THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by **Joseph A. Schabert** for the degree of **Master of Arts.** They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of **Master of Arts.**

Herbert Woodrow

Chairman

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Aug. 2d 1918

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Report

of

Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given **Joseph A. Schabert** final oral examination for the degree of Master of **Arts** . We recommend that the degree of Master of **Arts** be conferred upon the candidate.

Minneapolis, Minnesota

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Individual Differences in Emotional Response as Measured by the Psycho-galvanic Reflex

A Thesis submitted to the
Faculty of the Graduate School of the
University of Minnesota
by
Joseph A. Schabert
In partial fulfillment of the requirements
for the degree of
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I.

Historical Introduction (1)

Before the year 1888, Vigouroux had made a study of electrical phenomena in the human body, but in that year Féré and Tarchanoff, working separately, observed that there exists a relation between these phenomena and psychic excitations of subjects. Féré used an extra-somatic source of current; Tarchanoff, however, employed only the current generated by the body. In both cases electrical changes were detected by means of the galvanometer. Tarchanoff considered the activity of the sudoriferous glands of the skin as the cause of the electrical changes. In 1897, Stricker tried to use these electrical phenomena of the skin to represent objectively excitations of sensibility. He concluded that "the current brought about by excitation is a complex phenomenon in which the psychic excitation and the secretion current influence the excitation of the local capillary system". During the years 1902 and 1905, professor Sommer of Giessen studied the physical and physiological nature of these phenomena, and decided that they should be explained physiologically by unconscious movements of the hands and fingers which, during the experiments, produced a variable pressure on the electrodes. The next year, Fuerstenau investigated the physical nature of these phenomena, using in his experiments electrodes of unlike metals. He considered the skin a conductor which he assigns a place between zinc and aluminum, and which has a positive potential when placed in contact with one group of metals and a negative potential when in contact with another group. Sommer's assistant, Knauer, studied especially the latent period of galvanic deflections. He proposed still another theory to explain the deviations. They are due to variations of electrical potential of the skin under the influence of psychic excitation; for he considered the skin a semi-permeable membrane between two electrolytes, the liquid of the body internally and the perspiration externally.

Note (1) A complete bibliography is given at the end.

In 1904, E. K. Mueller, an electrical engineer of Zurich, discovered independently of Féré, changes of conductibility of the human body under the influence of psychic and physiological processes. He told his discovery to the neurologist Veraguth who carried on experiments which confirmed many of the facts already observed by those mentioned above and added other data. Veraguth employed an extra-somatic source of current, and so studied only the variations of conductibility of the human body from the physical point of view. Psychologically his investigations were concerned largely with affective states brought about chiefly by means of association. The publication of his researches induced a number of investigators to undertake similar experiments. Jung and Peterson, later Jung and Ricksher, made a comparative study of galvanic reactions and respiratory phenomena under the influence of psycho-physiological factors. Peterson also published articles on the measurement of emotions with the galvanometer. In collaboration with Morton Prince, he studied the influence of subconscious psychic processes on psycho-galvanic phenomena. Binswanger made special researches on the deviations of the galvanometer during the application of associative stimuli. H. Mueller and later Aebly again investigated the physical nature of the phenomenon, and called attention to the polarization which takes place in the organism during the passage of an extra-somatic current. All these investigators following Veraguth employed an extra-somatic source of current, consequently they discussed in the first place the changes of conductibility in the body.

The other method (used by Tarchanoff originally) was employed by Sidis in his later experiments made in collaboration with Nelson. In his earlier investigations carried on in connection with Kalmus, he too employed an extra-somatic source of current. Sidis and Nelson denied the existence of changes of conductibility in the body and asserted that all the deviations of the galvanometer are due to the new electromotive forces which develop in the organism under the in-

fluence of psychic excitations, and have a muscular origin. Dunlap, in a discussion with Sidis, criticized both the physical procedure and the conclusions of the latter. Starch carried on experiments and asserted on the basis of their results that the intensity of the deviations corresponds to the intensity of the emotion. Piéron propounded a physical theory analogus to that of Aebly on the changes of conductibility. Albrecht holds that there are two factors that enter into the whole phenomenon: variations of electromotive force and variations of resistance. Wells and Forbes began an investigation primarily "to develop the best available method of applying the so-called 'psycho-galvanic reflex' to the study of the emotional reactions both in normal individuals and in various forms of psychoses". After rather elaborate experiments they doubt the validity of Sidis' conclusions and pronounce the evidence adduced by him inconclusive. In regard to the nature of the psycho-galvanic reflex they believe their experiments show that it is principally the result of a single physiological activity, the secretion of sweat, which manifests itself physically in two ways, by changing the electrical potential of the surfaces of the body and by lowering the resistance of the skin. In the same year, 1911, Moravcsik reports experiments in which galvanic deflections were produced in the waking and in the hypnotic states by various stimuli. Abramowski investigated the influence of voluntary effort on the psycho-galvanic reaction. The most expensive recent investigation of this phenomenon was carried out by W. Radecki. He studied the physical, physiological, and psychic sides of the problem using at one time an extra-somatic source of current and at another only the current generated by the body. His analysis of the data he obtained from many experiments is very thorough. Among his conclusions regarding the physical side of the phenomenon is this: During certain psychic excitations the conductibility of the whole human body relatively to an extra-somatic current changes.

II.

Statement of the Problem

The main problem selected for investigation in this study is the measurement of individual differences in emotional response by means of the psycho-galvanic reflex. Though this inquiry in itself is of sufficient interest, it was hoped that the data obtained might throw some light on the question whether there is such a thing as general emotionality. Specifically, the following problems were studied: (a) What effect does repetition of a stimulus have upon the psycho-galvanic response, and does it have the same influence on the affective response? (b) Given a considerable variety of stimuli (five were used) do subjects show individual constants? (c) How do the psycho-galvanic responses of highly emotional individuals compare with those of unemotional people?

III.

Apparatus and Procedure

The following apparatus was employed: A Leeds and Northrup mirror galvanometer, the Ayrton shunt, one lead storage cell, two commutators, several standard resistance boxes, and water electrodes. The deflections were read directly from a millimeter scale, 50 c. m. distant from the galvanometer mirror. By calibrating the galvanometer and drawing up a scale, the readings in millimeters could be turned into ohms. All results are thus stated in terms of ohms. This method was thought satisfactory both because the ohm is the unit of electrical resistance and because the results stated in terms of ohms would be quite definite. The galvanometer was shunted at 1/100 of its full sensitivity. A lead storage cell (2 volts) was used because this type of cell has little polarization, giving greater constancy of current. One commutator was connected with the galvanometer in order to detect polarization there by reversing the current through the galvanometer. The other was placed in the circuit through the human body in order

to obtain some data on the amount of polarization in the body. The resistance boxes were arranged so as to form a Wheatstone bridge of which the body was one arm. The resistance of the body was then calculated according to Ohm's law. Water electrodes were used in order to avoid errors due to variations in pressure incident to the employment of metal electrodes. The subject's hands were fastened with canvas straps to rubber covered boards which were securely clamped in vessels of water. Each vessel contained one gallon of water, and covering the entire bottom was a copper plate connected with the wires of the circuit.

IV.

Preliminary Experiments

Preliminary tests were made to find any error due to movement of the hands. The subject, with his hands fastened in place, was told to move them as much as possible (which was very little). This was seen to have no effect on the deflection of the galvanometer. Hence, it was concluded that the subject could not move sufficiently to cause any error.

Since the hands were immersed in water, tests were also made to discover the effects of soaking. The subject's resistance was measured in the usual way, then he removed his hands, dried them and sat perfectly quiet for ten minutes. At the end of the ten minutes of rest, his resistance was again measured. These results were then compared with results obtained when the subject's hands were in water for the ten minute period. The following table gives two cases:

Subject R. R.	R. at beginning	After 10 Min. resting	Difference
Hands not in water . .	7910 ohms	10035 ohms	2125 ohms
Hands in water	7185 "	9305 "	2120 "
Subject H. G.			
Hands not in water . .	7910 "	13900 "	5990 "
Hands in water	8500 "	10700 "	2200 "

(It should be noted that in each case the so-called curve of rest tends upward rather than downward in these particular cases, i. e., the resistance in-

creases during the period of rest; sometimes the reverse is true.)

From these results it is clear first of all that soaking the skin does not bring about a fall of resistance, for, as can be seen from the third column in the table, the resistance is just as high(even higher in the second case) after ten minutes of rest with the hands out of water as it is when they are immersed for that period of time. In the second place it is obvious that soaking is not responsible for the rise in resistance, since the rise is just as pronounced -- sometimes more so -- when no soaking goes on. Moreover, since this condition is standard for every one it will not interfere with our main problem no matter what slight effect -- and it could be only very slight -- the action of the water on the hands may happen to have.

A preliminary test was also made to ascertain the effect of reversing the direction of the current through the human body. The curve of rest may tend downward or upward or proceed zigzag fashion on an approximate level, i. e., the resistance during a period when the subject merely remains quiet, may increase or decrease or remain approximately the same. If, after a time, the direction of the current through the body is reversed, there will be a fall of resistance. In forty seven observations on fifteen individuals, it was found that when the curve of rest tended downward (gradual decrease of resistance) reversing the current after a period of eighteen or twenty minutes, registered uniformly a resistance lower than that observed at the beginning of the experiment. When the curve of rest remained on an approximate level, reversing the current registered a lower resistance, but went lower than that at the beginning of the experiment according to the proportion of 6 to 2. Finally, when the curve of rest tended upward, reversing the current lowered resistance, but it went below that at the beginning of the experiment in the proportion of 7 to 25. If a series of reversals of current (at 3 Min. intervals) are observed, it is seen that at each reversal the resistance falls below what it was immediately before the change.

Still as a rule, with each succeeding reversal the resistance falls less. (The typical case presented in tabular form on page 8 will make this clear).

These results do not seem to harmonize with Aebly's theory -- based on experimental evidence -- that all the deviations of the galvanometer ought to be explained solely by the diminution of the current due to polarization in the human body. Polarization would of course be a sufficient explanation for a constantly increasing resistance during a period of passivity on the part of the subject. This is made more plausible by the fact that reversing the current shows a decrease in resistance. But when, during a period of passivity, the resistance gradually decreases there is a opposite effect which must have a cause different from polarization. Radecki suggests another factor besides polarization, fatigue. It might also be that this continued gradual decrease in resistance is due to a current generated in the body, for this flowing in the same direction as the extra-somatic current, would augment the latter and thereby register a lower resistance. And yet, the addition of a body current to explain constantly decreasing resistance during passivity does not harmonize with the fact that reversing the current always lowers the resistance beyond what it was at the beginning. Still,whatever be the correct physical or physiological explanation or these phenomena, it seems quite justifiable to use resistance changes as a measure of effect of stimuli on the psycho-galvanic response. For the phenomenon is found in all individuals, i. e., a change of direction of the extra-somatic current is followed by a decrease in resistance. More important still is the consideration that when using an extra-somatic source of current the effects of stimuli, if they have any at all, show diminished resistance. Hence, whatever be the physical or physiological explanation of the resistance changes, these changes may profitably be used as a measure of the effects of stimuli because these rather sudden changes in resistance follow the stimulus closely and would not take place if no stimulus were given. Finally, a little

Table presenting data on reversing the direction of the current through the body.

Min.	Resistance in ohms	Difference due to reversal	Progressive decrease of effect	Total decrease of effect
1.	8500			
	9060			
2.	9385			
	9690			
3.	9900			
	10070			
	(9610)	460	1110	1110
4.	9740			
	10000			
5.	10295			
	10360			
6.	10500			
	10570			
	(9935)	635	325	1435
7.	10000			
	10295			
8.	10360			
	10500			
9.	10570			
	10600			
	(10175)	425	240	1670
10.	10295			
	10570			
11.	10740			
	10700			
12.	10700			
	10700			
	(9870)	830	-305	1370
13.	10000			
	10135			
14.	10250			
	10295			
15.	10295			
	10360			
	(9970)	490	100	1470
Reversal every thirty seconds:				
16.	9970			
	(10135)	+165	165	1635
	10310			
	(10000)	310	-135	1500
17.	10295			
	(10030)	265	30	1530
	10295			
	(10295)	---	265	1795
18.	10470			
	(10100)	370	-195	1600
	10205			

(The figures in parenthesis give readings taken during the 30 second intervals. The lines in the column at the left indicate the time of reversal. The plus and the minus signs are obvious in meaning from the headings of the respective columns.)

observation easily convinces one that the sudden fall of resistance following stimulation is a phenomenon quite distinct from the gradual decrease sometimes seen during the period of passivity. The lowering of resistance due to stimulation takes place quickly; it lasts only a short time and then returns (somewhat more gradually as a rule) to nearly what it was before the stimulus was given.

V.

Effect of Repetition of a Stimulus

In seeking an answer to the problem of the effect of repeating a stimulus, the following method was used. Subjects were tested once a day for a period of ten days. They were instructed to remain quiet during the experiment, with the hands fastened in the outer electrodes, and with as little mental activity as possible. The current was cuts and readings were taken every thirty seconds. At the end of ten minutes a stimulus was given. The stimulus in this case was the striking of an eighteen inch gong by a wooden hammer falling 40 c. m. The readings were continued ten minutes longer and the stimulus was repeated. The results show that repeating the same stimulus both on the same day and on succeeding days, produces a decreasing effect. The decline in effect is rather irregular, but it is sufficiently marked to allow the generalization that the repetition of a stimulus both on the same day and on succeeding days shows a decreasing effect. The tables on pages 10 and 11 give the data on which these statements are based.

To determine whether the repetition of the stimulus had the same effect on the affective responses as on the psycho-galvanic reaction, introspections were taken and recorded. Since only two of the subjects had training in introspection, the following conclusions may not be wholly accurate. Still, the questions were put very simply — subjects were merely asked to compare the

Summary table giving the responses to repeated stimulus of five subjects.

	Subj. R. R.		Subj. P.W.		Subj. W. B.		Subj. H. B.		Subj. A. W.	
Days	1 Resp.	2 Resp.	1 Resp.	2 Resp.	1 Resp.	2 Resp.	1 Resp.	2 Resp.	1 Resp.	2 Resp.
1.	905	330	3475	1625	351	140	200	80	215	115
2.	300	400	2835	1895	240	100	150	65	---	10
3.	210	---	1170	1740	300	120	180	70	---	--
4.	---	130	2535	795	280	100	140	80	---	--
5.	170	125	1300	1010	260	90	90	60	---	--
6.	300	465	560	435	230	75	100	40	---	--
7.	145	150	950	360	260	80	75	30	---	--
8.	160	55	1175	690	195	70	50	--	---	--
9.	210	100	175	85	130	80	--	--	---	--
10.	150	175	725	565	135	40	--	--	---	--

Table giving in detail the responses of one subject for ten days:

Min.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
1.	8500	9000	13690	12600	8300	8700	12710	13900	12330	13000
	9000	9700	14195	13400	9000	9500	13800	14600	12230	13690
2.	9500	10420	14475	14070	9740	10000	14600	15950	12190	14860
	9875	11100	14600	14510	10295	10430	15535	16900	12040	15950
3.	10200	11600	14715	14705	10930	10785	15950	17500	12000	16075
	10575	11950	14715	15075	11500	11000	16210	17900	11950	16075
4.	10790	11000	14795	15200	12040	11250	16430	18100	11865	16290
	11000	10140	14600	15200	13410	11335	16500	18100	11725	16430
5.	11180	9930	14405	15275	12805	11410	16500	18000	11690	16500
	11325	10090	14740	15125	13050	11500	16500	18000	11600	16500
6.	11500	11125	13900	14995	13220	11635	16210	17900	11600	16360
	11600	10300	13900	14905	13165	11725	16210	17800	11460	16290
7.	11775	10570	13690	14860	12900	11725	16075	17500	11335	16210
	11875	10295	13500	14715	12900	11725	16000	17400	11250	16210
8.	11875	10570	13500	14715	12805	11725	15890	17300	11205	16140
	12040	10785	13400	14475	13000	11725	15810	17100	11250	16075
9.	11875	11000	13335	14475	13000	11690	15690	17000	11205	16000
	11875	11000	12805	14905	13000	11690	15625	16800	11175	16000
10.	11875	11175	12805	15075	13000	11690	15575	16700	11175	16000
S	11875	11335	12805	14995	13165	11600	15425	16600	11175	16000
11.	9000	8500	11635	12460	11865	11205	14600	15810	11090	15275
	8400	9245	12040	12600	12040	11125	14475	15435	11000	15950
12.	8650	9480	12190	13710	12280	11040	14360	15275	10970	16000
	8800	9610	12230	12805	12370	11040	14300	15200	10850	16140
13.	8900	9690	12410	12900	12560	11090	14360	15125	10850	16290
	9000	9790	12500	12950	12710	11125	14360	15135	10786	16430
14.	9000	9935	12600	13000	12805	11175	14300	15275	10810	16430
	9125	10100	12710	13050	12900	11125	14300	15200	10850	16290
15.	9250	10295	12770	13100	13000	11175	14300	15275	10740	16210
	9200	10500	12805	13165	13100	11175	14300	15275	10740	16075
16.	9250	10570	12860	13400	13450	11175	14600	15250	10850	15890
	9300	10700	13000	13400	13500	11175	14600	15425	10700	15810
17.	9500	10700	13000	12400	13575	11125	14510	15425	10700	15740
	9425	10785	13000	13400	13690	11125	14510	15425	10700	15690
18.	9425	10785	13000	13400	13690	11000	14510	15425	10700	15575
	9500	10500	13000	13400	13690	10930	14510	15350	10740	15500
19.	9125	10570	13000	13400	13500	10900	14475	15350	10740	15425
	9240	9740	13000	12900	13400	10970	14475	15275	10740	15350
20.	9240	9935	13000	12600	13320	10570	14475	15275	10785	15425
S	9500	10000	12950	12130	13050	10570	14360	15200	10785	15425
		(8105)	(11210)	(11335)		(10135)			(10700)	
21.	7675	8600	11335	11500	12040	10205	14130	14715	10740	14860
	8200	8850	11500	11690	12230	10260	14070	14510	10780	14795
22.	8500	9000	11600	11550	12250	10295	14000	14510	10740	14600
	8650	9190	11690	11690	12410	10295	14000	14510	10740	14510

(The Roman numerals at the top indicate the days. The Arabic figures at the left mark the minutes. Readings were taken every 30 seconds. The figures in parenthesis are readings taken during the 30 second intervals.)

affectiveness of the second stimulus on the same day with the first, and the stimuli on the one day with those on the preceeding day. And because this method is relatively easy -- it is recommended by Wells and Forbes as the very best method, the results should be fairly satisfactory. All subjects were of the opinion that on the whole the affectiveness of the stimulus decreased as time went on. Occasionally, however, a subject would say that the stimulus seened more affective on a particular day than on the preceeding. And some of these introspections agree perfectly with the tables given above. A few do not harmonize with the psycho-galvanic response. With regard to the second stimulus on the same day, the introspections do not harmonize quite so well with the objective results given in the tables. Out of six cases where the second stimulus was said to be more affective than the first, two correspond with the data presented in the tables. Broadly speaking the results show a striking agreement between the psycho-galvanic reaction and the affective response.

VI.

Individual Constants with a Variety of Stimuli

To answer the question do subjects show individual constants when submitted to a variety of stimuli, the following procedure was used. A series of five stimuli were selected; the gong mentioned above, perfume (of a rather good quality), an organ pipe, a three hundred candle power electric light, and ammonia. The subjects were instructed to remain seated quietly with the hands fastened in the water electrodes, as explained above. They were also told to keep the mind as inactive as possible. The circuit was made and readings were taken every 30 seconds, or oftener if any large deviation of short duration occurred during the 30 second intervals. At the end of ten minutes, the first stimulus was given. The gong was struck as described before. The readings were continued five minutes longer and the second stimulus, the perfume was given. It was necessary to

Summary table giving the results of a variety of stimuli:

Subj.	Emotional type	Gong	Perfume	Organ pipe	Bright light	Ammonia	Average	M. V.	Order of rank G	P	O	L	A
M. B.	E	1260	600	700	850	575	797	206.4	3	2	3	2	3
D. M.	"	810	312	767	1730	598	643.4	350.7	5	7	2	1	2
J. M.	"	800	1125	100	450	400	575	310	6	1	13	5	5
E. S.	"	738	300	350	850	529	553.4	192.48	8	8	8	2	4
M. H.	"	1410	120	455	425	220	526	390	2	10	7	6	8
M. S.	"	795	350	600	260	360	473	179.6	7	5	4	9	6
R. R.	"	900	360	270	330	200	412	214.8	4	4	9	7	9
M. O.	"	67	0	195	625	723	322	281.6	15	12	10	3	1
M. C.	"	430	119	516	290	253	321.6	121.12	9	11	6	8	7
M. T.	"	160	0	10	0	21	38.2	48.72	12	12	15	13	12
A. B.	"	90	0	60	0	0	30	36	14	12	14	13	13
P. E.	U	1480	345	855	470	0	630	308	1	6	1	4	13
S. J.	"	125	200	170	215	185	179	25.2	13	9	12	10	10
I. B.	"	190	400	0	50	0	128	133.6	11	3	16	11	13
M. G.	"	390	0	0	0	0	78	124.8	10	12	16	13	13
C. G.	"	50	0	60	25	50	37	19.6	16	12	14	12	11
L. S.	"	0	0	173	0	0	34.6	55.36	17	12	11	13	13
C. R.	"	0	0	0	0	0	0	0	17	12	16	13	13
H. G.	"	0	0	0	0	0	0	0	17	12	16	13	13

Note: In the table E stands for emotional and U for unemotional subjects. The letters at the right, G., P., O., L., A., stand for the stimuli. In the order of rank, two subjects having the same resistance change for a stimulus were given the same rank. This happened only once excepting the cases of zero.

ask the subject to "smell this". Readings were then continued for five more minutes. The second day the procedure was the same except that the stimuli were different -- organ pipe, bright light, and ammonia. Since three stimuli were employed on the second day, the readings were continued five minutes longer. The results (in ohms) are given in the table on page 13.

These data do not of course show a constancy of amount of resistance change following stimulation. The mean variations are very large; and the arrangement of the responses in the order of rank, shows one subject with two responses at one extreme and one at the other. But this quantitative variability is to be expected, since there is no reason to suppose that the different stimuli are equal or equivalent, or that an individual would respond the same to them if they were equal. Still the data do point to something like a tendency on the part of some subjects to react strongly to most, if not to all, of the stimuli, and on the part of other individuals to react feebly. Looking at the order of rank, one sees the smaller numbers fairly well grouped in the upper portion of the table and the larger numbers similarly collected towards the bottom.

VII.

Individual Differences in Emotional Response

As stated in section II, the main problem selected for investigation is : How do the psycho-galvanic responses of highly emotional individuals compare with those of unemotional people? And, since the chief object of the work is to find an objective method of measuring emotional response to stimuli, a means of selecting and classifying subjects had to be found. As the subjects were to be recruited largely from the students attending the summer session of the University, it was decided to solicit the assistance of several professors who would select from their classes students whom they considered either distinctly emotional or unemotional. Each professor chose some of each type. This procedure

doubtless had some disadvantages. First of all, the number of people attending the summer session, was not large enough to allow great scope for selection, and the students were without doubt more homogenous than would have been desirable for the purpose of the experiment. Again, in some instances the professors had only a short acquaintance with the members of their classes, and as a consequence did not feel absolutely certain that they had chosen correctly. However, these difficulties were not so formidable as one might be inclined to think, because the emotional type to which a number of the subjects belonged, was quite obvious. Moreover, doubtful cases were submitted to the judgment of some one who was qualified by profession or acquaintance to judge. Nineteen subjects were tested. Of these fourteen were women and five men. Sex differences were not taken into account, excepting the precaution of having about equal numbers of the same sex in each group. Thus there were eight women and three men in the emotional group, and six women and two men in the unemotional group. The question of difference due to age was not investigated. The subjects were all adults, and none were old.

The procedure has already been described in section VI above. And the data are the same as those used to study individual constants and presented in the table on page 13.

Looking at the table of results (p. 13), it is clear that the fall of resistance following stimulation is on the whole much more marked in the emotional group than in the unemotional group. In fact, with the exception of four or five individuals (the last two of the emotional group and the first two or three of the unemotional group), the psycho-galvanic response harmonizes very well with the selective grouping. These five subjects (M. T., A. B., P. E., S. J., I. B.) forming as they do a special problem, were given special consideration. M. T.was classified by one of his professors as "rather emotional for a man", but the opinion of a fellow student who claimed to know M. T. well was quite the opposite.

From my own observation, I should say that M. T. is slightly nervous but rather unemotional. Though very much interested in the experiment, he was quite calm and gave no signs of perturbation during the preparations for the experiment. It might be, however, that this is a case of error due to sampling. That is to say, if more stimuli were used or other stimuli employed, there might have been much more response. The second subject offering difficulty, A. B., was a music student and was selected for a member of the emotional group in the experiment largely on the basis of her musical ability -- there is a rather prevalent opinion that musical people are emotional. Now, the assumption that musical ability depends on degree of emotionality (or anything approximating this relation), is to say the least open to question. This is particularly so in the present instance since the subject, though very intelligent and refined, did not impress me as one possessing a very rich emotional life. Finally, a close friend of A. B. and a person without question highly emotional, assured me "you won't find A. B. emotional". From these considerations, it is only fair to infer that A. B's classification is doubtful, and that she might very well be placed in the unemotional group. The third exceptional case, P. E., was classified by her professor as unemotional. One of her friends, when questioned about P.E's degree of emotionality, could not definitely decide on the class to which P. E. should be assigned. This friend remarked that P. E. "seemed quite cold and chose friends of a rather unemotional type, but that she displayed a good spirit of rivalry and ambition". On first seeing P. E., my own impression agreed with that of the professor who classified her as unemotional. But P. E's behavior in the laboratory contradicts this opinion. Although she had some training in Experimental Psychology and, therefore, was accustomed to laboratory experiments, her attitude was the least serious of all the subjects employed. Though instructed to remain perfectly quiet and to keep the mind as inactive as possible she laughed out loud during the first experiment after the first stimulus had

been given. The only explanation she gave of this behavior was that it seemed funny in the dark, still room. During the second experiment, she laughed after the first stimulation and once asked the experimenter if the fact that she could not keep her mind passive would spoil the experiment. This seeming lack of seriousness could not be attributed to want of interest in the work, for she asked to have the apparatus explained and desired to know the results when the experiment had been completed. These considerations tend at least to throw some doubt on the original classification. And although they are not sufficient to warrant the decision that P. E. is highly emotional, still they are doubtless quite sufficient to justify removing P. E. from a distinctly unemotional class. In regard to the fourth special case, S. J., it must be pointed out that error in classifying her as unemotional was made more likely owing to the fact that she was a nun. Her mode of life would tend to repression of emotional expression and to the promotion of a calm and dignified demeanor. And, since the results of the experiment do not point to pronounced emotional response, she might easily have been classified as unemotional when, as a matter of fact, she was slightly emotional. Thernext subject, I. B., was classified both by her professor and by me as "rather unemotional". And since this opinion agrees very well with the data in the table there is no special difficulty in this case.

On page 18 is given a table of correlations between the stimuli as classified according to affectiveness by the subjects and the psycho-galvanic reactions. The correlations vary greatly -- from 1. to -.08. It must be pointed out , however, that the two minus correlations are in cases where there were no galvanic responses. Moreover, many of the correlations are very high, and those that are low may indicate poor introspection as well as indefinite knowledge of the precise thing to attend to in the classification of the stimuli.

If the explanations of the special cases given above be accepted as sufficient to dispose of these seeming exceptions in the table (on p. 13), the results

Table giving the correlations between the psycho-galvanic response and the introspective classification of the stimuli according to affectiveness by the different subjects.

Subject	M. B.				D. M.				J. M.				E. S.				M. H.			
	G	I	d	2d	G	I	d	2d	G	I	d	2d	G	I	d	2d	G	I	d	2d
Gong	1	1	0	0	2	1	1	4	2	1	1	4	2	1	1	4	1	1	0	0
Perfume	4	5	1	4	5	5	0	0	1	4	3	36	5	5	0	0	5	5	0	0
Organ pipe	3	3	0	0	3	3	0	0	5	5	0	0	1	4	3	36	2	2	0	0
Bright light	2	2	0	0	1	2	1	4	3	3	0	0	4	2	2	16	3	3	0	0
Ammonia	5	4	1	4	4	4	0	0	4	2	2	16	3	3	0	0	4	4	0	0
Correlation		.90				.90				.30				.30				1		

Subject	M. S.				R. R.				M. O.				M. C.				M. T.			
	G	I	d	2d	G	I	d	2d	G	I	d	2d	G	I	d	2d	G	I	d	2d
Gong	1	1	0	0	1	1	0	0	4	1	3	36	2	1	1	4	1	1	0	0
Perfume	4	5	1	4	2	3	1	2	5	5	0	0	5	5	0	0	4½	3	1½	9
Organ pipe	2	2	0	0	4	4	0	0	3	4	1	4	1	2	1	4	3	5	2	16
Bright light	5	4	1	4	3	2	1	2	2	2	0	0	3	3	0	0	4½	2	2½	25
Ammonia	3	3	0	0	5	5	0	0	1	3	2	16	4	4	0	0	2	4	2	4
Correlation		.90				.95				.92				.90				.32		

Subject	A. B.				P. E.				S. J.				I. B.				M. G.			
	G	I	d	2d	G	I	d	2d	G	I	d	2d	G	I	d	2d	G	I	d	2d
Gong	1	1	0	0	1	1	0	0	5	1	4	64	2	3	1	4	1	1	0	0
Perfume	3½	3	½	1	4	3	1	4	2	2	0	0	1	1	0	0	2½	4	1½	9
Organ pipe	2	4	2	16	2	2	0	0	4	5	1	4	4½	4	½	2	2½	5	2½	25
Bright light	3½	2	1½	9	3	4	1	4	1	3	2	16	3	2	1	4	2½	3	½	2
Ammonia	3½	5	1½	9	5	5	0	0	3	4	1	4	4½	5	½	2	2½	2	½	2
Correlation		.56				.90				0				.85				.52		

Subject	C. G.				L. S.				C. R.				H. G.			
	G	I	d	2d	G	I	d	2d	G	I	d	2d	G	I	d	2d
Gong	2½	1	1½	9	2½	1	1½	9	1½	1	½	2	1½	1	½	2
Perfume	5	5	0	0	2½	5	2½	25	1½	4	2½	25	1½	3	1½	9
Organ pipe	1	2	1	4	1	2	1	4	1½	5	3½	49	1½	4	2½	25
Bright light	4	3	1	4	2½	4	1½	9	1½	3	1½	9	1½	2	½	2
Ammonia	2½	4	1½	9	2½	3	½	2	1½	2	½	2	1½	5	3½	49
Correlation		.67				.38				-.08				-.08		

show an almost perfect agreement between the psycho-galvanic reaction and the emotional type. Ans what is equally important, the data indicate that the psycho-galvanic response is an objective means of classifying people with regard to emotional response. Even with the five cases unexplained the table tends very strongly to justify the employment of the psycho-galvanic reflex as an objective means of determining the emotional type of an individual. But the work is neither sufficiently detailed nor extensive enough to hazard the construction of a scale of degrees of emotionality or to say precisely how large a psycho-galvanic reaction is compatible with a type called unemotional, and how much resistance change is required to classify an individual as distinctly emotional. But, leaving this to further investigation, the present results are, in my opinion, sufficiently significant to warrant the employment of the psycho-galvanic reflex for the determining of individual differences in emotional response.

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