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ARTIFICIAL PSYCHOSES PRODUCED BY MESCALINE.*

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PROGRESS in general medicine is brought about by clinical observation or carefully controlled experimental research. In psychiatry there is little opportunity for the latter approach. One of the few methods available at the present time is the use of intoxicating drugs. It was Kraepelin who first emphasized the importance of studying psychological changes produced by drugs. Following his lead many observers have tested their action on various psychic faculties. Copious data have been collected about such agents as alcohol, caffeine, hyoscine and cocaine. But the value of these observations in bringing about an understanding of the psycho-pathology of the major psychoses is limited, since it is rarely possible to produce the picture of a true psychosis without giving the drug in amounts sufficient to bring about dangerous or chronic intoxication.

Mescaline, however, is a substance which produces psychotic phenomena without immediate risk or deleterious after-effects. On an expedition to Central America in 1886, the pharmacologist Lewin heard of a peculiar intoxicating substance which the Red Indians used for religious ceremonies. He found it to be a small cactus, from which the *mescal buttons* originate. The plant, called Peyotl by the natives, was identified as an anhalonium and was named *Anhalonium Lewinii*. The use of the plant for ritual purposes goes many centuries back. The peyotl cult spread to the North American Indians, where it can still be found. The rites vary from tribe to tribe. The publications of Lewin, Beringer and Rouhier give information on many interesting historical, ethnological, botanical and pharmacological points. The most active of the several alkaloids discovered in the mescal buttons is mescaline, a well-defined

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substance which can be obtained synthetically. The first self-observations of mescaline intoxication were published by Prentiss and Morgan (1895), Weir Mitchell (1896), and Havelock Ellis (1896), who used the original mescal buttons, which were taken by the mouth. Their results do not differ greatly from the findings gained with the pure mescaline, which was first used by Kraepelin's collaborators, Knauer and Maloney, for the study of hallucinations. Little attention appears to have been paid to the complete clinical picture produced, and only one self-observation was published, that by Serko. Since the war experiments with mescaline have been renewed at Heidelberg. Mayer-Gross and Stein have investigated alterations of sensory perception during the intoxication, Beringer has published a monograph on the history and clinical picture of mescaline intoxication, and Rouhier a very complete account of the ethnology and pharmacology of peyotl. Many psychiatrists and psychologists have also gained personal experience of psycho-pathological phenomena such as hallucinations and delusions by self-administration of the drug.

The following description is based on 60 personal observations,* mostly on normal persons. A synthetic preparation of mescaline was used throughout, kindly provided for me by Dr. Slotta, Professor of Chemistry at São Paulo, who has developed a new method of synthesizing mescaline and kindred substances. Generally it was injected, but sometimes given by mouth. The dose varied between 0.1 and 0.4 grm.

The physical symptoms may be mentioned first. There is always a mydriasis of several hours' duration. The pulse becomes rapid, and the blood-pressure rises by 10 to 20 mm. Respiration is usually normal, but overbreathing in two cases accompanied excessive anxiety, while another case exhibited a rhythmical change of breathing resembling a Cheyne-Stokes attack. Nausea or vomiting is common at the beginning, if more than 0.2 grm. of the drug is used. Other vegetative symptoms such as blushing, sweating, salivation and abnormal dryness and thirst are very variable in their occurrence. One subject showed an intense desire for a particular food (chocolate), and several asked for champagne, apparently to overcome their depression or retardation; on the whole, however, they have little or no appetite.

Although visions are the best-known symptom of mescaline intoxication, hallucinations of other senses occur, and will be described first. Smell and taste are rarely affected. One of my subjects asked for a glass of water and reported, "To my disgust it smells like a glass of paraffin". He was so convinced that he asked the nurse if she could smell it as well. Another noticed a smell like chloroform and ether. Havelock Ellis mentioned an olfactory hallucination—"the air seemed filled with vague perfume". Some subjects said that real smells appeared particularly obtrusive or altered in quality. A few complained of bad taste in the mouth; soda-water tasted "awful" to one of my subjects. Ellis observed an abnormal co-ordination

* The first experiments were carried out in collaboration with Prof. J. Lange, Breslau.

between taste and sight ; he noticed that a high intensity green produced for him a sweet metallic taste, while blue had a taste which resembled phosphorus. Similar synæsthesiæ will be mentioned later on.

Very commonly the subjects complained of being hypersensitive to noises. True *auditory hallucinations* are rare, but on some occasions observations were reported such as—" I thought I heard the sound of violins, as if the air itself was singing. There was a tune which could not be of this world ; it formed itself from nothing ". Intelligent subjects sometimes described a hyperacuity of their auditory perceptions. One of my subjects was disturbed by the scratching of my pencil on the paper when I wrote ; as D. H. Lawrence put it, " she could distinguish the sound of evening flowers unfolding ". The localization of tones may be changed peculiarly. Two subjects reported that the sounds surged towards them in an impressive way ; one added, " as if I were within the tune ".

Sometimes familiar noises and voices acquired strange qualities, and were described as loud, shrieking or terrifying.

The disagreeably obtrusive noises were frequently misinterpreted. Still more common was a doubtful, suspicious attitude to the content and characters of what was heard. This character of the perceptions cannot be separated from the total attitude, which we shall have to speak about later on.

Tactile sensation was impaired rather frequently. Some subjects complained of paræsthesiæ in the tips of their fingers, others of numb feeling in the face, " as if there were a swelling of the lip ". One person said she felt as if the skin was " unusually vivid ". Cold and warmth were perceived abnormally. Objects felt too hard or too soft. Metals seemed flexible like wax. " The weight of objects changed ; small objects like a fork appeared to become so heavy that I could not lift them."

Most striking are the sensations related to the *perception of one's own body*. " There's a funny feeling in the whole of my body " was a common remark. Frequently subjects noticed that their limbs changed size and shape independently of, and uninfluenced by, visual perceptions. " There were funny sensations in my right hand. If I looked at it and observed its normal shape I had nevertheless the feeling that it was huge and inseparable from the surrounding space." Loss of orientation upon the body, of the localization of the extremities and of the perception of their connection with the total organism are frequent and characteristic. " Gradually the feeling of the body vanished, the position of the limbs could not be localized ; the posture of the body could hardly be determined ; it could scarcely be separated from its surroundings." One of my subjects raised her hand, dropped it again and reported that she felt as if her hand might hover in the air, although she knew through the dropping of the hand that it was lying on the cushion. Another subject felt that his left arm had disappeared. Another said, " There was nothing left of my body but a humming feeling ; I had no bowels any more ", or, " Instead of

my body I only noticed slight rhythmic waves", or, "If I sat down comfortably there was only the head left". A remarkable description of such bizarre sensations was given by Serko. He wrote: "Involuntarily I paid attention to the position of my limbs, which I perceived in an unusually clear and distinct way. I felt my body particularly plastic and minutely carved. At once I had a sensation as if my foot was being taken off . . . then I felt as if my head had been turned by 180 degrees. My abdomen became a fluid, soft mass, my face acquired giant dimensions, my lips swelled, my arms became wooden, my feet turned spirals and scrolls, my jaw was like a hook and my chest seemed to melt away."

Some persons have less fantastic and more pleasant experiences: "There came over me a feeling of bodily lightness. When I walked my limbs had no weight; if the toe of my shoe touched the wall there was no hard contact. This sensation of weightlessness persisted, I think, throughout the whole of the time that I was under the influence of the drug, but after its first onset I quickly became accustomed to it; it seemed inevitable and natural, and I did not again notice it until I was beginning to emerge into the everyday world." Other persons felt their limbs heavy. Some people mistakenly felt as if they were trembling or shaking or swaying. Sensations like these are sometimes followed by movements such as grimaces and mannerisms. Thus a subject said: "The first change I noticed definitely was some dullness and stiffness, especially in the face. I lost control of the position of the face. This uncertainty was very disturbing and disagreeable. I pulled faces. Afterwards the chewing muscles were affected, later on the muscles of my back. The tension made it pleasant to clinch the teeth and to sit bolt upright. I became restless because everything was so stiff, exactly as I had started grimacing because of the stiffness of my face. It was as if I was always trying to find a new position." One of Knauer's subjects reported—"To my great surprise I realized that I had no head, but in its place a sheet of ground glass, such as is used in a camera as a screen . . . where my ear was, was an insoluble mystery; I could not find it so long as with open eyes I followed and controlled the movements of my searching hand. I was quite unconscious of the position of any part of my body". It is interesting to learn that changes like those described were noticed also in the phantom limbs of persons who had had amputations and who were given mescaline by Zador.

The majority of subjects realized as the first sign of *disturbances in the visual sphere* that the colours of the objects were intensified. They became more obtrusive, although the hues themselves did not change. The contrasts became more marked, the after-images increased in intensity and duration. Soon after the objects acquired coloured edges; they changed their colours and finally true hallucinations appeared. In the beginning one could often provoke them by pressing the person's eyeballs. First, entoptic phenomena appeared, stars, lights, flashes, colours. The hallucinations were more distinct

in a dark room than in daylight. Some persons experienced them only under such conditions. The spontaneous hallucinations consisted at first in coloured clouds or mists or patches. Characteristic geometric forms were seen—ornaments, architectural patterns, carpets, nets or lattice-work. These ornaments were usually arranged in long rows or other regular patterns. Here is an example of a self-description: “The visions began. I saw them when I closed my eyes, and especially when with my hands I shielded my closed eyelids from the light, never when my eyes were open. At first they were no more than indefinite white clouds, moving on a dull black ground. Soon they became more clearly defined, and resolved into an interlacing pattern of white lines. The background became a deeper and a richer black, the lines themselves were exquisitely sharp, fine and delicate. I saw a human eye, some faces traced by the lines in their earlier stages, but for the most part the rich black ground was covered with meaningless arabesques, never still, crossing and interweaving in an endless flow. Every line was duplicated, its outline repeated beside it again and again, growing at each repetition fainter, until, infinitely multiplied, it receded into eternity. Now colour entered the scene. The white lines turned first to yellow and orange, thickening until broad patches of brilliant colour glowed against the black, always beautifully defined. Other colours appeared, a superb emerald green, iridescent as a humming-bird’s wings, a red like the sound of a trumpet, a flaming orange, a vivid purple.” Next the shapes of things were distorted and disfigured in every dimension. Sometimes bits of them disappear, although there is no definite defect in the visual field. “The faces of the persons round me changed permanently, sometimes extended in this direction, sometimes in the other; sometimes a half of the face appeared as if dented, the chin was missing, the forehead magnified, the eyes huge and menacing.” The most peculiar disturbance was the alteration of the perception of movements. There is an increase as well as a decrease of perceived movements. The former phenomenon is rarer. One of Beringer’s subjects, if one moved a burning cigarette in front of him in the dark room, saw, not a line or a circle as normally, but a number of small glowing marbles. They were so distinct that he was able to count them. There was no trace between them but the intervals were dark. In contrast to that, one of my subjects said: “When I happened to look at a burning cigarette it started sparkling like firework; the whole room was filled with small fiery stars. If the cigarette was moved, circles, oblongs and other shapes appeared. The hallucinations moved to and fro, the rings and circles danced, things swayed, the lamp on the ceiling, the pictures on the walls moved up and down. Also the faces of people were in constant movement and showed extraordinary distortions of expression.”

The visual hallucinations were not limited to such simple examples; complex scenes were also hallucinated: “Then I was transported a thousand miles away from the surface of the earth. The distance I knew to be exactly a

thousand miles. I was looking at the heavenly body, which was glowing like an iridescent plum-pudding suspended in the sky exactly a hundred miles above the earth. It had become the source of the lightning. The surface of the earth was corrugated by three chains or rather massifs of snowclad mountains. These were three continents, and it was a matter of cosmic importance on which of these three massifs the lightning would strike. For in that continent civilization would be kindled. The surfaces of the three continents, their snowclad mountain ranges, became lit up with innumerable pinpoints of white pointed flame which seemed to be beckoning to the lightning to strike them. I looked up at the heavenly body, and saw with a mixture of surprise and a sense of the inevitability of the event that it had changed into a sun god. This was a sort of Aztec figure, whose head was set in a halo of waving plumes of yellow light which I connected somehow with the tails of flagellosperms. When I looked down at the earth again, I saw that the surfaces of the mountain ranges were no longer covered by beckoning flames, but by innumerable pairs of white uplifted arms, stretched towards the Aztec figure in the sky. I looked again at him to see how he was proposing to respond to these supplications and was surprised to find that he had changed into Dr. N. N—, who was, at the same time, God. He seemed about a mile high, and I saw him in profile, dressed in a long white robe or toga, like a Cæsar participating in a triumph—a wonderfully majestic figure. In his extended right hand he held the lightning in a flickering sheaf of electricity.”

The alterations of the perception of movements are connected with a change of the *perception of space*, as will have been gathered already from what has just been said. Observations have been reported such as—“The space was peculiarly distorted. It had new dimensions, indescribable new qualities”. Very characteristic are remarks on the infinite extension of rooms. Very frequently one hears them described as long cloisters, pillared halls, corridors and so forth. As with many other symptoms of mescaline intoxication, these phenomena exhibited fluctuations of intensity which in this instance were described as changes in the lengths of these corridors. One of my subjects reported that he felt he was moving into a tunnel and saw that he drove away quickly from the entrance and the next moment dashed again towards it.

These disturbances can hardly be separated from the alteration of *time perception* which is a very usual symptom of mescaline intoxication. “Time passed with little sense for me of its passage” said Weir Mitchell, and Knauer and Maloney observed that persons under the influence of mescaline enormously over-estimated time periods. Seconds seemed minutes, minutes seemed hours. One of the persons investigated who had been left half an hour in the dark thought he had lived through the whole night in this time. They investigated this phenomenon experimentally, and found that the over-estimation, although largely subjective, was still demonstrable objectively.

Reports like the following are self-descriptions of mescaline intoxication :

“Time seemed to stand still. I had a feeling of relief when I heard that it was five minutes later. I was dreadfully impatient. I was the more embarrassed that it was impossible for me to follow the small hand of the watch or to count my pulse to orientate myself.” “I drank a spoonful of soup, looked around me, and looked down again at my plate; it had been in front of me for hundreds of years. But my movements, the conversation at the table, were no slower than in normal life; indeed they appeared somewhat accelerated. I must have kept everyone waiting—that was my first momentary thought. Then I realized that if it were true they had been waiting for æons, that it could not be true; and in fact of course it was not.”

In some experiments the subjects were asked to guess one second and to repeat it ten times. The times for these ten intervals were a little longer under the effect of the drug in all cases. Furthermore in all cases the objective time recorded became slower under the influence of the drug. When the subject was asked to tap at intervals of 15 seconds, and if asked to keep on repeating this time interval, the result was similar; the average time became markedly shorter in the majority of the experiments. Only one subject showed an extension of the times tapped. This was the man who reported the standstill of time so impressively. He stated clearly that during the experiment he always was aware of his disturbance. Afraid that his over-estimating of time would give a wrong result, he tried to allow for the subjective extension of time and then over-compensated.

A very interesting phenomenon in the field of sensory alterations during mescaline intoxication consists of *abnormal synæsthesiæ* in persons who in their normal condition have none. The irradiation of sensations from one sense to another can take place without the existence of hallucinations, or more commonly it can accompany and modify pre-existing hallucinations. “When I closed my eyes, I saw lovely lines and patterns. They began to move to the rhythm of the wireless outside. With the deeper tones the colours changed into blue and black, the lines became greater and more compact, the rhythms quicker. When the music became louder the lines and colours were vivified, the movements became more complicated and the colours changed towards yellow. If there were pauses in the music, or if a door were banged, the whole picture stood still, a bright yellowish red flamed up, which slowly turned into darker shades, and then the rhythmic movement went on.” Fernberger studied phenomena like these experimentally. Two of his observers reported that a change of the rhythm of the drum-beat had an effect on the rapidity of change of visions, and another observer reported the drum or rattle-beat had an effect on the form as well. Only one of nine persons stated that no influence could be observed. Similar co-ordinations can be observed between all the other senses as well (Havelock Ellis’s observation has been mentioned above), and eventually in some cases a sort of chord of all senses is experienced. This may be illustrated by an observation of Mayer-Gross: “I felt, saw, tasted,

smelled the tone. I was the tone myself. . . . I thought, saw, felt, tasted my hands. Everything was clear, absolutely certain. Criticism is nonsense in view of the experience of the impossible."

The symptoms of mescaline intoxication are not exhausted by the enumeration of hallucinations, as one might suppose after reading popular descriptions. Looking at the total picture from a psychiatric standpoint, one is not only impressed by the variety of hallucinations, the beauty of the visions, the absurdity of bodily sensations, and the oddity of *synæsthesiæ*, but one notices symptoms in other spheres as well. *Changes of mood*, generally opening the picture, are very impressive. In the large majority of cases euphoria is characteristic. Its intensity varies, and it can appear in numerous shades. It often mercifully covers the initial nausea and sickness. The intoxicated persons are merry and cheerful, talkative and jocular. They feel superior to their surroundings. They often compare their state with a slight drunkenness. In fact the picture is similar, apart from the hallucinations. But alcohol intoxication leads to a simple weakness of intellectual functions, whilst mescaline produces a peculiar disorder of thinking which will have to be described below.

At the beginning of the intoxication the subjects are aware of and surprised by their disinhibition. Later on some of them go into a state of extreme bliss, exaltation or ecstasy. Others show a wise, more introverted sort of happiness, a sense of well-being, of careless and happy resignation, a quiet mirth, a pleasant laziness and satisfaction, a condition which one of Beringer's subjects called metaphorically the mood of "l'heure bleue", and which finds expression in Tennyson's—

". . . they came into a land
in which it seemed always afternoon."

In other cases one sees a facetious jocularity with a tendency to superficial and bizarre associations. Finally we observed outbursts of laughter for which no reason could be given even retrospectively.

Other subjects complain of poverty or lack of emotions: "There is no joy . . . everything is indifferent." A rather common emotional state is a bewilderment frequently related to the hallucinations. In other cases perplexity, with more or less anxiety, is the dominating affect. The anxiety may be a pure feeling of oppression with tremor, sweating and even over-breathing (leading even to tetanoid spasms). Other subjects are definitely frightened of things or persons.

Pure depressions are rare. Some subjects complain of loneliness. Several reported suicidal tendencies. "I saw the open window and felt inclined to step out on the window ledge. There was no real impulse to kill myself, but I wanted to fly out of the narrow room. Finally I shut the window because I thought my behaviour ridiculous, and I was afraid people might regard this as a histrionic, demonstrative suicide." Indolence, lack of criticism and judgment together with hallucinations almost led to accidental suicide in several cases.

One subject told us that he felt inclined to walk out of the window of a room on the first floor so as to test whether he could reach the lawn in one step. Only his laziness prevented him from doing so.

There was hardly one experiment in which suspicion was not present at some time or other. It varied from the slightest sensitiveness and resentful attitude to fully developed paranoid delusions. There is often great distrust towards the experimenter who is suspected of laughing at the intoxicated person. Other people are thought to look, smile or whisper at them. Doubts were uttered several times as to whether mescaline had really been injected, or else only saline, or perhaps a very small dose only for testing the subject's reliability, though marked psychopathological phenomena were described at the same instant. On the other hand the idea arose that there might be no experiment, but that the subject had turned mad spontaneously or been driven into lunacy deliberately. Repeatedly subjects wondered whether there might be poison in the food, and some of them refused to eat, drink or to smoke for reasons of that kind.

Many subjects go through a stage of increased self-awareness. They feel susceptible to great ideas, and ascribe a particular importance to everything they do and think in this state. This is often expressed in subsequent sayings and letters on the "unforgettable experiences", "the most interesting states", in the thanks for "giving me the opportunity to live some hours of my life intensively, to see the carpet of my life spread out in front of me in bright colours."

Splitting of the personality has previously been described as the characteristic symptom of mescaline intoxication. This term pointed to the fact that often the observing ego faces the observed self in a very distinct and detached way. This capacity of self-observation and, of course, the clear recollection, is what makes mescaline intoxication so valuable an object for psycho-pathological studies. "Partly," one of my subjects said, "I am not responsible, partly I know what I do. There is always the other fellow present, the one with the 144 pulses." However, the perception of and the attitude towards one's own self varies. All degrees of depersonalization are experienced, ranging from feelings of strangeness to complete loss of personality. Eventually it becomes impossible to feel oneself as a distinct form. "All demarcation melts away; one feels lost in the cosmos." On several occasions subjects said that only some small points kept them in connection with reality; the painful site of the injection, especially, played this role.

Derealization—feeling of the unreality of things—is still more frequent than depersonalization: "I began to feel that things were not real, that I was sleeping and would wake up in a minute. I felt anxious I would not be sure if it were a dream or not." Other examples: "The whole surroundings appeared to me as if I were returning after a long absence to a room which had previously been very familiar to me, but where now all the objects were

as if they had become quite strange and were saying, 'Go away again; you will not find your previous relationship to us; you are quite strange and altered.' " "During the whole experiment all doings and sayings of the persons round me were absolutely unintelligible to me, like the rules of a strange game." "My parents are so incredibly far away, so detached . . . all friends, acquaintances, relatives are at a far distance. I try hard to have some longing for a person, a place, a time, but I cannot get it."

In contrast to this states are described in which things are particularly clear and impressive. Thus Weir Mitchell writes: "I had a certain sense of the things about me as having a more positive existence than usual. It is not easy to define what I mean, and at the time I searched my vocabulary for a phrase or word which should fitly state my feeling. It was in vain." Another person said, "The objects stood out more distinctly. The faces of the people around appeared to me more sharply outlined and more deeply furrowed than before without appearing actually disfigured."

Among the *disturbances of volition* the talkativeness may be mentioned again. This was described by some of our subjects as follows: "I did and I said things which I disapproved of thoroughly without being able to help it," or "When I read my tongue simply ran away with itself". A sense of disquiet sometimes makes subjects rush about. However, lack of impulse and spontaneity is more characteristic of mescaline intoxication. The persons sit about in lax and sunken attitudes. They do not answer unless pressed; they move only if requested to do so, but once they respond they do it without resistance. They themselves say that they cannot make up their minds. This lack of decision renders even eating, drinking or going to bed almost impossible. Some persons saw the need for doing things, but had no will-power or hardly any. Negativism was also observed in some cases. One person answered questions only by writing; another one shook hands very reluctantly, and only after having looked round very suspiciously. Another subject was negativistic when she was asked to sit or to lie down. She refused food and was resistant to all suggestions. Several persons complained of their will being influenced: "Her glance was fixed and menacing. It penetrated into my eyes. I felt that to be or not to be was at stake, unless I succeeded in escaping this dreadful stare. I felt powerless, forced by a terrible might, I had to face the abominable eye. At the moment when I thought I was to plunge into the vast emptiness of her pupil and to dissolve myself into nothing, the sound of my own voice reached my ear. I heard myself shouting, 'I am hypnotized', and the spell was broken." "I felt I was not free any more, no more master of my senses; I was afraid I had to take the knife."

Disturbances of thinking are present in every case. They are noticed at first subjectively. The subjects complain either of general slowness and hardness of thinking or of a lack of concentration: "Thinking was difficult and slow. Asked about professional knowledge, I was only able to mention

the most elementary things. Concentration was difficult, but not as much from increased distractability as from blocking of thought." Another one complained about the impossibility of following a sequence of thoughts to its end. Sometimes the subjects are able to tell more exactly the nature of their disturbances. Somebody said, "If I was questioned I had a corresponding idea, and I tried to answer, but immediately another idea forced itself upon me. I began to form the answer, I started answering, but had to stop again." Sometimes visual images interfere with speaking. One of the subjects analysed his disturbance of thoughts: "Each word I thought was connected with a picture. This hindered my thinking, as the concrete pictures held me." Others complained of flight of ideas and pressure of thoughts. Another variation of the thought disorder was compared by one of my subjects to a musical stave—she simultaneously had five trains of thoughts running parallel.

A few words on the connection between thinking, imagery and the contents of the hallucinations may be expected here. The spontaneous utterances on this topic differ. Some of the subjects say, like the student mentioned above, that every thought is visualized instantaneously. In other observations people try in vain to provoke visual images. Immediately afterwards the desired pictures appear spontaneously. Fernberger was especially interested in this question; in particular he tried to find out whether and how far the visions could be influenced or suppressed. This was because Petrullo had learnt from the Delaware Indians that it had become considered socially admirable and desirable to suppress these visions. They stated that after some practice they succeeded in doing so. They also say that they can change the visions. Five observers in Fernberger's group reported that the visions could be controlled in duration, in colour and form by suggestion. Only two reported a failure in this respect.

In order to obtain an objective picture of the disturbance of thoughts some of the subjects were tested before, during and after the experiment. Dr. M. Slotta made these investigations, at the suggestion of Prof. Lange. Some of the experiments were spoiled by the psychotic behaviour of the subjects during the intoxication. The other experiments gave very consistent results. Surprisingly enough, the scores for Bourdon's cancellation test did not differ under the influence of mescaline. The number of additions done under the intoxication decreased to a large extent, whilst the number of mistakes increased. In a third test, in which the subjects were asked to sort some cards into two categories, the mistakes increased, and the time needed for the performance of the test went up considerably. The different result of the Bourdon test may be referred either to the fact that this test was always carried out as the first of the battery or, more likely, to the mechanical type of effort it requires.

In other cases the subjects were given tests generally used for testing concentration, reasoning and judgment, and in all cases of intoxication of considerable degree the failures were very striking.

Mescaline is known to the Red Indians as an anaphrodisiac drug. Knauer and Malone have previously observed that sexual ideas played no special role during mescaline intoxication. Beringer's observations differ only in that he twice noticed the occurrence of homosexual inclinations. The persons used for these experiments were questioned about this topic. Nothing was noticed that would point to sexual stimulation or excitation. Only in five cases were the utterances of the persons equivocal. Three of them were psychopathic patients. The first, under treatment for depression, talked about the history of his sexual impotence in the state of disinhibition at the beginning of the intoxication. Similarly a second patient mentioned that she had masturbated as a child and had not dared to speak of it until now. A male patient, a morphinist, after the withdrawal of the drug, saw erotic pictures. Another subject who reported a vision in which a naked figure played an important role said afterwards: "Though the evolution of the picture was in the highest degree erotic, I was in no way conscious of erotic sensations. On the contrary, I was lost in admiration of the magnificence of the figure and delighted with the unexpectedness of the metamorphosis." Fernberger investigated this side especially. His subjects, nine American scientists, noticed that calling up of erotic images, both visual and verbal, proved ineffective. In several cases physical auto-manipulations of the genitals failed to produce the usual physiological effect. The calling up of erotic images, visual and verbal, was equally ineffective. This anaphrodisiac effect of the drug would explain, according to Fernberger, the totally unerotic character of the ceremonies of the peyotl cult which is unlike that found generally in American-Indian ceremonies, and it may be of fundamental importance for the explanation of the mescaline symptomatology and its differences from other intoxications.

These details of the symptomatology illustrate the variety of psychopathological symptoms which can be provoked in a normal person by means of this drug. The enumeration could be enlarged by many examples. Some components could be analysed more in detail by psychometric methods. But all this would not suffice to give a total picture of the mescaline psychosis. Therefore a short description in the usual clinical way may follow.

There is no need to discuss the *aetiology*. The noxa is known. It is this fact, so unusual in psychiatry, which makes mescaline intoxication so valuable an object of our studies. There is roughly speaking a direct correlation between the intensity of symptoms and the amount of poison taken.

Very little is known about the working mechanism of the drug. Mescaline produces catatonia in animals (de Jong). But this effect is not specific enough to draw definite conclusions. According to Quastel, it reduces the respiration of brain tissue; the effect is reversible. Investigations into its effect on the action potentials of the brain, commenced in Dr. Golla's laboratory, do not as yet permit of any conclusions.

The course of the psychosis is typical. If one keeps to the experimental

conditions, one can predict the temporal development. The symptoms appear most quickly if the substance is injected intramuscularly, somewhat slower after subcutaneous injection, most slowly when given by mouth. The first vegetative symptoms develop after 30–60 minutes. Next come the changes in mood, later the first anomalies of sensory perception, very often accompanied by the first disturbances of thought. If the dose has been large enough—about 0.3 grm.—hallucinations with alterations of perception of time, space and personality appear. After these symptoms have disappeared, there nearly always remains a more or less marked paranoid attitude which may be elaborated to a varying extent. A state of physical fatigue follows in which the tendency to introspection prevails. The subjective experiences of this stage gain a peculiar significance. Sometimes the subjects are concerned with their experiences during the acute intoxication, which they describe more extensively than precisely. Sometimes great problems of life such as God, nature, ethics, absorb their thoughts. This introversion is often associated with profound depression. During the night after the experiment sleep is frequently disturbed. Several times a re-occurrence of mescal hallucinations during the hypnagogic state has been reported. Some persons reported that they had to ruminate on the problems and ideas of the last stage for some subsequent days. I have seen only one exception from this regular course. A student who had a relatively high dose fell into a negativistic stupor and refused food and drink. The starvation was probably the reason why symptoms of the intoxication lasted for 48 hours. On the whole, the course is so typical that one might be inclined to regard mescaline intoxication as an argument in favour of the ancient conception of a disease as something that befalls the organism and takes its course regardless of the individual concerned. But more detailed examination discloses many individual differences which involve fundamental problems for psychiatry.

Some of the differences may be explained as variations of intensity. The severest intoxications, measured by the amount of the drug given, exhibit the most intensive vegetative symptoms, all the psychological features described above, and eventually produce true disturbances of consciousness with subsequent gaps of memory.

If medium doses are given, all the symptoms described above make their appearance, but tend to be arranged into certain syndromes. The catatonic pictures are most impressive. All symptoms of stupor can be observed—mutism, lack of spontaneous activity, rigidity of muscles, negativism. Also catatonic impulsive actions, outbursts of laughter, bizarre hypochondriacal ideas fit into this picture. The scattered way of thinking, the disturbances of self-consciousness, the hebephrenic type of euphoria remind one of other schizophrenic pictures. So do paranoid features. One might be inclined to explain the latter in the light of the situation, many of our subjects being in a mental hospital for the first time. In such a situation, where in addition the

patients find themselves looked at by many people with interest and curiosity, asked funny questions and subjected to odd tests, one should not be surprised if they become suspicious. On the other hand, however, one has to bear in mind that the subjects were sensible persons who had considered the experiment before, and that people like these do not become paranoid in similar situations if they are not intoxicated. Moreover, many of them were medical students or undergraduates to whom the atmosphere of a hospital was quite familiar. Thus another factor must be assumed for the explanation of the paranoid reaction, and one is probably justified in attributing this to the alteration of the core of the personality—which is perceived even if it is not stated in spontaneous utterances and self-descriptions. This alteration is due to a physical, a toxic factor which in this example is a well-defined one—mescaline. It may be that something of similar, though unknown, kind is at the root of similar pictures observed in mental patients. One should keep this in mind when attempting to understand and to explain paranoid delusions.

Mescaline intoxication itself has no direct clinical bearing, since addition to the drug in Europe is unknown. Experience has proved those authors wrong who supposed that the pleasant state of intoxication produced by it would quickly lead to addiction.

The final aim of studies like these is to learn something of general importance for psychiatry. As has been said above, the first investigators were mainly concerned with the physiology and pathology of sensory perception. Mayer-Gross and Stein were able to show that the anomalies of visual and tactile sensations can be explained as an alteration of the normal process of fatigue and recovery of the sensory organs. They have pointed out how important for all theories on the physiology and psychology of sensory perception is the fusion of all kinds of sensations in this exceptional state. Furthermore they have emphasized that “illogical” experiences like these might explain some reactions of schizophrenics, such as their incapacity to describe the absurd world they live in. In their need to overcome this difficulty subjects may produce neologisms, as schizophrenics do under similar conditions. This has been noticed only once in these experiments. The subject reported: “. . . . The coloured dragons had a perfectly obvious and indeed familiar name—spulaces (spume, spue, laces and laice)—and the emissions from their mouths were ‘filicils.’”

Two types of hallucinations are generally distinguished—simple and compound ones. Both are to be observed in mescaline intoxication. The former—lights, colours, flashes—remind one very much of what is described in some cases of migraine and after stimulation of the occipital lobe. Some examples have been given above of how far accessory sensory stimuli, psychic representations and thoughts may influence the visions. Zucker and Zador have utilized observations like these for analysing the various sources of complex hallucinations. Their findings cast new light on some phenomena in delirious

states in which the same mechanisms are at work. This is confirmed by some experiments by Zucker. This author gave mescaline to patients who had hallucinations. He found that schizophrenics were able to distinguish the experimental hallucinations from the pre-existent ones, whilst delirious patients were not able to do so. This method could be used for differentiating hallucinations if one keeps in mind the following source of error: schizophrenics have a greater tendency to auditory, confused patients to visual hallucinations; therefore the contrast between the mescaline phenomena and the previous experiences should be more striking for schizophrenics. Zador intoxicated persons with various disturbances in the optic system in order to find out some details about the mechanism of visual hallucinations. The following observation is interesting with regard to the problem of hallucinations in a defective visual field. A subject saw ocelli and reported: "The shape of the ocelli were always the same—oval, the long axis being perpendicular. I recognized the shape as being that of a central scotoma which I have in my left eye." I have had the opportunity of confirming one of Zador's findings from my own experiments, namely that people with acquired peripheral blindness have mescaline visions of typical description. I had no decisive results in visual agnosia and colour-blindness, in the latter case because the dose given was too small to produce hallucinations at all. Some patients of Zador who were blind for long periods had the same disturbances of space perception as normal subjects, but the crucial experiment has still to be done; we do not know whether one can produce visual hallucinations or anomalies in the visual component of space-perception in congenitally blind persons.

Dr. Maclay and I have tried to make therapeutic use of the effect of mescaline on the sensory functions. The drug was given to patients with depersonalization and derealization. The result was that the patients' symptoms could be influenced for the period of the intoxication in so far as they complained of changes in the outside world (derealization). Depersonalization in the strict sense of the word, the feeling of one's own personality having changed, remained unaffected by the drug.

One cannot recommend giving mescaline continuously over longer periods, since very little is known about chronic mescaline intoxication and its possible dangers. (Only Moeller has taken a small amount for twenty consecutive days, and he observed no symptoms of any kind.) It has been suggested that a single intoxication might be employed for convincing the patient that the terrifying feeling of unreality is reversible, and we use this impression as an adjuvant for reassurance. As mentioned above, the state of acute intoxication is often followed by a period in which the subjects ponder over great problems. There is reason to suppose that patients in such a state may be very susceptible to psychotherapeutic influence. In order to utilize this upheaval one ought to know whether the material that comes to the surface during the intoxication is, in its psychological significance, equivalent to spontaneous phantasies, free

associations or dreams. If it is so, the intoxication could be made use of as a sort of forced or concentrated analysis. Before this can be assumed, however, the question has to be answered, whether and how far the reactions during the intoxication belong to the personality and are specific for it, or whether they are characteristic for the drug or dependent on an interaction of both factors.

As a contribution to this problem some experiments have been carried out by means of the Rorschach test. This is designed as a method for characterizing a personality as a whole. In this country P. E. Vernon and A. Guirdham have discussed the value of this test in several recent publications.

The technique in these experiments was different from that used by Wertham and Bleuler, who first used the test in persons intoxicated by mescaline. Following a suggestion by Dr. Vernon, the test was divided in the same way as was done by him for computing its reliability. One half of the test was given before, the other half during the intoxication. The details of the procedure, the possible sources of errors and the attempts to correct them will be described

Changes in Rorschach Responses in Mescaline Intoxication.

	Total number.	"Whole."	"Movement."	"Colour."
Before intoxication	. 281	. 75 (21)	. 23 (8)	. 23 (7)
During intoxication	. 348	. 60 (17)	. 45 (13)	. 43 (12)

more fully in a later publication. Changes have been found in the total number of answers and the amount and percentage of "whole", "colour" "movement" answers (see table). Moreover, the order and succession of answers are generally affected, as are also some minor points, viz., the originality of the answers, the tendency to perseverate and the quality of form answers. When the individual cases are analysed, the change in the proportion of "movement" and "colour" answers is very striking. This proportion and the other factors mentioned above are the chief data for characterizing the personality of a testee, and therefore the conclusion seems justified that during mescaline intoxication the personality is changed—at any rate in so far as it falls within the scope of the Rorschach test. On the other hand, these results cast some light on the significance of this method of appraising personality. The alterations of sensory functions, as analysed by Mayer-Gross and Stein, and the changes in Gestalt-formation, as found by Lewis and Hubert, may partly account for the findings in the Rorschach test. It may also be that the preponderance of sensory experiences during the mescaline intoxication is responsible to some extent for the change of mental behaviour. In any case, all these experiments show the importance of the perceptual sector of the personality, which has been somewhat neglected in the modern psychology of types, only Jaensch's eidetic types being conceived along these lines.

Jaensch has also tried to make use of mescaline for characterizing his

psychological types. He described differences between eidetics and non-eidetics in their reaction to the drug. Fernberger could not confirm his conclusions. Nevertheless Jaensch's experiments remain interesting, since they were the first attempt to explain the individual differences in the clinical picture of the intoxication. This problem did not escape Beringer's attention either, but he felt unable to solve it, in spite of his large experience. Bensheim tried to outline the differences between the reactions of cyclothymics and schizothymics. His results, based on a rather small case-material, are not very convincing. He says that emotions ranging between euphoria and depression are significant for the cyclothymic group, ecstasy for the schizothymic. Furthermore, he points to the fact that the sensory phenomena in the first group are more intimately related to reality than in the latter.

Experimenting with normal persons, one faces the difficulty of characterizing a personality in so simple a way that one can correlate it with the types of experimental changes. In patients or convalescents at least one side of the personality is definitely characterized by the reaction-type of the preceding psychosis. Kant has done interesting experiments in the line of such considerations. He examined the effect of small doses of hashish on manic-depressive and schizophrenic patients after the termination of their acute psychosis. He observed that the manic-depressive patients reacted in the form of their previous psychoses, i.e., the depressive ones became depressed, in marked contrast to the otherwise euphorizing effect of the drug. The schizophrenic patients, even the depressed ones, developed euphoria and anxiety. Exactly parallel observations were made by Zador, who used nitrous oxide, which also produced depression in depressive states, euphoria or anxiety in schizophrenic states. In Dr. Maclay's and my own experiments with mescaline it was striking that pure emotional reactions were found in those cases that were clinically diagnosed as endogenous depressions.

Variable as the psychotic pictures are, one cannot learn very much about the role played by the personality in symptom-formation if one is restricted to such types only as schizoid and cycloid. Experiments on the same individual either with different noxæ, or with various amounts of the same agent or with variations of accessory conditions, appeared to be much more promising. Lindemann and Malamud have reached interesting results, working with this method. They used psychotic or psychopathic patients as subjects and gave four different drugs to each of them. In this way they found very interesting differences in the psychological effect of the drugs used.

Wolf and Curran have proved in careful investigations on a large material that there is no correlation between the kind of agent and the symptomatology of toxic-infectious psychoses (dysergasic reactions). The authors themselves have pointed out, however, that matters are different in mescaline and hashish psychoses, which do show a very characteristic picture. They rightly emphasize that the experiences with these drugs do not justify an all-inclusive

generalization. They reach the same conclusion that has to be drawn from these experiments, namely, that "there is need of a searching investigation in terms of the subject's setting and individual equipment before specificity of reaction can be established". The experiments quoted above, especially those of Lindemann and Malamud, appear to be a promising beginning.

There are only very few experiences gained by the method of repeated intoxication of the same person with the same drug. (Beringer published three cases.) There are four among my material. They are far from sufficient to permit a decision as to how far the picture of the reaction is due to the drug, how far to actual or permanent disposition of the personality. There are too many factors which have to be considered and may be varied experimentally or accidentally, the most important ones being the amount, time of resorption and course of excretion of the poison; the physical condition of the subject (state of health, metabolism); the psychic state (mood, intention, experiences, preoccupation, fatigue); the physical and psychic constitution.

Only if it were possible to keep the majority of the conditions constant or to examine them over some time and to vary them separately could one get an exact knowledge about the influence of each individual factor. This means a vast amount of work. Before continuing experiments on such a scale one cannot help asking what has already been gained. It has been attempted in this paper to give a survey of the results which, disregarding many details, may be summarized in the following points:

(a) A new aspect of disintegration of sensory function, namely in the direction towards *synæsthesiæ*.

(b) A new idea of the importance of the perceptual sector within the personality.

(c) Some therapeutic prospects, especially with regard to depersonalization states.

(d) An opportunity of experiencing undescribable mental changes as a help in understanding the mental life of schizophrenics—a point so important for psychiatrists.

For the future it may be expected that experimental work, as previously outlined, may lead to a better understanding of the complicated interplay of *ætiological* factors in the origin of psychoses. Careful analysis of one intoxication like mescaline promises a reliable basis for knowledge in the field of toxic psychoses generally, and perhaps hints for the solution of the great problem of psychiatry, that of schizophrenia.

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