

VARIATIONS IN THE SENSORY THRESHOLD FOR FARADIC STIMULATION IN PSYCHOPATHIC SUBJECTS

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IV. THE ALCOHOLIC GROUP*

The first indication that information of clinical value could be obtained by the determination of the sensory threshold for faradic stimulation in psychopathic individuals was in the alcoholic group, and the present study shows that this value lies chiefly in its prognostic importance. In the first study (1) the following conclusions were drawn in regard to this group: "The average threshold for alcoholic cases was 252, and among alcoholic cases the polyneuritic or Korsakoff cases ran highest. Upon withdrawal of alcohol and in convalescence the threshold falls, and the method may even have practical value in gauging the degree of progress toward recovery in the delirium tremens group." These conclusions appear to find ample substantiation in the present series. Before presenting the results the experimental procedure and findings in normal cases will be briefly set forth.

Experimental Procedure.—The method used is that described by Martin (2) for the measurement of induction shocks. It depends upon the fact that with a given current running through the primary coil of an inductorium the shock delivered by the secondary (on making or breaking the primary current) is dependent upon the proximity of the secondary to the primary in any given plane. The fact that the amount of shock does not vary proportionately to the distance between the two coils makes it necessary to calibrate the inductorium used according to the method described by Martin. The current running through the primary used in this work was 0.3 ampere. The shocks were delivered by means of the Martin "Make and Break Key" (3), the advantage of which lies in the fact that it gives a uniform break or make as the case may be. Throughout this work only break shocks were used. The electrodes consist of two tubes about 5 inches long and of a diameter to admit the fingers

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comfortably. The wires from the secondary coil are led to the bottom of these tubes (one into each tube) over the top of the tube. The insulation of the wires is stripped for a distance of about 1-2 cm. from the ends of the wires which rest on the bottom of the tubes. Around the ends of these wires is a layer of mercury, over which lies a layer of calomel paste to a depth of 2 cm. The rest of the tube is filled with 15 per cent. salt solution.

The patient, who sits in a different room from the operator, dips the index and middle fingers of his left hand into the electrodes and is instructed to press a telegraph key whenever he feels a shock. The operator starts with the secondary coil in a position where it will deliver a subliminal shock and gradually approaches it to the primary, breaking the current at short, irregular intervals. Finally the patient signals, indicating that he has felt the shock. This point and its environs are tried and retried until the point furthest from the primary is found where the patient feels nearly every shock. This can be found within 2 mm. as measured on a scale which has as its zero the point where the secondary is over the primary. This procedure is repeated three times with 10,000, 20,000, 30,000 ohms respectively added to the secondary circuit. Thus it is evident that deception on the part of the patient is impossible. The entire procedure consumes about 6 minutes, on the average, although perseverance will frequently procure a reading from a subject who at first seems to offer no coöperation whatever. The resistance of the coil used in this work is 2,900 ohms. In work of the highest accuracy it is well to determine the resistance of the patient's skin in each case by the Kohlrausch method. These resistances have been found to be very constant, however, and in our work we felt that it was better not to determine the resistance in each case on account of the time necessary for the procedure and the restiveness of certain patients. We have taken the resistance of the skin to be 2,100 ohms. About 75 per cent. of all resistances lie within 300 ohms of this figure and the remainder vary from 1,000 to 4,000 ohms. This introduces such a small percentage error (especially inasmuch as we are dealing for the most part with pathologically high thresholds) that the plan of not taking resistances appears to be justified. We have, then, in the secondary circuit the resistance of the secondary coil (2,900 ohms) plus the resistance of the patient (2,100 ohms) or 5,000 ohms. Our four readings of the position of the secondary of the coil are made with the resistances of 5,000, 15,000, 25,000 and 35,000 ohms respectively in the secondary circuit. From these resistances, the value of the primary current, and the position of the secondary of

the coil we arrive at the value of the shock necessary to cause sensation by certain formulæ developed by Martin (2). The final result is expressed in beta units. Throughout this work the threshold has been expressed in these units, and, of course, the higher the figure the less sensitive is the subject. One beta unit is the average amount of shock necessary to cause a minimal contraction of a frog's gastrocnemius stimulated through the sciatic nerve in the well-known nerve-muscle preparation. Thus it will be seen that these units have a physiological basis.

The average human threshold for the fingers in these electrodes was found by Martin, Porter, & Nice (4) to be about 100 Beta Units at 2:00 P. M. It was later found that this threshold had diurnal and nocturnal variation (5, 6) which correspond closely with the diurnal and nocturnal variations of the nervous system as observed by other methods. It was also found that general fatigue raised the normal threshold (7) to a marked degree but not to abnormal figures. All the present observations were made at a time when the threshold is at a high point in the daily rhythm, *i. e.*, between the hours of four and eight P. M. It has been found by Dodge and Benedict (8) that the normal threshold is raised by alcohol and by Martin, Grace, and McGuire (9) that a similar effect is demonstrable after the ingestion of acetphenetidin. From these last two observations it will be seen that the following evidence has a solid experimental basis.

The Present Material.—The present series falls naturally into the following groups and will be considered under these heads:

- I. Delirium Tremens.
 - II. Acute Alcoholic Hallucinosi.
 - III. Korsakoff's Psychosis.
 - IV. Unclassified and Miscellaneous Conditions due to Alcohol.
 - V. Other Psychoses complicated by the use of excessive Alcohol.
- Again in this group as in all others much depends on the accuracy of the diagnosis. The diagnostic error of the Psychopathic Hospital diagnoses as judged by further observation of cases sent from here to other state institutions is about 20 per cent. (10). Although not specifically mentioned in the paper quoted the diagnostic error of this group must be much smaller. Many of the cases here considered were never sent to other institutions, but were observed at this hospital during the entire period of their psychosis, and inasmuch as the diagnoses here used are the final discharge diagnoses they are probably as correct as it is possible to establish. Furthermore the diagnostic lines can be more sharply drawn in this group than

in the dementia præcox group, for instance, and thus the opportunity for diagnostic error is considerably less.

There were in all 94 cases tested¹ of which number there were two from whom it was impossible to get a valid reading at any time.

TABLE I

Types	Total Cases	Males	Females	Limits of Variation	No. of Observations	Av. Threshold
Group I.	22	18	4	85- 493	33-1= 32	241 β units
Group II.	17-1=16	15-1=14	2	46- 545	26-1= 25	269 "
Group III.	7-1= 6	3	4-1= 3	156-1,560	20-2= 18	443 "
Group IV.	14	14	0	86- 600	20-0= 20	249 "
Group V.	34	29	5	23-1,661	74-0= 74	246 "
Total.	94-2=92	80-1=79	15-1=14	23-1,661	173-4=169	270 "

As one looks over the alcoholic cases (cf. Table I) the one fact that is impressive is that the ingestion of alcohol undoubtedly raises this threshold. This is more apparent when one finds that almost every low value is in a recovered case, or at any rate in a case that has not had alcohol for some time. We have divided the observations into three fields (1); normal (under 150 beta units, doubtful (150-175), and pathological (over 175 beta units). According to this scheme it is found (cf. Table II) that the highest threshold values

TABLE II

Groups	No. of Observations ²			Average Time of Observations Before Discharge		
	Normal	Doubtful	Pathological	Normal	Doubtful	Pathological
I. 22 cases.	7	2	23	4	6	9
II. 16 cases.	3	1	21	3	12	11
III. 6 cases.	0	1	17	-	5	90
IV. 14 cases.	4	3	15	3	3	21
Total. 48 cases.	14	7	76	3	6	24

are obtained nearest the point where the alcohol is withdrawn and that lower values are obtained the longer after the withdrawal of the drug the observations are made. Group V was omitted from

¹ The case numbers are: 2820, 3573, 2845, 1759, 2318, 1857, 1713, 1877, 380, 2220, 2812, 1879, 2054, 1999, 1926, 2323, 3894, 2824, 2209, 999, 2942, 2280, 1420 (), 4382, 4255, 3720, 3926, 3942, 3816, 3776, 1097, 1354, 2509, 1900, 3697, 1635, 2299, 1831, 2853 1483, 3808, 1952, 1919, 4208, 4252, 3164, 4332, 2303, 2365, 2334, 2020, 1941, 2840, 227, 2850, 3755, 3681, 2089, 4392, 3578, 3757, 1886, 2030, 2210, 3571, 2336, 2154, 2078, 2058, 4001, 2851, 2354, 2347, 1837, 1926 (3958), 4277, 3583, 292, 1109, 2367, 164, 2227, 3694, 3830 (3627, 3037), 3591, 1848, 2180, 3699, 3880, 3862, 2165, 1849, 2297, O. P. D. No. 2679.

² Invalid observations are excluded from consideration.

this table as the variation of the threshold is complicated by the variations of the values in the psychoses to which the cases in this group belonged and about which not enough is known to enable them to be taken into consideration. It is from this fact that the hope that this test might prove to be of prognostic value arose, and we feel that the evidence afforded by the present group of cases is quite conclusive on this point.

Group I.—The delirium tremens group offers the best material for prognostic study. There were five cases tested more than once,

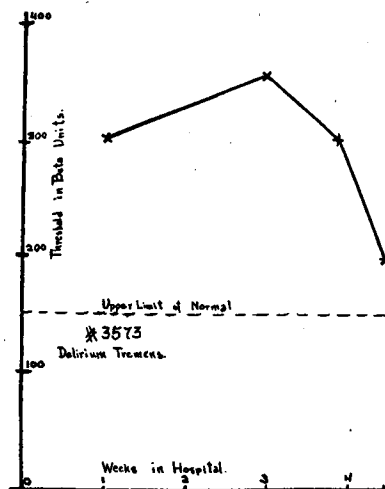


FIG. 1. Shows a curve of recovery in the delirium tremens group. The ordinate represents the threshold expressed in the number of beta units required to produce sensation, the abscissa the duration of the patient's stay in the hospital in weeks.

and each one showed a downward trend, until at the time of discharge a normal value was obtained. Only one case failed to show a pathologically high threshold when tested soon after admission. This man (No. 380) was a morphinist and at the time he was tested was possibly suffering more from this drug than from alcohol. Fig. 1 shows the type of progress of these cases. This case (No. 3753) showed an increase in threshold before the final fall to normal, acting in this respect like certain of the acute hallucinosis cases. In other cases this rise was not obtained.

Group II.—The group of the acute hallucinoses shows no great divergence from Group I, though clinically characterized by a longer course. Fig. 2 shows the course of a case frequently observed.

Group III.—Characteristic of the polyneuritic or Korsakoff group is the wide variation without any particular trend either up

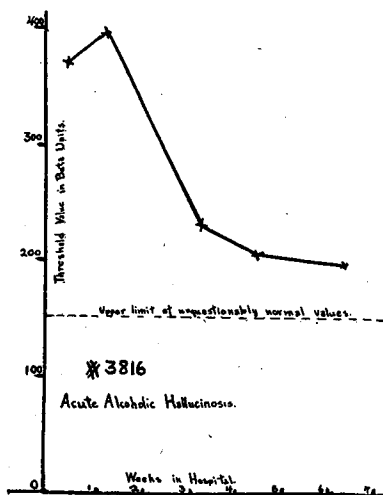


FIG. 2. Shows a curve of recovery in the group of acute alcoholic hallucinosia. Ordinate represents threshold value in beta units, the abscissa weeks in the hospital.

or down (cf. Fig. 3). Two of these cases recovered. One recovered case (No. 1919) seemed to be getting worse (according to this test) when last tested; the other recovery had a very short course (No. 2853) and fell like the delirium tremens cases. The most

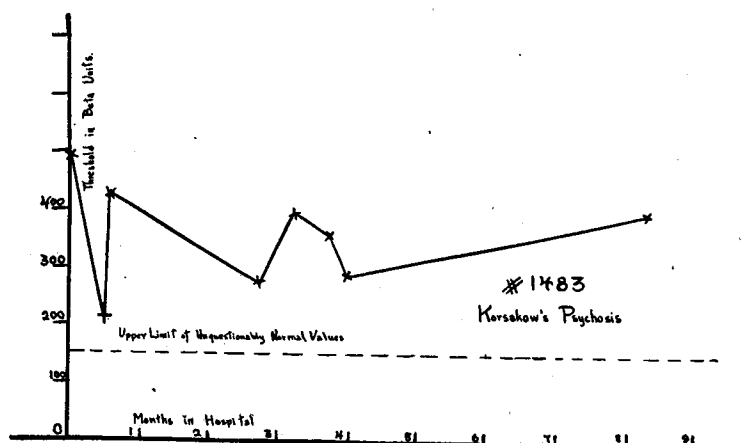


FIG. 3. Shows a curve from one of the cases of Korsakoff's psychosis. Ordinate represents the threshold value in beta units, the abscissa months in the hospital.

severe case (No. 1952) gave only one valid observation. Clinically the patient showed very marked mental deterioration and extreme contractures.

She also showed the highest threshold of the group. Here again may be a point in the prognosis. It is worth while noting that the check on the replies of the patient is especially valuable in this group with its confabulatory abilities.

Group IV.—This group shows a series of high thresholds in a number of cases of mental disease caused by alcohol. There are only three cases in the group that show normal values. One of these is really a high normal (149), the other two are cases of acute alcoholism (cf. Table II). Apparently from these observations in

TABLE III

Chronic alcoholism	4	243
Unclassified alcoholic psychosis	3	279
Acute alcoholism	2	115
Alcoholic paranoid condition	1	149
Pathological intoxication	1	257
Alcoholic delusional insanity	1	216
Periodic drinker	1	230
Alcoholic epilepsy	1	397
Total (20 observations)	14	249

the light of Dodge and Benedict's study (8) alcohol in any form raises the sensory threshold for faradism but does not raise it to a pathological degree unless the imbibition of the drug continues over a certain length of time. In regard to the withdrawal of the drug we find in this group the same type of result that is found in the others. The longer after the withdrawal of the alcohol the lower becomes the threshold (cf. Fig. 4). The case figured is a case of "alcoholic epilepsy."

Group V.—This group of cases consists in those patients who, in addition to having another condition, have used alcohol to excess. In many of these cases alcohol was considered to be a factor in producing the existing mental condition and in as many others it was not so considered. The average of this group as compared with an earlier average of random psychopathic cases (including the alcoholic cases) shows again the tendency of chronic alcoholism to raise the sensory threshold; the first series averaged 223 β units as against 246 β units for this group. It seems fair to regard this as a definite increase in average as the number of cases compared is such that wide variations are obscured in the averages and inasmuch as the composition of this group is very similar to that of the former series. The average threshold of the cases in the first group of

cases studied whose diagnosis was not connected with alcohol was 211 β units. This contains the cases of these psychoses in which alcohol was used to excess, but is more comparable to this group than the average of the entire group. From these figures the effect of

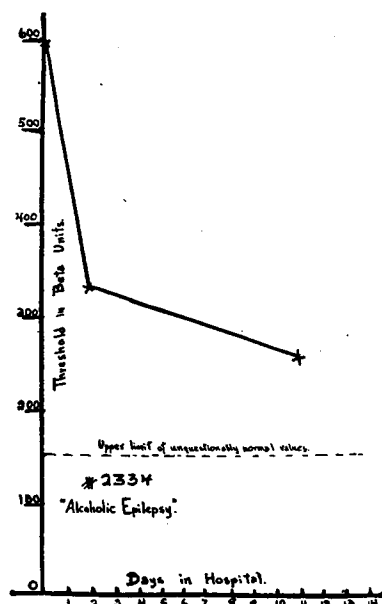


FIG. 4. Shows the variation of the threshold values in a case of alcoholic epilepsy. The ordinate represents the threshold value in beta units, the abscissa the duration of patient's stay in the hospital in days.

chronic alcoholism is even more apparent than from the former comparison. The only class of cases that contain enough instances (cf. Table III) to compare with the remainder of their particular group that have not used alcohol to excess is the dementia præcox

TABLE IV

	No. Cases	No. Observations	Av. Threshold
Dementia præcox.....	14	23	190 β units
General paresis.....	5	13	258 "
Unclassified.....	4	7	228 "
Psychoneurosis.....	3	13	251 "
Defective.....	3	5	182 "
Syphilis of the central nervous system....	2	5	293 "
Manic-depressive insanity.....	2	5	474 "
Hyperthyroidism.....	1	1	183 "
Senile dementia.....	1	2	456 "
Total.....	34	74	246 β units

cases. 37 cases of this psychosis in which alcohol was not used to excess averaged 168 β units and the dementia præcox group as a whole (11) averaged 186 β units as compared with 190 β units for the alcoholic group of this psychosis. One case deserves special mention as an exception to the rule that alcohol raises the threshold value. This was one of the manic-depressive cases (No. 2165) and had the lowest threshold in that group (23 beta units). It was a manic case and this value was obtained on the day of admission and it was suggested that this might account for the exceedingly low value (12), in spite of the excessive use of alcohol by this patient. It is not profitable at present to discuss the effect of the withdrawal of alcohol on the threshold value in this group as this is complicated by the variations seen in the various psychoses here represented and of which not enough is known to estimate their influence. However, in certain cases it is observed that the alcoholics had discordantly high thresholds which came down to the level of the other cases of the group to which they belonged after the withdrawal of the alcohol.

In conclusion, it is again to be emphasized that the chronic alcoholic has a pathologically high threshold even if his psychosis is not due to alcohol, that the threshold falls after the withdrawal of the alcohol, that the impressions gleaned from the first series have been substantiated by this study, and that this test may be used in gauging the course of recovery in the alcoholic group, the Korsakoff cases showing an irregular type of falling curve, whereas the other types of cases show a more regular curve of falling threshold.

CONCLUSIONS

1. The alcoholic psychoses show a pathologically high sensory threshold for faradism for varying periods after the withdrawal of the alcohol. Acute alcoholic excesses do not appear to raise the threshold to a pathological value. The thresholds of cases having other psychoses complicated by chronic alcoholism often show that alcohol raises the threshold above the general level of the group to which such a case belongs.

2. In convalescence from the alcoholic psychoses the threshold falls, reaching a normal value if recovery takes place. This fall appears to follow a smooth curve in the delirium tremens and acute hallucinosis cases and shows irregular variations in the protracted Korsakoff cases. In cases of other psychoses complicated by chronic alcoholism the threshold falls to the level of the other cases in the group to which the particular case belongs, after the withdrawal of the alcohol.

3. This test appears to have practical value in gauging the rapidity and time of recovery in the alcoholic psychoses.

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