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Recording Galvanometer

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reactions in persons of diverse somatic and physiological types, as described by Kretchmer.

In forensic fields it would seem to present a simple, certain and humane means of ascertaining the truth and therefore of serving the ends of justice.

The author reports complete success in discriminating the guilty from accomplices, and guilt and complicity from innocence in persons charged in diverse places with many types of crime, as murder, assault, abduction, burglary and illegal entry. The instrument appears to offer a most valuable addition to the scientific methods utilized in criminal investigations. By finding out the truth more directly it may tend to replace more complicated, but less certain and less humane methods. If its general use bears out its promise as an instrument of truth finding, it may lead to revolutionary results in some fields where its employment may be indicated.

THE LEGAL ASPECT OF USE OF LIE DETECTOR

This issue of LINACRE contains also a discussion by Mr. William Harman Black, Justice of the New York State Supreme Court, on the legal aspects of using a lie detector for the investigation of the guilt or innocence of men accused of crime.

RECORDING GALVANOMETER

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(Read before the Yorkville Medical Society, January 27, 1937.)

THE present apparatus developed in the psychological laboratory at Fordham University resulted from our efforts to devise an instrument for the exact recording of human emotional variations. There is a long history of investigation of the nature and characteristics of the psycho-galvanometric reflex. Instruments for these investigations ranged all the way from the simplest type of galvanometer to the Einthoven string galvanometer. From the time of the early Greek physicians, it was known that emotional changes even of a minor character could be detected by changes in heart rate, pulse and respiratory changes. These methods were refined in more recent times by Marston, Larson and Keeler. In our early investigations we employed pressure and respiratory apparatus to discover that they were not adequate to record many important emotional changes which not only were introspectively and consistently reported by subjects, but were definitely recorded by electrical instrumentation.

Our work began with an ordinary Wheatstone arrangement with a sensitive galvanometer which had a light and scale attachment. The ordinary laboratory D'Arsonval galvanometer proved unsatisfactory because of its inability to pick up small electric variations. We discovered that the more sensitive the galvanometer, the more sources of error crept into our results. The greater sensitivity involved a longer periodicity in which the primary results we were endeavoring to record were masked by secondary and tertiary electrical phenomena. The next step in our investigation was the development of a cathode-ray oscillograph with photographic recording attachment hooked up with a direct current amplifier. We succeeded in developing a fairly good amplifying system, the perfecting of which took considerable time. An ordinary cardiograph deals with a 30-cycle phenomenon. We had to devise an amplification system that would respond immediately and consistently to a phenomenon which was producing one variation every four to ten seconds. For this purpose we found that alternating current amplification was altogether unsuitable and consequently we were obliged to develop direct current amplification. The whole apparatus is now part of our museum. It became increasingly evident that to utilize a photographic record made by the movements of the beam of light in the cathode-ray oscillograph, lengthy protocols were necessary for exceedingly small units of every experimental process. We decided to change the apparatus and to develop a direct and visibly recording device which would eliminate a great deal of the details required in the recording of experimental data when we employed the cathode-ray oscillograph.

The apparatus ultimately constructed is the result of four years of painstaking and careful research. It is composed of two pieces, one an amplification and filtering unit, the other a graphic recorder. The fundamental electrical concept employed in the principal circuit is that of two balanced electric circuits, the box containing a very complex circuit and the subject the second and more simple circuit. Any disturbance in the electrical balance is indicated by the meter in the amplification unit and is put in permanent form on the recording milliammeter. The milliammeter chart is clock-driven and can be varied according to the requirements of the experiment. In work on the emotions we generally employ a chart speed of three-quarter inch per minute.

Amplification was one of the vexing problems. We had several types of amplification and finally settled on a system of rectification and amplification which would be applicable for the majority of cases with which we had to deal. As employed in the present arrangement, the amplification is two-stage and ranges from 0 to 350. This enables us to obtain maximal scale deflections for a subject whose resistance is 100,000 ohms. With resistances less than this amount, the deflections

are kept on the graph, which is 4½" wide, by means of a shunt. An additional dial affords another means of increasing the sensitivity of the instrument or of controlling the deflections of the recording galvanometer.

The instrument has been employed for more than a year. When we were satisfied with the sensitivity of the instrument, we proceeded to investigate instrumental errors due to current fluctuation, lag of the recording needle due to friction, hysteresis and heating effects. We finally placed all resistance units outside of the box represented on the right so that the amplification unit would not be interfered with by heating effects. The amplification unit as we employ it at present is a screened unit.

The first work we completed with the apparatus was an investigation of the differentiation between emotion and sentiment. The results of this experiment were read at a meeting of the New York Branch of the American Psychological Association, held at Fordham University last April. We were able to show that there was no statistical significance between intensity of sentiment and degree of physiological concomitance. There is no relation between intensity of sentiment and intensity of the sensory accompaniment. This study enabled us to present a new theory of affective reactions. We inferred from our study that feeling, or that which we interpret as pleasure or unpleasure, is a basic activity of the affective order. Emotions and sentiments are specific instances of feeling. Emotional reaction occurs when there is feeling with a predominant sensory factor. Sentiment is feeling with a predominant intellectual factor. In sentiment feeling is not necessarily accompanied by the same amount of organic or physiological changes which are present in emotional reaction.

We had employed the instrument to detect emotional changes which accompanied deception. Considerable discussion was brought to bear on the applicability of an instrument of this type in actual criminal circumstances. Last summer we decided to investigate the reliability of the instrument in criminal situations. We planned, however, to develop a laboratory situation which would furnish a very close approximation to a criminal situation. We believed that a procedure of this type was absolutely necessary in order to establish the reliability of the instrument before it should be applied in any detailed investigation of criminal activity. In the experiment we employed fifty groups of college and graduate students, male and female. Each group was divided by drawing lots into two sub-groups. The first sub-group in each test was presented with a closed box which contained a valuable article, a twenty-dollar bill, an expensive watch, jewelry or perfume. The instructions given this group were the following: "I would like you to consider that you three have conspired to steal this box. When

I leave the room, open the box and you will discover a valuable article. This article cannot be divided among you three. So, draw lots. And the winner of the draw will take the article enclosed in this box. Make this draw after I have left the room. Subsequently, I shall ask you questions." All members of this group were instructed to deny personal guilt, any knowledge of the guilty person and to deny possession of the article in question. The responses to all other questions were to be truthful. A final condition was placed: If the person who won the draw and so possessed the article in question succeeded in deceiving the experimenter, he or she could keep the article. If the experimenter discovered the guilty person, this person would be obliged to perform a penalty to be named by the experimenter after the whole group had been tested. The second sub-group in each test was unaware both of the guilty person and of the article taken by the guilty person. Hence in each test our subjects fall into three groups:

(a) the person who took the money or jewelry or the watch or other article;

(b) the person who knew both what was taken and who the guilty person actually was;

(c) the controls, those who knew neither what was taken nor who the guilty person actually was.

The results of the experiment were rather satisfactory. Forty-nine of the fifty guilty persons were detected by our procedure. Of these forty-nine, nine were discovered on a re-examination, but in each of these nine cases there was definite evidence of either complicity or guilt on the first test. In the accomplice group of eighty-six, sixty-four or seventy-four per cent were definitely established on the first test to be accomplices and not guilty persons. In all but two of the remaining twenty-four, the fact of complicity was established by second tests.

There were ninety-one controls utilized in the fifty group tests, eighty-two of this number were established on first tests to be innocent. Startle effects and the limited number of questions we employed most probably interfered with better results on first tests, both here and in the complicity group. The ninety per cent efficiency for the control group was increased to one hundred per cent by re-examination.

Seventy-five per cent of the subjects employed in this study were used in four or more group tests. Our object in utilizing these subjects so often was to test the value of our technique in the conditions of possible diminished emotional response due to the fact that the subjects might become familiar with the procedure. In some of these cases, the responses to the critical questions showed a diminished reaction, but only where all reactions of the subject to critical and non-critical questions were proportionately diminished.

During the progress of the experiment we decided to check our results against those furnished by a Keeler Polygraph. We wished to contrast the relative reliability of our instrument and the polygraph. We utilized twelve groups which involved sixty-two persons, each one of whom was hooked up to both instruments during the process of examination. The comparison of our instrument and that of the polygraph revealed the following:

A. Where we had 100% correct in the detection of guilt, the polygraph established 54% doubtful and 46% negative.

B. In the accomplice group we had 85% correct on first tests where the polygraph had 92% which were either negative or doubtful.

C. In the control group we had 95% correct on first tests where the polygraph had 47% correct.

We do not wish to put any final value on these differences. Before presenting a final conclusion we should like to spread the study over a wider range of cases. The results of this study were presented before the September meeting of the American Psychological Association at Hanover.

This is the first time that an instrument of this type has ever been subjected to rigorously controlled scientific tests before being applied in criminal circumstances. The results conclusively establish the validity and reliability of the use of the instrument and technique in the detection of deception. Such pronounced success in laboratory situations and such marked superiority of the instrument over that already utilized in criminal investigations indicated that this instrument might prove to be the most valid and reliable in the actual detection of guilt, complicity or innocence in criminal procedure. In response to the many requests which have come from all parts of the country we have utilized this instrument and technique in numerous criminal investigations. These cases, from such diverse places as Rhode Island, Maryland and New York, were all serious in character; they included instances of murder, assault, abduction, burglary and illegal entry. In all instances of the use of this instrument there was complete success in discriminating the guilty from accomplices, and guilt or complicity from innocence. These results were confirmed by confession, judicial procedure or subsequent investigation. The success of the criminal application established conclusively the reliability of the technique which had been previously determined by a long series of experiments.

The results of these investigations have aroused considerable interest and discussion among the members of the legal profession. The instrument has been demonstrated before judges, district attorneys, professors of law and prominent lawyers. A distinguished judge has

given a public address on the possibility of introduction of this type of evidence in court. Of extreme interest to members of both the legal and medical professions is the research in progress on the discrimination of feigned from real delusions.

The flexible character of the instrument makes it possible for it to be used in many allied investigations. In the near future we plan to continue our investigation of emotional reaction types with the object of discovering whether or not there is a consistent incidence of emotional reaction referable to physical and physiological typology. There are several other problems being contemplated, the chief of which are the value of an instrument of this type as an objective control of introspection and a study of its possibilities in the testing of candidates for various positions where emotional control and ability to change judgments in complex emotional situations are necessary.

REMARKS OF JUSTICE WILLIAM HARMAN BLACK AT MEETING OF THE NEW YORK PHYSICIANS-YORKVILLE MEDICAL SOCIETY IN THE SQUIBBS BUILDING, FIFTH AVENUE AND FIFTY-SEVENTH STREET, WEDNESDAY, JANUARY 27th, 1937, AT NINE P. M. ON THE "LIE DETECTOR".

I AM asked to discuss in connection with the legal aspect of lying a mechanical lie detector (a machine that thinks in the inexorable terms of science) and the practicability of using it in the investigation of the guilt or innocence of men accused of crime, and also in their trials by jury. I have not been asked to speak on the social possibilities of this invention. The time may come when no family, indeed no engaged couple, will be complete without two machines, one adjusted to the robust honesty of the male and the other to the sympathetic pliability of the female mind. If intending proposers, generally of the male persuasion, were assured that their emotions would be graphed with accuracy and translated with fidelity, it might do much to prevent hasty marriages and attemptedly hasty divorces. If these machines should be used in alimony motions, husbands would hesitate to brag about their earnings in business or their winning at poker, knowing that with the inexorableness of fate the truth would be wrung out of a willing lie detector. Perjury might be confined almost entirely to the exuberant expressions of the genus known as "puppy-lovers," or the never believed promises of some politicians.

In every jury trial there are at least fourteen lie detectors, a judge, a lawyer on each side of a case, and twelve jurors. These are the cleverest lie detectors because they are human, but, being human, they are also fallible.

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