character and with a dramatic tendency. But after all this author adds nothing to the description of Kahlbaum, whose ideas he accepts.

Spitzka² classifies katatonia among the group of genuine mental diseases not being the essential manifestation of a neuropathic constitution, nor having any relation to the biological epochs. It figures in the class of diseases without demonstrable lesions of the brain, amongst those which are *primary insanities*, and characterised by expansive, fundamental or emotional symptoms (mania), depressive (melancholia) or pathetic (katatonia).

Neuendorff³ reports two observations which have been communicated to him, but presenting certain deficiencies, and which he compares to the katatonia of Kahlbaum, after a rather confused discussion, and without arriving at a very precise conclusion.

Schüle⁴ devotes a whole chapter of his book to katatonia and seems to differ in his opinions regarding it from those authors we have already referred to. According to him katatonia is a special form of systematised acute hallucinatory insanity⁵ (Wahnsinn), characterised by a nervousness of

¹ Hammond, "Remarks on Cases of Katatonia" (*Amer. Journ. of Neurol. and Psych.*, 1883, p. 302).

² Spitzka, *Amer. Journ. of Neur. and Psych.*, 1883, p. 313.

³ Neuendorff, *Centralblatt f. Nervenheilk.*, 1883, No. 23, p. 529.

⁴ Schüle, *Klinische Psychiatrie. Specielle Pathologie und Therapie des Geisteskrankheiten* (Leipzig, 1886).

⁵ A subject written upon by M. J. Séglas (*La Paranoïa. Arch. de. Neur.* 1887).

the muscles which are tense; this is sometimes permanent, at others intermittent or irregular, whilst at the same time the conscience of the individual—a victim to hallucinations and illusions—closes itself more or less completely to the influence of external perceptions. The motor rigidity may adopt a physiognomonic character, and as such express in a realistic manner an insane idea (such as the attitude assumed by a pugilist, a preacher, or one undergoing crucifixion) or something which may be purely physical (cataleptic or tetanic). The psychical stage may limit itself to the condition of acute insanity, or descend to the condition of real temporary dementia (stupor). Recovery is possible in both cases, but in the last it takes place after a period of marked intellectual weakening, with katatonic reminiscences at intervals. The course of the disease is cyclic and accompanied by a significant implication of the vaso-motor system which converts it into a true psycho-neurosis. The varying states of excitement depression and rigidity which one meets, seem (when their relations and order of succession are considered) to be connected with the course of the vaso-motor nerves. From its clinical aspect this form of insanity may be divided into expansive or depressive katatonia (with religious or demoniacal delusions), and further, into katatonia resting upon a basis of hysteria. While treating of hysteria, Schüle reverts to this subject and amongst the forms assumed by hysterical insanity, he describes katatonic *wahnsinn*. This very frequent form of hysterical *wahnsinn* generally commences in maniacal excitement; then there always arises the question of an "invalid" constitution (by birth or acquired) which is mostly associated with anæmia. The importance of puberty, self-abuse, &c., must also be noted.

A quite recent work by Clemens Neisser¹ also appears to support the existence of the disease which is now under our consideration. Neisser only admits the katatonia of Kahlbaum and rejects the description of Schule, who refers to it as a form of systematised mania (*Wahnsinn*). For according to him the motor difficulties are primary and

¹ Clemens Neisser, *Ueber die katatonie*, Stuttgart, 1887.

fundamental; the physical modifications being secondary and subordinate, and otherwise of little importance, as is indicated by Roller.¹ He admits also that the stupor is not necessarily a symptom of melancholic depression, but an essential part of the motor phenomena of katatonia and of that alone. While desiring to remain exclusively on the clinical and even "empirical" domain of description, he ventures to give physiological explanations as well, and he attempts—in following the ideas of Rieger²—to refer the cataleptic and other phenomena, the indications of opposition, &c., to the same cause, namely, the pathological innervation of the muscles antagonistic to those which must accomplish a given act. He reports besides a certain number of interesting observations which lead him to conclude that it is not merely some certain or special symptoms but the whole disease which constitutes a striking spectacle "to the eye and tact" of the clinical student, and this whole is katatonia. Neisser neither refers to the differential diagnosis, the etiology, or the pathological anatomy of the disease, and he does not occupy himself at all with the foundation on which it can develop itself.

II.

On the other hand, by the side of these authors who admit the existence of katatonia,³ there are others who express entirely opposite opinions.

Arndt⁴ rejects the existence of this disease as an essential form of *Spannungs-Irresein*.

¹ Roller, *Ueber motorische Störungen beim einfachen Irresein* (*Allg. Z. f. Psych.*, Bd. xlii., H. 1, 1885).

² Rieger, *Ueber Normale und Kataleptische Bewegungen* (*Arch. f. Psych. und Nerv.* Bd. xlii., 2, 1882).

³ We may be permitted to refer in this place to several monographs on katatonia, which we have been unable to procure: Rush, *Diss. inaug.* 1879; Rebs, *Ein Fall von katatonie*, Diss. Erlangen, 1877; Jensen, *Allg. Encycl.* Bd. xxiv. At one of the last meetings (Nov. 2nd, 1887) of the Medical Society of Berlin, referring to a communication by M. Moll, on "Hypnotism," M. Jensen described the katatonia of Kahlbaum, which he classed after the epileptic or unconscious states, and which, he said, closely resembled hypnotism (*Deutsche mediz. Zeit.*, Nov. 10th, 1887, p. 1026).

⁴ Arndt, *Ueber Tetanie und Psychose* (*Allg. Z. f. Psych.*, 1874, Bd. xxx., S. 28) and *Ueber Katalepsie und Psychose* (*Ibid* S. 53).

Westphal¹ admits, as does the original describer of katatonia, that the stupor is not necessarily accompanied by melancholia, and that it is sometimes found in delusional insanity (*Verrücktheit*) with most marked delusions of grandeur, but that katatonia is not a special form of insanity; it is only an acute and somewhat peculiar form of *Verrücktheit*, in which the motor symptoms do not possess the character of spasms, neither have they the importance which Kahlbaum wishes to ascribe to them.

Tigges² gives to the assembly of German alienists at Nuremberg in 1877 statistics of various cases of mental alienation, in which he finds symptoms which one may attribute to katatonia. He does not at all admit such a distinct form, and to him the stupor and other special katatonic phenomena are only symptoms.

Von Rinecker³ read to the assembly of alienists of 1880, at Eisenach, a work by Fink on hebephrenia. In this memoir Fink describes three cases which according to him resemble very closely katatonia, and exhibit nearly all its symptoms. He cites Hecker (*Allg. Z. f. Psych.* Bd. xxxiii., S. 612), who describes a case of katatonia followed by hebephrenia. But according to Fink although katatonia is of a favourable prognosis, the insanity of puberty is very serious. A discussion took place on this subject. Sander did not admit the existence of hebephrenia and opposed Hecker's interpretation of it. Mendel rejected at the same time the insanity of katatonia and that of puberty. Sander replied that these attempts were detrimental to a satisfactory classification, and finally Rinecker declared that while he admitted the existence of hebephrenia, he refused to accept the existence of katatonia.

Krafft Ebing⁴ makes a variety of "folie circulaire" of

¹ Westphal, *Ueber die Verrücktheit*, (*Allg. Z. f. Psych.*, Bd. xxxiv., 1878, S. 252.

² Tigges, *Kahlbaum's Katatonie* (*Allg. Z. f. Psych.*, Bd. xxxiv., 1878, S. 731.

³ Rinecker, *Ueber die Bedeutung der Hebephrenie, &c.* (*Allg. Z. f. Psychiatrie*, Bd. xxxvii., S. 570). Fink, *Beitrag zur Kenntnis, &c.*, id. S. 490.

⁴ Krafft Ebing. *Lehrb.*, 2nd ed., vol. ii.

Kahlbaum's katatonia. Tamburini,¹ at the fifth congress of the Psychological Society of Sienna, in September, 1886, described some observations of katatonia and melancholia attonita with cataleptic phenomena. He asks himself whether the cases reported as typical, really ought to constitute a special morbid condition, because katatonic phenomena are to be found in other diseases, and because its course is that of a typical example of delusional insanity; thus bringing it under the forms accepted in our existing classifications, and he is inclined to consider it as a form of "folie circulaire" with katatonic phenomena.

These are all the principal attempts which have been made to isolate katatonia from closely allied forms of insanity. We have been much struck by the differences which exist between authors, not only in point of detail, but even in the manner in which the disease is considered, when taken in its entirety; the opinions of Schüle more particularly, varying considerably from those referred to in the memoirs we have just analysed. We have also seen that many authors totally rejected the conception of katatonia, and we will cite still others who without offering any opinion whatever on katatonia nevertheless report analogous cases, which they describe under different names. Moreover, even antecedent to Kahlbaum's memoir,² numerous cases of katatonia, although not specified, were to be found in special books; these cases are classified under mania, melancholia or stupor, as the special katatonia phenomena impressed the observers as merely complications of the disease they were describing (Hardy,³ Clevenger,⁴ Burrow,⁵ Kelp,⁶ Guislain,⁷ Griesinger,⁸ Morel⁹).

But even according to the opinion of the advocates of

¹ Tamburini, *Sulla Catatonia* (*Riv. sp. di fren.*, 1886).

² According to Hammond (*loc. cit.*) one of the first cases of katatonia is to be found in the reports of Bethlem Hospital.

³ Hardy, *Am. Jour. of Neur. and Psych.*, vol. iii.

⁴ Clevenger, *Ibid.*

⁵ Burrow, 'Commentaries,' 1828.

⁶ Kelp, *Corresp. blatt. f. Psych.*, 1863, p. 357, and 1864, p. 322.

⁷ Guislain, *Leçons orales sur les Phrénopathies*, 1852.

Griesinger, *Traité des malad. ment. (trad. franç. de Dumas)*, 1865).

Morel, *Études cliniques*, vol. ii., p. 275 and following, 292, 293.

katatonia, it was under the name of stupor that the affections had for a long time been diagnosed and described, especially in France (Baillarger¹). At the present time also, even after the work of Kahlbaum, many authors continue as in the past to report these symptoms as merely varieties of other diseases.

M. Cullerre² has published a description of catalepsy in a case of hypochondria with delusions of persecution, which we find mentioned by German authors. Further we have the description by Lagardelle³ of a case of catalepsy following an attack of acute mania. These observations in our opinion remind us slightly of the katatonia of Kahlbaum.

M. Dagonet⁴ seems to connect these facts with stupidity. The same ideas are found expressed in the recent work of Kræpelin.⁵ Amongst the observations of melancholia with stupor, and cataleptic phenomena, published under this title since the memoir of Kahlbaum, and which we have been able to procure, we may mention those of Angelucci,⁶ Wiglesworth,⁷ J. Voisin,⁸ and Wagner.⁹ In other analogous cases (J. Adam¹⁰ and Sankey¹¹) hysteria seems evident but has not been pointed out specially. In another similar case Fritsch¹² insists upon the importance of hysteria and degeneration.

The influence of degeneration is also admitted by Maudsley¹³ who while speaking of hebephrenia gives a description

¹ Baillarger, *Ann. med. Psych.*, 1843 and 1853.

² Cullerre, *Ann. med. Psych.*, 1877, p. 177.

³ Lagardelle, *Ann. med. Psych.*, 1871, p. 38.

⁴ Dagonet, *Traité des Malad. ment.*, 1876.

⁵ Kræpelin, *Comp. der Psych.*, Leipsic, 1883.

⁶ Angelucci, *Lo sperimentale*, May, 1880.

⁷ J. Wiglesworth, "On the Pathology of Certain Cases of Melancholia, Attonita or Acute Dementia" (*Jour. Ment., Sc.*, 1883, p. 355).

⁸ J. Voisin, "Notes sur un cas de mélancolie avec stupeur à forme cataleptique, &c." (*Arch. de Nouv.*, 1877, vol. xiii., p. 354).

⁹ Wagner, *Anal. in Semaine médicale*, 6th July, 1887, p. 280.

¹⁰ J. Adam, "A case of melancholia with stupor and catalepsy" (*Journ. of Ment. Sc.*, 1884, p. 508).

¹¹ Sankey, 'Lectures on mental diseases,' 2nd ed., 1884, p. 208, case 13.

¹² Fritsch, "Zur kenntniss der melancholia attonita" (*Wiener med. Presse* 1878, p. 1477, 1512, 1574).

¹³ Maudsley, *Pathologie de l'esprit* (trad. franç. de Gernont, 1883, p. 478).

comparable to that of katatonia, which has been quoted, moreover, even by the advocates of the latter.

Lastly, in his book on 'Folie à Double forme,' M. Ritti¹ refers to the presence of cataleptic symptoms during the melancholic stage and reports some observations on it. Several are taken from the writings of Kraft-Ebing whose views the author seems therefore to adopt.

III.

To sum up, we find ourselves before two opinions: (1) either katatonia is an essential morbid form, or (2) the cases classed under that name are only variations of types already known and described. Let us in the first place examine opinion number one, namely, that katatonia is a special form of disease.

Amongst the characters given as pathognomonic, we observe figuring in the front rank katatonic phenomena of the most varied nature: the pathetic attitude, stereotyped gestures, verbigeration, marked obstinacy (often systematic) and finally the cyclic course of the disease, on which however some authors insist less than others (Neisser).

Here a question arises. Are these katatonic phenomena as well as others mentioned before, really characteristic of a special form of mental disease? Let us consider them first by themselves and individually, beginning with the most important ones—the katatonic symptoms properly speaking.

A.—As one can see from the description of Kahlbaum, these symptoms may be most numerous, and of the most variable character—spasms, general or partial, epileptiform, hysteriform, choreiform, or tetaniform convulsions, cataleptic conditions, or even a condition of simple muscular stiffness. Together we here meet, isolated or even united in the same individual, almost all the known possible disturbances in the domain of the neuro-motor as well as the muscular systems (with the exception, however, of paralyses). Without considering the cases where these symptoms can show themselves in connection with different forms of disease (*e.g.*,

¹ Ritti, '*Traité clinique de la folie à double forme*,' 1883, Obs. 11, 12, 13.

rheumatism, typhoid fever), we can see that each of them may be met with in the most varied psychopathic conditions (Arndt, Krafft Ebing,¹ Freusberg,² Edel³).

In the first place we can classify the hysterical psychoses. The insane hysterical patient remains none the less hysterical; the insanity does not suspend itself, nor is it replaced by a fatal termination, such as may be produced by physical manifestations of nervous lesions, as convulsive, choreiform or tetanic seizures. So also with convulsions or contractions, cataleptic conditions are very frequently associated with hysteria apart from the attacks of catalepsy and hypnotism. Indeed, if in the state of watching the hysterical patient can exhibit the neuro-muscular hyper-excitability of lethargy or the cutaneo-muscular hyper-excitability of somnambulism, then we may also find the muscular flaccidity of catalepsy. Lasègue⁴ had already noticed the fact of catalepsy existing during the state of being awake, in the case of hysterical patients. M. Charcot⁵ in his lessons on hystero-traumatic paralyses speaks of a patient subject to hysteria, who presented while awake cataleptic immobility of his limbs, even when placed in the most varied positions. MM. Binet and Féré⁶ have recently taken up these studies in an interesting memoir, and have reported new instances as examples of this condition of muscular plasticity while awake.

These phenomena may also exist in degenerative conditions with mania, especially in the mystic (Morel⁷) or erotic types, and even apart from all maniacal symptoms; for example, we find it with imbeciles and epileptics. We shall here report two examples which we have been enabled

¹ Krafft Ebing, *Lehrbuch*, B. 1.

² Freusberg, *Ueber motorische symptome bei einfachen Psychosen* (*Arch. f. Psych.* Bd. xvii., 1886, S. 757).

³ Edel, *Allg. Z. f. Psych.*, Bd. xlii., 1886.

⁴ Lasègue, *Catalepsies partielles et passagères*, in *Etudes médicales*, vol. I., p. 899. *Anesthésie et ataxie hystérique*, *Ibid.*, vol. II., p. 85, and following.

⁵ Charcot, *Leçons sur les maladies du système nerveux*, vol. iii., p. 357.

⁶ A. Binet and Ch. Féré, *Recherches expérimentales sur la physiologie des mouvements chez les hystériques*, in *Arch. de physiol.*, Oct. 1, 1887, p. 323.

⁷ Morel, *Traité des mal. ment.*, 1860, Note of page 491, and *Etudes cliniques*, vol. ii., p. 178.

to study while under the care of our excellent colleague, M. Ch. Féré, of Bicêtre.

CASE I.—L., aged twenty, has been brought up in the service of children; frequent attacks of both diurnal and nocturnal epilepsy, which have caused intellectual weakening, becoming more and more pronounced. Biting of tongue, aura in the shape of a ball, no signs of hysteria, no anæsthesia, no loss of sensibility to touch or temperature, no disturbance of the muscular sense. This patient has the singular faculty of passively preserving for more than half an hour the positions which are given to his limbs, or which he will take himself, and this he does with his eyes open. In this condition his muscles only show a slight degree of stiffness.

CASE II.—F., aged twenty-six years. Epileptic since the age of nineteen. Slight muscular spasms; possesses the same power as the other patient, but more pronounced; he remains, it seems, longer in the same position. There is no stiffness with him when a limb is extended; besides, there are no indications of hysteria, no loss of feeling or impairment in the muscular sense.

These motor disturbances become graver in melancholia, and especially when associated with stupor. We will return to this important point in the nature of the stupor later on; for the present we will only remind our readers that it is under this name that many authors have described, and still do describe, the *katatonia* of Kahlbaum.

Guislain¹ also notices these symptoms in the condition which he names *ecstasy*; differing from the ecstasy of others especially of hysterical patients, and which also presents the symptoms we have under review (Morel,² Michéa³). They may all accompany symptomatic melancholia; one meets them for instance, during the periods of depression in circular insanity (Ritti) and in the different forms of alcoholic intoxication, where they are as it were the rule, occurring as shocks, spasms, or convulsions. We have recently had the opportunity of observing a case of alcoholism in a woman who suffering from panophobic stupor presented these symptoms under three different forms: muscular spasms, general rigidity and cataleptiform immobility. M. B.

¹ Guislain, *loc. cit.*

² Morel, *Traité clinique des maladies mentales*, 1860, p. 491.

³ Michéa, *Dict. de Jaccoud*, Art. *Extase*.

Battaglia¹ has also observed cataleptiform conditions in an individual intoxicated by haschich, and he accepts in this case the hypothesis of primary hysteria.

In the other forms of melancholia which do not present symptoms of depression, but rather those of simple anxiety, we also meet symptoms of the same nature, very different however from the tremblings so often found in the anxious melancholic. One of us has been able to procure a case of this nature, and although the observations are very incomplete, it may be interesting to report it, as it presents several particulars which associate it very closely with those published by Kahlbaum in the memoir which we have analysed.

CASE III.—Mrs. C., aged thirty-four, brought under our care on September 1st, has been subject for the past fifteen days to an attack of anxious melancholia, this being her fourth attack. We are unable to give any information regarding her previous illnesses. There is very great anxiety, panophobic terrors, numerous hallucinations of sight and hearing; she sees dreadful animals, hears voices who tell her that she is a murderess, and that she has murdered also her children. She has ideas of her own guilt, thinks she must poison herself, and fears for her relations; is continually sighing, never remains in one position, but is constantly walking about like a drunken woman, swinging her arms, and always about to fall. At other times she is agitated as one in despair. She repeats everything spoken to her, or which she hears around her. Spasms affect the right arm, giving to that limb almost a rhythmic movement comparable to *chorée malleatoire*. We have not discovered any hysterical symptoms.

September 30th.—She is no longer anxious, but depressed, still retaining her melancholic ideas. She works a little. No more movements of the arm.

October 20th.—She has again hallucinations, and is anxious, continually repeating: “*My poor children, my poor children;*” walks backwards. There are again jerking movements of the right arm.

November.—She calls herself a criminal, thinks she is about to be guillotined, that we are going to boil her. Is very anxious, and has the aspect of a maniac, cries, sighs, and is continually in motion. She has the staggering gait of an in-

¹ B. Battaglia, *Sal haschich e sua azione* (*La Psichiatria*, 1887, Anno 5 fasc. i., p. 21).

toxicated person. She talks and *sings in a pathetic tone all the little incidents of her life*. There are still jerking almost continuous movements of the right arm.

This patient, whom we have lost sight of, recovered some weeks later.

These particular symptoms may also be found in hypochondriacal mania (Cullerre) where Morel¹ has already noticed them. They may also exist in addition to the excitement (Lagardelle). We know moreover that in the gravest form of excitement, more particularly in acute delirium, that disturbances of the neuro-motor system can be most serious. Krafft Ebing² describes likewise katatonic symptoms in dementia.

Even in general paralysis at some stage or other we may meet with a variety of katatonic symptoms. Alongside of symptoms called paralytic we may meet convulsive attacks, and a condition of rigidity as described by Kahlbaum is found in cases of katatonia. We have recently had the opportunity of observing two female general paralytics at the Salpêtrière in whom the stiffness was so marked as to resemble permanent contraction. In one case especially that of a patient who maintained her limbs in a condition of forced flexion, to prevent permanent deformity and ulceration (which might have been produced by her nails) it was necessary to apply an apparatus fitted to her arms and hands; there were however neither contractions nor retractions. Instances of this kind are very common indeed and we will not further insist upon them. Nevertheless we may here call attention to an interesting work by Knecht,³ reporting examples of the combination of general paralysis and katatonia. M. Sage⁴ has from his standpoint studied choreiform movements in general paralytics.

To sum up, we thus see that katatonic phenomena taken singly have nothing to characterise them, for they are found

Morel, *Traité des mal. ment.*, p. 712.

² Krafft Ebing, *loc. cit.* Bd. i.

³ Knecht, *Ueber die katatonische Erscheinungen in der Paralyse* (*Allg. Z. f. Psych.*, Bd. xlii., 1886).

⁴ Sage, *Thèse de Lyon*, 1884.

in a multitude of mental affections. Apart from accidental motor disorders, such as spasms or contractions, which one may meet outside mental diseases properly speaking, there are motor disorders which belong specially to insanity, and which can be present in the most varied forms of mental disease. Morselli¹ divides them into states of increased reflex excitability of the muscles (tetany), increased muscular tonicity (catalepsy), and states of abnormal distribution of central motor impulses (such as stiffness at the beginning of a movement).

Consequently we may say with Arndt,² that the insanity of tonicity (*Spannungs-irresein*) is not a disease, but may develop itself upon the most diverse grounds and under the most varied conditions.

Further, considering them only in the cases called katonias, their mode of development, course and relations with the other symptoms have nothing to specify them and they present no regular characteristics. We may meet them in all the stages and during the whole course of the disease, or only during a limited period; they may be predominant or considerably effaced, and in their relations to the insane delusions they have been spoken of as primary, secondary or independent. Let us add also, that in their essentials even, they seem to us to differ completely from each other. First, their external manifestations present very varied forms; then they can be spontaneous or not, and we readily admit that if they are mostly the consequence of insane ideas there is nothing impossible in the fact that their direction may be changed, or at other times new symptoms may be suggested. On the other hand they may be independent of any insane idea, and we can see that with certain patients they appear to be subject to the influence of the will and are only a simple phenomenon of attention produced apart from all indications of effort, or at least with a minimum of effort, disappearing when the attention of the patient is fixed or directed to some other point. This fact has been ascertained in one of M. Ch. Féré's patients, and in

¹ Morselli, *Manuale di Semeiotica delle mal. ment.*, Turin, 1886.

² Arndt, *loc. cit.*

the case of a woman whom we observed at Salpêtrière. In other cases these phenomena seem to be outside the domain of the will, independent of the patient's attention, and performed unconsciously; admitting however—as we stated in our last observation or case—of explanation by referring to alterations of the muscular sense.

B.—Alongside of these symptoms there are others in closer relation to the psychical disturbances, and which Kahlbaum states are as equally characteristic of katatonia. He even considers them from the pathogenic point of view as being of the same nature as the preceding ones. Let us cite as examples, verbigeration, dumbness, stereotyped gestures, pathetic attitudes and systematised resistance. It is thus that, dominated by the idea that the spasm-element occupies a leading place in the disease he describes, Kahlbaum ascribes the verbigeration to a spasm of the speech muscles, due to an impulse from the central speech centres; the same might occur in the case of dumbness which might be due to a tonic convulsion, as opposed to verbigeration, due to a clonic one.

Similarly also, the stereotyped gestures might be ascribed to acts of combined spasms. It will be sufficient for us merely to signalise these statements; such physio-pathological hypotheses cannot even be discussed. They may be ingenious views of the mind but they do not form a foundation solid enough to build a new nosological form upon. Moreover, whatever may be the explanation of these phenomena, considering them from the purely clinical point of view, they have not in our opinion the importance which Kahlbaum gives them. We note in the first place that after having given the verbigeration as an important diagnostic sign, Kahlbaum adds that in the course of the disease it may transform itself into any of the other forms, from which he had previously distinguished it (ordinary *Redesucht*, loquacity of the mentally enfeebled, confused ideation, and confabulation). On the other hand, we are of opinion that this verbigeration has nothing that characterises it, for we may meet it elsewhere particularly in cases of primary or secondary

intellectual enfeeblement. Vogelsang and Jastrowitz¹ notice it also in general paralysis. Stereotyped gestures comparable to nervous twitchings, are also frequent in the same cases of mental weakening,² with or without the co-existence of mania which when it exists explain their nature frequently without the necessity of invoking the theory of co-ordinated spasms from certain cerebral centres. A well-known instance is that of the sigher (*gémisseur*) of Morel.³ As regards the pathetic, strange and sometimes cabalistic attitudes, they exist most frequently in delusional insanity, especially when it is grafted on a degenerative foundation. Indeed, some authors maintain that they are characteristic of this type.⁴ The obstinacy and systematised resistance present nothing worthy of remark, for they are mostly to be observed as associated with all cases of the melancholic state; so much so is this the case, that one author has given the name of "the insanity of opposition" to melancholia.⁵ Dumbness is also met with in the same conditions, especially in profound melancholia, of which it is almost a necessary symptom, and without there being any coincidence with the least katatonic phenomena.

C.—Neither does the course, called cyclic, of the disease offer anything characteristic; for the variable conditions through which the disease passes have nothing regular in their mode of appearing or in their relative positions. We may convince ourselves of this by reading Kahlbaum's descriptions and observations. This author who with the desire of noting a recurrence of the same phenomena goes the length of seeking in the previous life of the patient some attack of mania that may have happened years before, in order to establish his theory that a maniacal period exists always before the characteristic katatonic attack. He does not take into account the fact that katatonia does not always

¹ *Allg. Z.f. Psych.*, Bd. xlii., 886, p. 831.

² R. Bruglia e S. Marzocchi, *Dei movimenti sistem. in alc. forme d'indeb. ment* (*Arch. ital. per le mal. nerv.*, September 1887).

³ Morel, *Études cliniques*, vol. i., and *Traité des mal. ment.*, p. 713.

⁴ Tansl and Riva, *La Paranoia, contrib. al. storia delle degeneraz. psichiche* (*Riv. sper. di fren.*, 1884-5-6).

⁵ Guislain, *loc. cit.*

commence by a maniacal outburst. Not only does this initiatory period of maniacal excitement appear to us to be often one of melancholic anxiety, but many cases present themselves as depressed melancholics from the very beginning of the disease. Considered from another aspect the cycle of the malady presents nothing truly regular. We may easily note more or less regular alternations of excitement, and these attacks present themselves as often under the form of maniacal excitement as of *melancholic anxiety* (Hammond¹), and further, this depression may increase even to the stage of stupor. Taken in its entirety this would be the general course in successive phases of the forms of insanity noted by Guislain, Zeller and Griesinger. Let us add also that Kahlbaum recognises "that mental diseases in general, including katatonia, begin with melancholia, pass into mania, next into *Verwirrtheit*, and finally end in dementia." In another place he says: "Melancholia attonita which has been considered until now as a special form of disease *develops itself primarily in very rare cases*; it pursues in general rather a course of simple melancholia, or a condition of melancholia following mania in such a manner that the melancholia attonita is the third phase of the complete process which terminates in recovery or dementia." This is an incontestible clinical fact which has moreover been known for long, and frequently verified (Morel,² Guislain, Griesinger,³ Dagonet⁴), so much so that "for the same attack of disease there are four constituting phases. It follows from this according to Guislain, Zeller, and Griesinger, that the various forms of insanity have different phases, and that, no more than simple melancholia mania or dementia, can melancholia attonita either be considered to be a particular form." This argument is perhaps excellent for Kahlbaum who wishes to believe that simple melancholia attonita is merely a mild form of katatonia. But for us who admit with difficulty a katatonia without

¹ Hammond, *loc. cit.*

² Morel, *Traité des mal. ment.*, p. 489, and *Études cliniques*, vol. ii., p. 257.

³ Griesinger, *loc. cit.*, p. 295.

⁴ Dagonet, *loc. cit.*

katatonic symptoms, and who hope not to be contradicted when saying that many cases observed in asylums do not present the katatonic symptoms of Kahlbaum—for us therefore the above argument seems to have little weight; and as we have just seen that he also associates the course of katatonia with that of other forms of insanity in general, we say of it what he says of melancholia attonita, namely, that it must not be considered as a particular form, at least as judged by its course. We have likewise seen what can be said in support of its symptoms in particular.

To sum up, isolated, not one of the symptoms which we have passed in review can by itself characterise a special psychopathic form of disease. Is it otherwise with them when considered *in toto*?

IV.

In short, in order that a union of symptoms not characteristic in themselves may constitute an essential pathological entirety, it is necessary that they possess among themselves close relations with regard to their nature, origin, mode of succession and causation, in such a manner that notwithstanding their inevitable variations, one can always grasp their relations, recognise their connections, and refer them to a defined primitive type, and to a common superior cause.

Now this is not the case here; we do see a co-existence in the description of katatonia, but not an association or a combination of symptoms. Whatever the advocates of katatonia may say of it, the difference between it and general paralysis is great. The origin of the latter rests on a solid foundation of anatomical lesions, the intimate nature of which is perhaps not yet absolutely known, but which is sufficient even with our present imperfect knowledge to create a morbid class, and perhaps in time we may succeed in determining its varieties. Here on the contrary nothing is precise, for the meningitic lesions of a tubercular nature found in some cases are not the anatomical characteristics of the disease; and they all rest

on hypothetical data of hyperæmia (Meynert) producing vaso-motor contractions, or spasms from certain cerebral regions (Kahlbaum, Neisser) which are variable, multiple, and which we can only vaguely determine owing to the imperfection of our actual data as regards the anatomy and physiology of the brain.

Kahlbaum admits himself that the pathological anatomy has yet to be made and Kiernan after long dissertations arrives at the conclusion that the essential characteristic is a primary vaso-motor dilatation; leaving aside the meningitis, which one might imagine he should have utilised for the purpose of making a suitable anatomo-pathological foundation. Besides, as we have seen, Brosius divides katatonia into three groups, which resemble one another little anatomically. Other authorities do not refer at all to the pathological anatomy. Therefore the anatomical lesions are absent, and as nothing does authorise us to associate these phenomena (which we may suppose to be of dynamic order) to identical known symptoms resulting from an organic cause, it follows that the pathological structure cannot show a solid or rational foundation.

But in the absence of an anatomical substratum and determined physiological data by what can a morbid form characterise itself? We are left to deal with the symptomatic evolution and the ætiology. Again, the absence of a certain anatomical criterion necessitates extreme care in the choice and classification of the phenomena and of described examples of the condition. Now even the classification of the varieties of katatonia which Kahlbaum gives at the end of his memoir show us, even if the reading of the symptomatology and his observations had not already convinced us, how varied were their intensity, mode of appearing, succession, and even the evolution of the different stages of the disease. It seems to us superfluous to dwell upon this point further, as we have already exposed these fallacies in the early parts of this work. We should only be repeating ourselves.

As regards the ætiology, which if we exclude certain particular exceptions fails to assist us in making a differen-

tial diagnosis in general medicine, the causes above recorded are absolutely insufficient in cases of mental diseases, where ætiology is one of the most unsolvable problems to which the alienist physician devotes his energies daily. One may know the very numerous causes of mental disease in general; but it is almost impossible to determine the action of a particular cause in a given case, when considered from the point of view of its origin, or the particular form it may take, and the special course that it may follow.

Moreover, the ætiological causes which Kahlbaum gives are perfectly common-place ones, and such as we may find at the source of all possible forms of mental disease. There are however two causes which in our opinion might induce a special predisposition and serve to characterise the foundation on which the disease develops itself. These are: degeneration in general, and the hysterical state. These two factors are not mentioned by its advocates, and yet they seem to us to be of great importance. In fact, we find in the description of katatonia, most of the features common to all hereditary forms of insanity; such as an alternation of the delirium with the succession of exalted or depressed states (Morel¹), monotonous verbosity, incoherent or emphatic language, theoretical poses, strange cabalistic attitudes, a predominance of poetical, theoretical, or mystic ideas, such as are described in Kahlbaum's observations, and so frequently noticed as to induce Schüle to consider katatonia as a kind of religious Wahnsinn. Let us also call attention to the frequency with which psychical disturbances occur at certain biological epochs in those with a hereditary tendency to mental disease; we will then not be surprised that certain authors should have classified katatonia amongst the insanities of puberty (Maudsley²). Besides, most of the causes noted in the observations of katatonia do commonly act only as occasional factors on individuals having more or less a hereditary taint. Let us here cite as examples sexual excesses, onanism, puberty, accouchement, menstruation and alcoholism, upon which Kiernan insists: Finally, our study

¹ Morel, *loc cit.*, p. 479.

² Maudsley, *loc. cit.*

of the observations shows us that even the majority of the patients present different characteristic features, indicative of mental degeneration, and sometimes even of physical deformities, the importance of which has seemed to have escaped the observers' notice, who we must say have in the examination of their patients paid insufficient attention to the question of degeneration in general.

With regard to hysteria which especially in its maniacal forms may approach and even be classed with degenerative states, it partakes of the same characters as above enumerated, but it may also favour the production of katatonic phenomena properly speaking. Is it not in hysteria chiefly that one observes more or less defined convulsive seizures of a hysterio-epileptic character,¹ attacks of catalepsy, lethargy, muscular contractions, ecstasy, and choreiform movements, without taking into account simple hyper-excitability (neuro- and cutaneo-muscular) and muscular flaccidity while awake? Now hysteria has never been seriously sought for in the observations of katatonia which we have read of; only very briefly and in a vague manner have researches on sensitive anæsthesia been referred to. The nature of the attacks is always badly defined and in very general terms; they are called hysteriform or epileptiform seizures, &c., or perhaps one is satisfied with saying that a patient has a hysterical aspect. Yet we would be readily inclined to think that a more attentive research could have disclosed in the patient the presence of some hysterical symptoms, and this so much the more because we meet in reading the observations symptoms which are often enough found in hysteria to induce one to be arrested by them. However, their importance does not seem to have been understood, or

¹ Morel (*Études Cliniques*, vol. ii., p. 285, and following) reports under the name of "stupidity" cases which seem to us analogous to katatonia, and he rightly considers the presence of the principal phenomena (called later on katatonic), and the special course of the affection to be connected with a state of mental degeneration, and of very grave prognosis. Elsewhere (*Traité des mal. ment.*, 451), he says that the phenomena of ecstasy and catalepsy are associated in a more intimate manner with the history of epidemic insanities, especially to that of religious mania, and to certain neuropathic conditions, such as hysteria.

they have been associated with the katatonia, whereas in some cases they have preceded it by several years. We also find tonic spasms occurring in episthotonos in the course of convulsive seizures, re-appearing several times in one day (Case II. of Kahlbaum); uncertain convulsive attacks (as found in almost all the observations) and followed later by involuntary attacks of weeping and laughter (Case III.); loss of sensibility of the pharyngeal mucous membrane (Case IV.); recurring attacks of laughter at the same hour for several years in a nervous subject (Case I. of Hecker) before the beginning of the katatonia which was moreover followed by hebephrenia; convulsive attacks associated with episthotonos, with intense delirium towards the termination of an attack of typhoid fever and before the first symptoms of katatonia appear (*Ibid*, Case II.); a similar attack presenting some of the characters of *the arc de cercle* (Case IV. of Neisser) occurring in a woman in whom Kröepelin had suspected the existence of hysteria, but this factor had been neglected by Neisser (Obs. IX.). In two other cases referred to by the same author we find somnambulism, with black visual hallucinations (Case X.), prolonged cough without pulmonary phenomena, attacks of syncope, and repeated seizures of vomiting and cephalalgia and amyosthenie (Case XII.). A fact which seems to confirm our conception of viewing this condition, is the peculiarity noted by Kahlbaum, of convulsive epidemics of katatonia. It would be also interesting to ascertain the hysterical influence in these cases especially when the disease sets in suddenly by stupor after an accident; this may be only a hypothesis, but it presents at least nothing improbable, since the more recent researches of the School of Salpêtrière have brought to light the great importance of traumatism in developing morbid manifestations when acting on a hysterical basis. This neglect of attention to hysteria which we have noted is no doubt due to the fact that the majority of German physicians seem to take little notice of hysteria in general and oppose determinedly the theory advocated by M. Charcot, that male hysteria is of common occurrence.

Schüle is the only author who has occupied himself with

a study of these neglected factors in the examination of his patients, and his observations have finally induced him to describe a form of hysterical katatonia (sixth type of *hysterischer Wahnsinn*), and from another aspect he classifies katatonia in general among the psychoses developing themselves in a morbidly modified (*invalidé*) brain.

Besides, the study of hysteria in this class of patients may be interesting to explain, at least in certain cases, the production of some of the motor disturbances. We know how frequently the muscular functions become altered in hysterical patients and it is not irrational to suppose that a connection might be found to exist between those alterations and the particular spontaneous or induced attitudes assumed by the subjects of katatonia.

We here report the case of a hysterical patient whose symptoms presented many features of resemblance to that of the katatonia of Kahlbaum, and in whom we discovered slight disturbances of the motor functions.

CASE IV.—Mdlle. L. Ch——, aged twenty-four, admitted to Salpêtrière on June 24th, 1887.

Hereditary Antecedents.—*Father*, weak, both mentally and in character. *Mother*, nervous, but without (hysterical) attacks; of feeble intelligence; had tremblings of the head. No consanguinity. No definite information regarding the grandparents.

Personal antecedents.—Nothing particular noticeable in childhood. When thirteen years of age Mdlle. Ch—— seems to have become subject to illness for the first time. She was then a little nervous, and was treated for anæmia. At the age of twenty a convulsive attack of hysterical character is first recorded; then a second attack three or four months afterwards; and after that these attacks returned about every month; never by night. At the same time she had slighter incomplete attacks, with giddiness. She suffered also from frequent headaches. In disposition she was willing although rather weak, and she was always a “spoilt child.” Two years ago she became associated with a young girl who occupied herself with spiritualism, and who rapidly gained a great ascendancy over her. That girl soon persuaded Mdlle. Ch—— that the latter could be cured by her through magnetism, and they commenced to practise without the knowledge of her parents. The attacks, however, continued, the last occurring on May 19th. She last menstruated on June 6th.

The delirious symptoms date from thirteen days ago. She began to show signs of agitation; was no longer mistress of herself, of her thoughts and actions; visual hallucinations have existed since the first day; there is insomnia, but no *premonitoir* dreams. On the third day hallucinations of hearing occurred; her friend tells her that she magnetises her. She answers that her friend has deceived her by not curing her. Her agitation increases and she makes passes as if she were magnetising somebody. She even tries to magnetise herself so as to cure herself of a condition similar to her friend's, who is infirm in one leg, and has been magnetised for it without result. She becomes loquacious, speaking often in her delirium of a letter which in her practices of spiritualism, her friend had caused to be written by her brother, who died twelve years ago. Since that occasion her agitation has steadily increased; refuses food; absolute sleeplessness.

June 24th.—Actual condition. Violent maniacal agitation. We are able however to fix her attention for a moment at a time by insisting or shaking her energetically. She is dishevelled, hardly dressed, feet naked, has hallucinations. There is excessive facial mobility; her actions are disordered. She expresses incoherent language, all her words relating seemingly to magnetism. She cries, makes incantations, and assumes cabalistic gestures; she arranges the chairs around her, and seems to magnetise imaginary persons who are supposed to be seated thereon.

There is no evident sensorial anæsthesia. An examination of the sight is very difficult; however she names colours correctly, and there does not seem to be any alteration in the visual field. Both iliac fossæ and the lower mammary regions are painful on pressure. There is facial asymmetry, the right side being the smaller. The nose deviates to the right side, the right eyebrow is on a lower level than the left and there is discolouration of the left eyelashes, dating from infancy. The palate is malformed; the ears, hands, &c., are well proportioned. The skull is regular and symmetrical.

Maximum transverse diameter	...	...	...	...	13.9
Antero-posterior diameter	...	...	...	...	17.9
Bizygomatic diameter	...	...	...	...	12.1
From between the eyebrows to alveolars	...	...	...	...	6.5
Maximum horizontal circumference	...	...	...	...	53.5
Anterior half circumference	...	...	...	...	25.5
Posterior half circumference	...	...	...	...	28
Transverse curve (from one tragus to the other)	...	...	...	...	32
Antero-posterior curve	...	...	...	...	34

July 2nd.—The agitation continues; the hallucinations are at all times very numerous. In the day time she lies down on a grass plot in the garden and remains during some ten minutes with her eyes shut, and her neck and limbs stiff, as if in a condition of contraction and declines to respond to any external impressions.

July 3rd.—She begins to have confused ideas about her left hand and asks herself whether it can at all belong to her. All at once she extends her right arm and remains thus several minutes fixed and immovable without answering the questions addressed to her.

July 6th.—Very excited, but chiefly anxious, face restless, dishevelled, weeps and laments much. Hallucinations (of sight and hearing) are at all times very numerous, intense and almost continual; however, by insisting, one can fix her attention. At times she assumes attitudes resembling the passionate position of hysteria, and the few phrases she pronounces are uttered in a reciting pathetic tone. She continually repeats that she is dead, and no more herself. Her limbs remain for some minutes in any position we may place them in, or which she has assumed herself, but are not rigid—a cataleptoid condition. Loss of control of the rectum and bladder (gâtisme).

July 8th.—Is much calmer, but the hallucinations continue although she says they are not so numerous. Her sentences are unconnected, apparently in reply to her hallucinations. There is an induced cataleptiform condition for some minutes at a time, the right arm being extended, and the left arm in a semi-flexed state. Her face reveals no fatigue, respiration normal, the arms retain absolutely their position, following only the movements of the whole body. Slight trembling of the extremities, with a flexibility of portions of the limbs, which retain the various positions given to them successively.

Muscular sense of left arm somewhat disturbed. On this side she is unable to find her hand if her eyes are shut. The estimation of different weights is less accurate on the left arm than on the right. Contact and pressure are not so well perceived on the left side as on the right, and pricking seems to be less distinctly felt on the right side.

She continually repeats that she is dead and without a body; that there only remains to her a left leg, a right arm, and two eyes; that she is “retournée,” and to take her right hand with the left one she passes the latter behind her back, because she is “retournée.” When one fixes her attention this dis-

appears momentarily, otherwise she is very anxious about it. She weeps, is disconsolate, says that everything is changed around her, that she no longer has a personality, and yet she is indeed L. She believes herself persecuted by another patient (female); she has caught the disease of another, and this has caused her left leg to become immovable. The parts of her body not belonging to her have been attached to her, she doesn't know why. She calls out for her parents; generally she is gentle and calm; at times she has attacks of anxiety. In the afternoon she remained for a long time lying extended on the grass, her arms being extended crosswise; she tells us that this is a conjuration.

July 9th.—The symptoms vary very much however; she is no longer maniacal as on admission. She assumes "theatrical attitudes," especially when agitated, and when speaking again of magnetism. Her ideas run always in the same groove; she repeats them continually, but never uses the same words; she has no special vocabulary. She assumes peculiar attitudes, holding her hands crossed on her knees; the right hand on the left knee, and *vice versa*. In the morning she calls herself complete, and recognises her left hand by a spot of smallpox she has on the forefinger; however, some moments afterwards she recurs to the ideas of the previous evening, and she even says she has lost both her eyes. She is unable to explain herself because she is perplexed.

July 16th.—She assumes cabalistic attitudes, crosses her legs when holding herself upright, to prevent misfortunes; keeping her knees as above noted. She remains fixed and immovable in these positions. These induced cataleptiform states continue for some minutes. She has been very calm, and somewhat depressed for some time; speaks little, isolates herself, remaining apart from the other patients, weeps much, is still sleepless, and always has loss of control of the rectum.

August 1st.—There is considerable improvement, no more excitement, no attacks of sadness or tears; she asks for her family and worries herself as to what will become of her; she thinks her illness may do her harm in the future, or return, &c. There are no more cataleptic attacks and she is beginning to sleep.

August 16th.—Is no more delirious, sleeps and works well and may be considered as cured. Physical examination shows nothing noteworthy in particular; no signs of hysteria.

September.—Menstrual functions re-established. Recovery completed. Discharged.

The following case, which one of us had been able to study at a previous time, presents likewise many of the features given by Kahlbaum as characteristic of katatonia, and here again we find both heredity and hysteria well proved.

CASE V.—Mdlle. N., aged nineteen years.

Hereditary antecedents.—The grandmother of the father of the patient died demented, as also her son (the patient's paternal grandfather). The father himself is a very nervous man, strange, violent, and subject to arthritis.

Personal antecedents.—Little is known regarding her childhood; she has always been very nervous, strange and whimsical. For some years she has been suffering from and treated for hysterical symptoms. In January, 1884, she became sad without reason and courted loneliness; in June, she had an attack of maniacal excitement, becoming insubordinate, wilful, attempting continually to escape from home; fancied that the Shah of Persia loved her, and was going to ask her hand in marriage, and she was continually singing comic operatic airs. In July this excitement was replaced by melancholic depression; she then feared that she was going to become sick; that she had cholera and was going to die, begging pardon from everybody for her errors, as she stated a voice commanded her to do so, and she believed that the worms gnawed at her. At this time she presented a state of rigidity almost general but without contraction, one having some difficulty in overcoming the resistance of the muscles, and when the limbs were moved they became immovable in the new position given them, but remained rigid.¹ This condition of melancholia became more serious, and gradually merged into a state of stupor with dumbness, refusal of food and progressive emaciation.

August 22nd.—Actual condition. She has the expression of melancholic stupor—fears, absolute dumbness, complete refusal of food, extreme emaciation, she cannot even sit or stand, but lets herself fall about as if she were an inert mass; breath foetid,

¹ For this information we are indebted to the kindness of M. Ch. Féré, Physician of Bicêtre, who saw the patient at that time.

urine scanty, and constipation. There is no lividity or œdema of the extremities, and she suffers from amenorrhœa and sleeplessness. There is almost complete analgesia; no certain signs of hysteria, and no stiffness. In stature she is tall, of regular conformation, head small, face asymmetrical, teeth irregular and the maxillary bones much incurved.

Treatment.—Extra nourishment by the tube (meat powder, soups, broth, milk, Peruvian quinine, bark wine, mixed with Bordeaux wine and arseniate of soda), mustard baths, and syrup. morphinæ.

August 26th.—There is an improvement in the general condition, dumbness, and refusal of food. She now resists the tube, which she had at first passively accepted.

August 27th.—She says: "I have typhoid fever; let no one come into my room."

August 28th.—Her expression has improved; no alteration in the mental condition; dumbness; refusal of food; systematic resistance to everything she is asked to do; but there are no motor disturbances, and she walks a little alone. She weeps much.

August 30th.—In the same condition; sensation is much better, although it is always a little dull, without special localisation.

September 1st.—She eats alone, the dumbness continues. Hydro-therapeutics.

September 11th.—She says, "I can't sleep in this bed, for they say it has been *offensé*."

November.—Towards the end of this month she menstruated. She still remains in the same condition; speaks only very softly and when alone, and if one speaks to her, she laughs and cries at the same time, but does not answer.

December.—Again she refuses her food on account of hallucinations of hearing; she seems also to have visual hallucinations. She speaks a little, and asks to be allowed to go away, because she costs so much, and that her father will be ruined thereby. Menstruation regular. On the 22nd of this month she wrote, "It is expected that I will be found dying from one moment to another; one desires to kill me in consequence of mad ideas which concentrate themselves in me; I am in such a stupid state that I don't know what I do; I lose my reason; I can speak no more; I am unable to do anything; I do not deserve to live; everybody finds me stupid, and this is true; I lose my

reason." At the same time she made figures, which she placed in a peculiar order; this is an exact copy of them.

1 k. 250
1 k. — 1000
250

1000 — k.
250

123456
384579

384579
123456

261123

3 7

8 9

3 × 9 27

8 × 9 72

7 × 3 21

9 × 8 72

(Vide Note 1.)

January 15th, 1886.—She eats a little, but only bread, which she buys by measure; she works a little and talks well; it is the Lord who speaks to her, and has forbidden her to eat, to expiate her sins. God told her to eat nothing; that she must die for she was not worthy to live. When she laughed, that was because voices spoke to her. She does not confess to hallucinations of sight, and believes firmly in the reality of God's voice.

January 20th.—She is no more delusional; is a little excited and insubordinate, crying without cause, but it relieves her; she occupies herself usefully but in a feverish manner. She is conscious of her past condition, and relates the delusions she had about her guilt; that she believed herself to have been the cause of the death of her mother, and that the Shah of Persia loved her. She heard the voice of God speaking to her in an imperative tone. She says that all these symptoms have entirely disappeared. There is still some genital excitement, inveterate self-abuse. These practices date, she says, from a very long time ago, and had been taught her by one of her female relatives, whose bed she shared when a child. There are no signs of hysteria. Discharged recovered.

November 15th, 1886.—The delusions have not appeared again, but it is possible to observe in her the presence of the *essentials of hysteria*, and symptoms of the same nature, analogous to those noted before the appearance of the delirious troubles.

¹ We might readily compare this with the copies of writings given by Nelsner, in which the same words or symbols are repeated in such a manner as to constitute a kind of written verbigeneration.

V.

We have 'finally seen what katatonia is, and we have explained the conclusions which have seemed to us to result from the examination of the descriptions of this disease, and of the observations given in its support. Kahlbaum's proposition has on the whole as yet been accepted by few writers. Having considered its advocates, we note certain differences existing in their writings, and more especially did we refer to Schüle, whose description of the disease is in our opinion much nearer the clinical reality than any of the others.

To sum up, in order to create katatonia, Kahlbaum insists on these two points: (1) The non-existence of attonity, except as a symptom, and (2) the circumstance, that the essentially katatonic phenomena becomes the characteristic features of those cases in which attonity is present.

One may dispute the entity of the stupor, and this opinion has nothing extraordinary in it. Everybody admits the possibility of stupor in any mental disease, but some authorities go no further than that; others however describe a special form of stupor, and amongst the latter, some consider it as a distinct disease, others, a more numerous class, connect it with melancholia. But, because in this last case the malady could follow the course indicated by Kahlbaum—passing through a stage of simple melancholia, or even through one of anterior mental exaltation (mania or anxiety), must it therefore be concluded that the stupor ought to be entirely rejected under the pretext that it is only a phase of the disease when considered in its entirety? This seems to us most irrational, for it is the stupor which constitutes in those cases the critical stage of the disease, the other phases being only premonitory, and often of short duration in comparison to the period of stupor. Let us add that the latter condition may exist as it were from the beginning of the disease. Because a malady cannot constitute itself at once from all its symptoms, and may pass through different stages before arriving at the critical state, must it therefore be rejected? If this were so, then there would be very little left of mental

pathology, for there are no mental affections which form themselves *de novo*, or remain identical during their whole course; and is not mental exaltation, and more especially depression or moral hypochondria, at the beginning of all forms of mental disease? We have further seen that Kahlbaum admits this himself, and to be logical, if we accept his argument in regard to stupor we must extend its application to all the other forms of psychical derangement.

The second point on which Kahlbaum insists is the necessity of giving the priority to the katatonic symptoms, which may be more or less pronounced, but the existence of which should form the rule in all cases of melancholia with stupor. We have already remarked that this seems to us a singular exaggeration. Very few of the published cases of melancholia with stupor present any symptoms called katatonic. We have seen several such cases, even after our attention was directed to this subject, and there is perhaps no alienist who has not observed similar ones. It is certain that if dumbness and opposition are to be considered katatonic symptoms, then all cases of pure stupidity, as well as many melancholics, are katatonics. But we have already given our opinion on these psycho-physiological exaggerations. We have also seen that one might express the same unfavourable criticism on these phenomena as Kahlbaum applies to stupor (atony), *i.e.*, that they are only symptoms presenting themselves in nearly all psychopathic forms, and that when they show themselves as prominent features and as associated with the conditions called melancholia attonita they do not constitute a regular entity either in their course, or in their mode of arrangement, or even in their intrinsic characters.

We may complete this study by saying, that Kahlbaum's attempt does not seem to us so far sufficiently justified. We might repeat in substance with regard to katatonia what M. J. Falret¹ said before concerning catalepsy, namely, that in the description of this affection, some authors have coupled together facts which, from different

¹ J. Falret, *De la catalepsie* (*Arch. gén. de Med.*, Aug., 1857).

points of view, are dissimilar; and that they have rather recorded the history of a symptom (or better, of a "syndrome"), than of a veritable disease.

If we consider further that from the physical point of view the prominent symptom is the presence of disturbance of the neuro-motor functions, whilst the principal psychical feature is a more or less acute condition of melancholia (the other symptoms, progress, &c., presenting nothing special), we are certainly of opinion that for the present katatonia must be classed under the general group of stupors—simple or symptomatic—of which it may only be a variety more closely connected with a degenerative and more particularly hysteric ground.¹ We must add, that this conclusion is not an explanation, but we think it to be the only opinion which can be formulated in the present state of science. We will leave to other writers, more competent and bold, the chance of venturing upon the path, still very imperfectly known, which leads to the elucidation of the various forms assumed by the hysterical psychoses, and to define, if possible, the domain, so extensive and so vague, of mental degenerations.²

Since the publication of this paper in the *Archives de Neurologie*, Dr. Haak Tuke mentioned a communication made to him ("Mental Stupor," Transactions of the Int. Med. Congress, London, vol. III., p. 634). He does not agree with Kahlbaum, but thinks that the cataleptic phenomena are due to a mental state of absorption under the influence of a sad hallucination. He separates sharply "mental stupor" from acute dementia, which has often been confounded with it.

Drs. Séglas and Bezançon (*Nouvelle Iconographie de la*

¹ In these cases, when we are able to discover actual or retrospective delusional ideas, they are mostly of a mystic nature, as has been remarked by Morel, Schüle, &c.

² The reader may also consult on this subject, Lanfener, *Ueber Katatonische Verrücktheit*, 1882. Konrad, *Beiträge zur Lehre der Katatonie*, *Orcost Hetilap*, 1882. Dunkerlost, *Ueber Ätiologie und Behandlung der Katatonie*, *Noed. Ver. f. Psych.*, 1883. Hammond, 'Treatise on 'Insanity,' London, 1883. Spitzka, 'Insanity,' New York, 1883. Edward Geoghegan, 'Case of Prolonged Maintenance of a Fixed Position' (*Journal of Mental Science*), 1882.

Salpêtrière, March and April, 1889) relate a case of cataleptic melancholia, presenting a cyclical progress with the peculiar symptoms attributed by Kahlbaum to katatonia. This paper contains pneumographic tracings and myographic tracings upon patients during her cataleptic attitudes, proving that they are accompanied with no effort. Moreover the patient, as those mentioned in the present review, bore evidence of other hysterical alterations.