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## History of Lie Detection

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# A HISTORY OF LIE DETECTION

PAUL V. TROVILLO†

*(Concluded from the previous issue)*

## *The Psychogalvanometer in Deception Tests*

Since few reports have appeared dealing with psychogalvanic criteria of deception, we will review this aspect of the subject in more detail than we did regarding the diagnostic elements of other tests. However, since the circuits, instruments, and techniques in use vary widely, the reader is urged to consult the original works for technical details.

The use of the galvanometer, or psychogalvanometer, for detecting deception, is of comparatively recent date; although Galvani, the Italian physiologist, after whom the modern instrument is called, published his paper on animal electricity in 1791. Following Galvani, other workers developed the idea and made extensive and complex revisions of apparatus. Probably the earliest suggestions for the application of psychogalvanic reactions to forensic problems came from Sticker, in 1897.<sup>99</sup> Sticker was convinced that a strong emotional connection was responsible for the phenomenon:

“I have repeatedly convinced myself that the origin of the galvanic skin phenomenon is under the influence of exciting mental impressions, and that the will has no effect upon it; this reflex could be used with great advantage for the discovery of words and pictures that influence the emotions. In a word—which will be listened to by many without any reaction—whoever takes the meaning of something to heart will react with a strong galvanic skin phenomenon. Whoever is from any cause emotionally roused on looking at a picture will react with a definite increase of the current; whilst whoever is unmoved by the picture, or in whom it arouses no memory, will have no skin excitation.”

Sticker's suggestions were made forty-two years ago. To those of us who are accustomed to thinking that the “lie-detector” is a

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<sup>99</sup> Sticker, “Ueber Versuche einer objectiven Darstellung von Sensibilitatsstorungen,” *Wiener klin. Rundschau*, Nos. 30, 31, p. 518 (1897). For English translation, see L. Binswanger in C. G. Jung's “*Studies in Word Association* (1919) 448-449.

product of the gangster era of 1930, forty-two years may sound like a long time. But Sticker based his proposals on the experimental ground work of several predecessors. In this connection we must remember that Adamkiewicz, in 1878,<sup>100</sup> was the first to offer experimental proof that the secretion of sweat is closely linked to psychological processes. He did not show that the galvanometer measures perspiration changes; indeed, even today we do not know conclusively that perspiration changes are alone accountable for the reactions observed. However erroneously, we are accustomed to speak of the reactions as apparent changes in the resistance of the skin to an external current.

Veraguth<sup>101</sup> was one of the first to make word-association tests with the galvanometer,<sup>102</sup> although Munsterberg was concurrently pointing to its application to criminal cases.<sup>103</sup> It was Veraguth who pointed out in 1907 some of the galvanic phenomena which forensic psychologists have only recently re-discovered for themselves. Our criteria of deception are only Veraguth's criteria of emotion, for he noted that emotional complexes, unveiled in word-association experiments, made an ascending galvanometer curve (as contrasted with the "rest curve" of non-crucial stimuli), and that these personally significant stimuli produced larger fluctuations than indifferent stimuli. Veraguth also indicated that the first indifferent stimulus words caused larger responses than succeeding indifferent stimuli. He probably was the first to use the term "psychogalvanic reflex" (1907). The term, however, is an unfortunate one, for, as pointed out by Ruckmick,<sup>104</sup> the reaction is not a reflex, its psychological nature being still incompletely understood. A better term which has been proposed is electrodermal response: this term does not imply that the reaction is as specifically determined as early investigators were wont to believe, and is in line with the current healthy skepticism as to just what the response is. Some consider the response an electrodermal indicator

<sup>100</sup> Adamkiewicz, Die Sekretion des Schweißes: Eine bilateralsymmetrische Nervenfunktion (1878). See also L. Binswanger in C. G. Jung's "Studies in Word Association" (1919) 448.

<sup>101</sup> Veraguth, S., "Das psychogalvanische Reflexphänomen," I. Bericht, Monatschrift für Psych. und Neurol., Bd. XXI, Heft 5. See also his "Der psychophysische galvanische Reflex." Bericht über den, II. Kongress für experimentelle Psychologie, pp. 219-224 (1907).

<sup>102</sup> See also Peterson, F., "The Galvanometer as a Measurer of Emotions," Brit. Med. J. 2:804-806 (1907); Peterson, F., and Jung, C. G., "Psychophysical Investigations with the Galvanometer and Pneumograph in Normal and Insane Individuals," Brain 30:153-218 (1907).

<sup>103</sup> *Op. cit supra* note 24 at pp. 118-133.

<sup>104</sup> Ruckmick, C. A., The Psychology of Feeling and Emotion (1936) 345-373.

connected to the sympathetic division of the autonomic nervous system, or perhaps to the parasympathetic division, but the conditions to which it is subject are not too well defined. Veraguth, however, believed that the electrical phenomena noticed by Féré, Tarchanoff, and Müller (both the so-called endosomatic and exosomatic currents), were attributable not to vascular changes in the skin but to activity of the sweat glands. The mental counterpart of these changes he ascribed to a feeling of reality or compulsion, or an emotional situation, or both. Soon thereafter, in Zurich, Jung and Peterson used the phenomenon for detection of emotional complexes.

Marston states that in 1917, he, Troland, and Burt experimented with a galvanometer or galvanometers for the detection of liars.<sup>105</sup> This experimental work was for the Army Intelligence Service, and was designed to discover which of several proposed techniques would be best for application to war-time problems. The report on the galvanometer was unfavorable.

Jung, writing in 1919,<sup>106</sup> gave a large bibliography for studies made with the galvanometer, but included none specifically concerned with deceit. In the last thirty years (or since the paper of Veraguth) more than four hundred and fifty papers dealing with the so-called psychogalvanic reflex have been published. But from Wells and Forbes<sup>107</sup> to the contemporary contributions of Darrow,<sup>108</sup> very little actual research on psychogalvanic criteria of deception has been done.<sup>109</sup> Nevertheless, Binswanger,<sup>110</sup> in 1919 was able to point out that "The analysis in many [of Veraguth's] cases discloses undoubted relationships of an 'old' complex to the present; in the same way an apparently 'actual' complex which momentarily seems very much to occupy the subject, may derive its essential effect

<sup>105</sup> Marston, W. M., *The Lie Detector Test* (1938) 59.

<sup>106</sup> Jung, C. G., *Studies in Word Association* (1919).

<sup>107</sup> Wells, F. L., and Forbes, A., "On Certain Electrical Processes in the Human Body and Their Relation to Emotional Reactions," *Archiv. Psychol.* 2 (16): 39 (1911).

<sup>108</sup> Darrow, C. W., "Differences in the Physiological Reactions to Sensory and Ideational Stimuli," *Psychol. Bull.* 26 (4) (1929); Darling, R., and Darrow, C. W., "Determining Activity of the Autonomic Nervous System From the Measurements of Autonomic Change," *J. Psychol.* 5:85-89 (1938).

<sup>109</sup> For a bibliography of experimental studies prior to 1929, see Landis, C., and De Wick, H., "Electrical Phenomena of the Skin," *Psychol. Bull.* 26:64-119 (1929); Gildemeister, M., *Handbuch der normalen und pathologischen Physiologie* (1926); Grunbaum, A. A., "Het psychogalvanisch reflexverschijnsel en zijn psychodagnostische waarde," *Ned. Tijdschr. v. Geneek* 1:1044 (1920). For a recent bibliography, see Ruckmick, C. A., *The Psychology of Feeling and Emotion* (1936) 345.

<sup>110</sup> *Op. cit. supra* note 106 at pp. 450, 469.

from events of long ago." Modern police interrogations which depend upon the electrodermal or psychogalvanic responses of a criminal suspect may find this very situation embarrassing. A suspect may give a large response, for example, not because he is guilty of robbing the place in question, but because he has robbed other and similar places. The operator is not always able to identify the basis for the reaction until after prolonged questioning about related or associated experiences.

It is significant to the investigator when he finds certain patterns in the electrodermal curves which he can identify as typical of the individual. Binswanger said of this circumstance:

"In phlegmatic subjects the whole curve runs a regular course—without distinct complex waves. The curve then presents almost a line without breaks. In hysterically disposed persons the curve is very different; it is quite bizaare, interrupted by sudden ascents and as rapid descents. The course of the galvanometer curve has become for me a reliable criterion of the affectivity of the subject."<sup>111</sup>

It is of interest here to recall that Kiesow<sup>112</sup> made parallel observations of blood pressure curves in 1895.

Of the many modern studies of electrodermal responses, those most closely concerned with deception usually are studies of fear. Since fear is customarily the main component in suppression of the truth, there is much of criminological interest in the excellent paper by Bayley,<sup>113</sup> in which she differentiated between sudden fearful shock and apprehension, and showed that in the psychogalvanic technique the two could be distinguished by the immediateness of the reaction and its duration. A considerable bibliography is appended to her paper.<sup>114</sup>

A promising approach to the differential diagnosis of electrodermal patterns came out of Germany in 1933. Enke classified the character types of her subjects at the time she secured from them the electrodermal responses. She found reactions of great magnitude and duration to come principally from the persons who were the most unstable and who had the most internal conflicts. If such types could be diagnosed in advance it might eventually be of service to the police investigator who employs the psychogal-

<sup>111</sup> *Supra* note 110 at p. 469.

<sup>112</sup> *Op. cit. supra* note 38.

<sup>113</sup> Bayley, N., *Psychol. Monog.* 38 (4):1-15; 21-33 (1928); see same in Wheeler, R. H., *Readings in Psychology* (1930) 199-224.

<sup>114</sup> Enke, E., "The Affectivity of Kretschmer's Constitution Types as Revealed in Psychogalvanic Experiments," *Inter. Quar. of Char. and Person* 1 (3) (1933).

vanometer in detecting criminal guilt.<sup>115</sup> Enke's results are interpreted in terms of the Kretschmer types and are suggestive of practical applications to forensic interrogation with the polygraph.<sup>116</sup>

A rare combination of academic interest and forensic application is seen in the work of Summers (recently deceased), whose development of the "Pathometer" lately excited much interest and criticism. Although the Summers apparatus has been used in over six thousand laboratory experiments, it has been employed in only about fifty actual cases involving the question of the guilt or innocence of criminal suspects. Summers stated that his "Pathometer" produced results with 98% to 100% accuracy, and the reason he did not attain perfection consistently was attributed to "the laboratory situation." Summers believed that it was "quite impossible for anyone so to control his emotions as to deceive the experienced interpreter of the records."<sup>117</sup>

The Summers technique involved giving three tests and comparing the amounts of deflection of the recording pen on crucial and insignificant questions. On the final test three significant questions were asked the suspect, each three times; repetition of the question produced similar patterns of response, which differed quantitatively. A gradual diminution of amount of deflection would indicate innocence; repeated responses of equal or greater magnitude would indicate guilt or guilty knowledge. The apparatus in use measures the apparent conductivity of the subject, or his apparent resistance to the passage of an external current measured in millionths of an ampere.

Bril, a consulting criminologist of New York City, worked for a time with Summers in the development of the apparatus which

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<sup>115</sup> For further treatment of duration of response, see Darrow, C. W., "The Significance of the Galvanic Recovery Curve," *Psychol. Bull.* 28:678-679 (1931). For comparison of electrodermal and reaction-time responses see Hathaway, S. W., "A Comparative Study of Psychogalvanic and Association Time Measures: A New Psychogalvanic Apparatus," *J. Appl. Psychol.* 13:632-646 (1929); and Hunt, W. A., and Landis, C., "Word Association Reaction Time and the Magnitude of the Galvanic Skin Response," *Amer. J. Psychol.* 47:143-145 (1935).

<sup>116</sup> The thesis of the European Characterology Movement, an understanding of which is necessary before one could follow up Enke's research, is well presented in Shuey, H., "Recent Trends in Science and the Development of Modern Typology," *Psychol. Rev.* 141 (3):207-235 (1934). A more recent paper by Nathaniel Cantor of the University of Buffalo, is of interest: "Recent Tendencies in Criminological Research in Germany," *J. Criminal L. and Crim.* 27 (6):782-793 (1937).

<sup>117</sup> Testimony of Reverend Walter G. Summers, County Court, Queens County, N. Y., Part 2: *The People of the State of N. Y. v. Raymond Kenny, defendant*, as tried before Hon. Charles S. Golden, county judge, and a jury. See also a brief report of a talk made by Rev. Summers: "Guilt Distinguished From Complicity," *Psychol. Bull.* 33:787 (1936).

subsequently appeared in portable form. The "Brilograf," brought out recently by Bril, is quite similar to the Summers-Bril "Pathometer." Bril is said to have been interested in adapting psychological apparatus to forensic problems for ten years. His apparatus, like the "Pathometer," measures apparent "changes in skin resistance."



FIGURE 9

The "Brilograf," devised by Jacques Bril of New York City. At the left is a recording unit; and between this and the psychogalvanometer proper is seen (1) a stimulus-response key for operating a chronograph pen, and (2) a shunt for governing the excursions of the recording pen of the milliammeter. At the extreme right lie the electrodes which are conveniently fitted into the palm of each hand. It was, apparently, essentially this same apparatus which was employed by Summers.\*

In 1930, Wilson, of the former Scientific Crime Detection Laboratory of Northwestern University School of Law, built a non-recording galvanometer, and in 1931, he and Keeler used it in several investigations of criminal suspects. In 1930 he developed a manual recording device which enabled the operator to record the response simultaneously with those of blood pressure and respiration. In 1935, Wilson designed and built an improved recording galvanograph, putting it into service in June, 1936. This apparatus consists of resistance elements constituting a Wheatstone bridge. In order to find the effective value of resistance in the unknown leg of the bridge, one of the ratio arms is arranged so that the standard resistance, which is continuously variable from 0 to 50,000 ohms,

\* The General Radio Company of Cambridge, Massachusetts, has recently developed a DC amplifier (type No. 715-AM) which was designed to be used with the Esterline-Angus Recording Milliammeter (type No. 715-AE). With some slight modifications, this could readily be applied to the detection of deception or in the recording of the electrodermal responses during emotion.

must be multiplied by factors of .5, 1, and 2. The null type of indicator is used in the conventional manner. A galvanometer is used for preliminary balancing. When the instrument is to record electrical changes in the subject, or X leg of the bridge, a General Electric photo-electric recorder is substituted for the galvanometer. This recording device has a full range sensitivity of thirty-three microamperes. A recording fountain pen traces the deviations from original setting, and these appear on the same paper chart which records changes in blood pressure, pulse, and respiration. Included in the control cabinet of the galvanometer is a sensitivity control and a microammeter to indicate the amount of current flowing through the tissues of the subject. Electrodes wet with a zinc sulphate solution (or a solution of sodium chloride, which has also been used) are attached to the palm and back of one hand.

In recent studies at the Chicago Police Scientific Crime Detection Laboratory the electrodermal responses of criminal suspects under test have been correlated with cardiac and respiratory indices of deception, and we submit below certain tentative criteria of the emotional influences which appear to exist in electrodermal records of deception. These emotion criteria relate to the pattern of the recorded electrodermal response. They are under constant check by control tests wherein the factor of deception is a known influence; these control tests are run on all criminal suspects and the pattern of deception in the test is compared to patterns of response on questions relating to the crime which the person is suspected of having committed. Under these circumstances we find considerable variation in deception patterns among individuals tested, some responding significantly one way, some, another. These patterns, however, include: (1) Relatively larger magnitude of response during deception than on non-significant questions; (2) Greater area of response in deception than on non-significant questions; (3) A gradually ascending electrodermal response, as an accompaniment of prolonged nervous excitation (in contrast to a gradually descending response accompanying relief of tension). (Ascent of the line, as recorded in the polygraph record, indicates increase of conductance of external current between palmar and dorsal surfaces of one hand); (4) The last comparatively large fluctuation (only during a control test in which but one of several responses is a lie); (5) A fluctuation having an angle of about  $45^\circ$ , a gradual not a sharp and instantaneous change. (We find that shock stimuli or sensory stimulation such as loud noise, slap on cheek, or thump-



ing of ear lobe, tend to beget a sharp deflection. These are in contrast to such ideational stimuli as are usually involved in repeated questions about a crime scene); (6) Pattern at point of deception may be considerably *different* from that at any other place in the test. This pattern may involve a deflection of unusual magnitude, or it may consist, indeed, of an absence of deflection;<sup>118</sup> (7) Duplication, on repeated tests, of pattern appearing in first test. This may also involve a similar magnitude of response—in contrast to decreasing magnitude for innocent subjects.

At the present time, although we have found the electrodermal responses very helpful in experimental cases (providing interpretations about 95% accurate), nevertheless in actual case work they have not been of consistent service. It may be that further research will modify our current position.

#### *Miscellaneous Objective Measures*

It is possible today, for objective investigation of deception, to utilize many different techniques and approaches.<sup>118a</sup> The most common have already been discussed. Others, including some not yet employed for this purpose, are available and offer fertile field for research. If we were to arrange an arbitrary classification of the phenomena which have been demonstrated to have some correlation with emotion, we might divide them, for practical purposes, into (1) involuntary responses, (2) semi-voluntary responses, and (3) voluntary responses.

*Involuntary responses* include the changes induced by emotion in blood pressure (systolic, diastolic; pulse pressure), pulse rate,

<sup>118</sup> C. W. Darrow, on the basis of considerable experimental work, takes the position that electrodermal changes are indicative of changing states of alertness and adjustive activity, whereas the blood pressure increase is generally identifiable with some disturbing or disrupting influence. "Deception, unmotivated by demands of self-defense, is but poorly betrayed in the blood pressure records and much better revealed in the palmar sweat changes. Verbal stimuli were found characteristically productive of increased blood pressure in normal persons when those words were 'disturbing' or 'embarrassing.'" Further, he finds, "In like manner 'irritability' and 'resistance' and 'blocking' in psychotic patients were frequently found by Dr. Solomon and the writer (1934) associated with large blood pressure and little or no galvanic change." He develops a theory that active conflict releases from cortical control the sub-cortical mechanisms of excited emotion. Darrow has been interested in the emotional reactions of psychotic patients rather than in deception situations. (Darrow, C. W., "Emotion as Relative Functional Decortication: The Role of Conflict," *Psychol. Rev.* 42:566-578 (1935).)

<sup>118a</sup> Regardless of the technique employed, however, the validity of results obtained in an academic laboratory is always open to serious question because simulated crimes are not crimes at all. F. K. Berrien discusses the quandry of the investigator, and suggests his own solution, in "A Note on Laboratory Studies of Deception," *J. Exper. Psychol.*, 24 (5): 542-546 (May, 1939).

blood volume, blood vessel dilation. (Although certain Orientals are known to be able to influence heart action at will, most of us cannot voluntarily control it.) The following phenomena, influenced under emotion, offer further possibilities for gauging the fear associated with deception: blood calcium, acidity of the blood, its sugar content, creatin, creatinin, and adrenin in the blood, blood counts, cellular contents; nitrogen excretion, spleen and stomach contraction, gastro-intestinal tone and activity, hydrogen-ion concentration of the saliva, the urine, and the perspiration; glandular dysfunction; bladder movements; electrodermal changes; alkali reserve. Besides these, one may eventually be able to measure more objectively than we now can the influence of external color, and the meteorological influences of humidity, barometric pressure, and temperature, on emotional states.

*Semi-voluntary responses* pertinent to studies of deceit include respiration volume, inspiration-expiration ratios, metabolic rate, regularity and rate of breathing; association of words and ideas; facial expression, speech vibrato, motor reaction, and reaction under such narcotics as scopolamine.

*Voluntary responses* include body posture, individualized movements of arms, hands, fingers, feet, legs; speech—its volume, inflection, tone, enunciation, and pronunciation; expression in the eyes ("eye light," reflecting mood, health, and attitude); general facial expression, including simulated emotion.

The very diversity of these fields of investigation is startling, and all we can do here is to furnish a few references to those papers having the greatest criminological application.<sup>119</sup>

<sup>119</sup> 1. Sir Bell, C., *Anatomy and Philosophy of Expression* (1808); 2. Darwin, C., *The Expression of the Emotions in Man and Animals* (1873) 262; 3. Mantegazza, P., *Physiognomy and Expression of Emotion* (1891); 4. Münsterberg, H., "Die Psychophysische Grundlage der Gefühle," *Proc. Int. Cong. of Exper. Psychol.*, London (1892); 5. Cannon, W. B., *Bodily Changes in Pain, Hunger, Fear, and Rage* (1915); 6. Healy, Wm., and Healy, M. T., *Pathological Lying, Accusation, and Swindling. A Study in Forensic Psychology* (1926); 7. Baumgarten, F., *Die Luege bei Kindern und Jugendlichen* (1926); 8. Brown, M. R., *Legal Psychology* (1926); 9. Lipmann, O., and Plaut, P. (Editors), *Die Luege* (in *psychologischer, philosophischer, juristischer, paedagogischer, historischer, soziologischer, sprach- und literaturwissenschaftlicher, und entwicklungsgeschichtlicher Betrachtung*) (Leipzig, Barth, 1927). See especially pp. 1-15, on the psychology of the lie; pp. 351-396, Karl Reininger, on the lie of children and adolescents as a psychological and educational problem; pp. 532-550, F. Schneersohn, on the psychosociology of gauging deception; and pp. 550-571, Karl Birnbaum, on pathological lying; 10. Burt, H. E., *Legal Psychology* (1931); 11. Moll, A., *Perversion of the Sex Instinct* (1931). See especially p. 74 on tendency of homosexuals to lie; 12. Ruckmick, C. A., *The Psychology of Feeling and Emotion* (1936); 13. Lund, F. H., *The Emotions* (1938); 14. Dunbar, H. F., *The Emotions and Bodily Changes* (1935) (Revised, 1938).

Two outstanding background-books for the criminologist are Gross' "Criminal Investigation" of 1907, and Munsterberg's "On the Witness Stand" of 1908. In the latter one may find reference to the application of many psychological principles to detecting guilt.<sup>120</sup> Munsterberg proposed to adapt a number of psychological instruments to a variety of bodily functions to make accurate records of the processes of emotion. Not only did he suggest that blood pressure and pulse tracings could have forensic importance; but he pointed in great detail to the utility of respiration records; posture and movement records; eye movements;<sup>121</sup> plethysmographic records of blood circulation; electrodermal resistance measures (using the galvanometer); variations, during emotional stress, of the knee jerk; changes in body temperature; and lastly, he showed how with the examination of criminal suspects the word association test could be quite valuable in diagnosing guilt. Munsterberg apparently made few criminological applications; the chief virtues of his magazine articles prior to 1908, and his books following 1908, lay in the unusual insight he had of the manner in which common psychological instruments, already in use for years around the world, could be applied to forensic problems.

Of the many possible techniques one might employ in the study of the criminal suspect, one of the most interesting and at the same time the most neglected, is that described by Crane in 1923.<sup>122</sup> Crane studied, among one hundred whites and one hundred negroes, in the South, (1) intelligence, (2) strength of impulse, gauged by withdrawal of the hand from beneath a falling weight, and (3) "self-control," as checked by the inhibition of the actual movement of withdrawal (accompanied by flinching, disturbances in breathing, etc.). He found negroes more often withdrew the hand, when frightened by the falling weight, but whites had a greater *tendency* to withdraw it, their poise being disturbed by muscle twitches and irregular breathing. He concluded that behavior differences between the races were not due principally to differences in intelligence or strength of impulse, but rather to

<sup>120</sup> See especially the chapter on "Traces of Emotions," pp. 118-133 of the 1933 edition by Clark Boardman Co., N. Y.

<sup>121</sup> Halstead, W. C. in "A Method for Quantitative Recording of Eye Movements," J. Psych. 6:177-180 (1938), describes "An Amplifier for Recording Eye Movements as in Reading, by Means of the Corneo-Retinal Potential," a modern technique which is vastly superior to that used by Münsterberg.

<sup>122</sup> Crane, A. L., "Race Differences in Inhibition," Arch. Psychol. 63 (1923). For discussion of application to negro criminals, see Brearley, H. C., Homicide in the United States (1932) 112.

power of inhibition. One sees here a means of measuring a criminal suspect's self-control, especially as it might be affected during interrogation by emotionally weighted questions.<sup>123</sup>

This idea of measuring the self-control of subjects during emotional stress was applied in 1923 by a Soviet psychologist, Luria, to the trapping of criminal suspects. Crane reported also, it will be noted, in 1923. But Luria's technique was quite different.<sup>124</sup> By examining murder suspects prior to interrogation by the police he had a high degree of success in securing confessions. The technique, now becoming well known in this country,<sup>125</sup> requires an especially prepared word-association list and apparatus for the recording of voluntary and involuntary movements of the hands. When a word is spoken the subject is to reply with another word, either the first word that comes to mind or one that satisfies a pre-arranged relationship, simultaneously pressing one hand on an actuating mechanism. The fingers of the other hand rest on another unit which receives any delicate tremors occasioned by disruption of the normal regulating processes. Thus a double check of motor responses is obtained. Reaction times are recorded. Disturbances of patterns of manual response, plus irregularities in the reaction and response-time, constitute criteria for the disintegrating influence of emotionally dominating stimuli. Luria's theory posits the breakdown, during emotion, of motor control, and the revelation of associative connections in the speech system. Although the idea is not a new one,<sup>126</sup> it has stimulated recent research in this country. Ebaugh

<sup>123</sup> Brearley's conception of "sociological age" is pertinent to any attempt to measure a suspect's self-control. (Brearley, H. C., *Homicide in the United States* (1932) 95.) He says: "A person's sociological age depends, accordingly, not upon his physical or mental development but upon his relative maturity in dealing with his associates, especially upon his emotional control in social situations. If under stress the individual acts towards others as a small child would, his sociological age is low. If, however, he behaves as mature adults should, his sociological age is much higher. If in the future it should become possible to learn a person's approximate sociological age in somewhat the same way that his mental age can now be roughly estimated from an intelligence test, it might be of inestimable value in revealing potential criminals. Such a development would be a fulfillment of the dream of Lombroso, who vainly hoped to achieve this result by a study of those 'stigmata' indicating biological degeneracy."

<sup>124</sup> Luria, A. R., "The Union of the Motor Method and the Investigation of the Affective Reaction," State Institute of Experimental Psychology (Moscow, 1928); "Die Methode der Abbildenden Motorik und ihre Anwendung an die Affekt-psychologie," *Psychol-Forschung*, Band 12, 1929; *Examination and Psychological Reactions* (1930); *The Nature of Human Conflicts* (translated from the Russian and edited by Horsley Gantt 1932).

<sup>125</sup> *Supra* note 124.

<sup>126</sup> For discussion and applications of method, see Trovillo, P. V., "Objective Criteria of Character Types" (M. A. thesis), Univ. of Kansas, Dept. of Psychology (1934).

and others at the University of Colorado have employed it with psychoneurotics.<sup>127</sup> Huston, Shakow, and Erickson <sup>128</sup> in 1934 studied hypnotically induced complexes. Runkel, in 1936, made

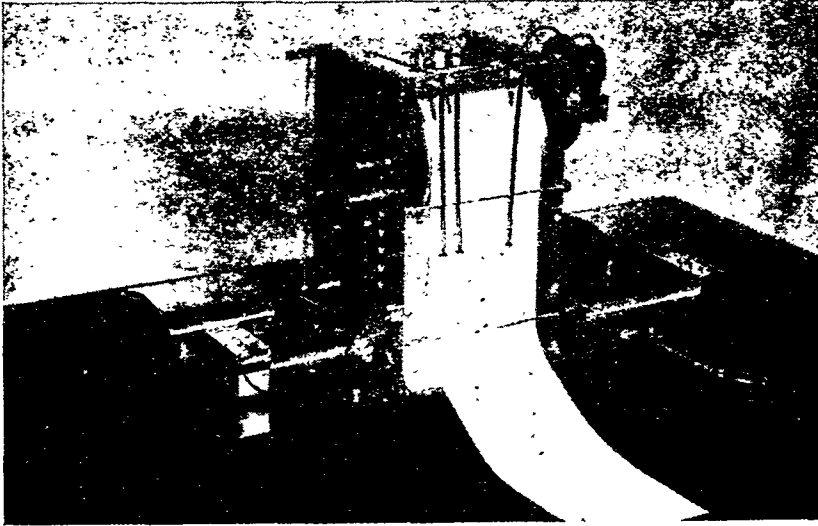


FIGURE 10

The portable polygraph of the Colorado Psychopathic Hospital. This association-motor apparatus is a modified form of the Luria apparatus, and was devised by C. H. Barnacle, F. G. Ebaugh, and F. Lemere of the staff of the Colorado Psychopathic Hospital, who began work on it in December, 1932. This front view (cover removed) shows right hand receptor (at left of picture), left hand receptor (at right), recording pens for both hands, button and cable linked to reaction-time recording pen, and (front right) switch for starting and stopping electric motor.

investigations wherein he appears in substantial agreement with the results of Luria.<sup>129</sup> In the same year Burt (with the assistance of Camp) reported a similar research,<sup>130</sup> wherein he said:

<sup>127</sup> Barnacle, C. H., Ebaugh, F. G., and Lemere, F., "Association-Motor Investigation of the Psychoneuroses," *Amer. J. Psychiat.* 91:(4) (1935); Ebaugh, F. G., "Association-Motor Investigation in Clinical Psychiatry," *J. Mental Sci.* (Nov., 1936).

<sup>128</sup> Huston, P. E., Shakow, D., and Erickson, M. H., "A Study of Hypnotically Induced Complexes by Means of the Luria Technique," *J. Gen. Psychol.* 11:65 (1934).

<sup>129</sup> Runkel, J. E., "Luria's Motor Method and Word Association in the Study of Deception," *J. Gen. Psychol.* 15:23-37 (1936).

<sup>130</sup> Burt, H., "Motor Concomitants in Word Association," *J. Exper. Psychol.* (Feb., 1936) 62.

"It is suggested to the crime detectors that while the association reaction has been considerably overshadowed by blood pressure, and so forth, it would be profitable to give it another 'try' using this supplementary manual technique."

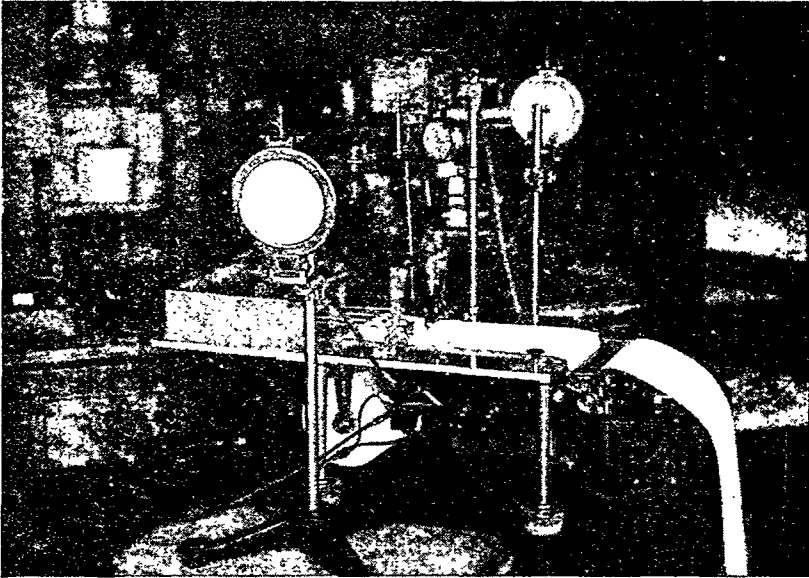


FIGURE 11

The Ohio State University Polygraph. The apparatus, as described by Harold E. Burr, Chairman of the University's Department of Psychology, records in ink, blood pressure, respiration (two curves), time in seconds, verbal stimulus and response (as recorded by a magnetic marker operated by the voice), and involuntary and voluntary reactions of the hands. Cuff pressure of only 40 millimeters mercury is sufficient to actuate the blood pressure unit, which consists of a chamber containing a metal bellows. The chamber itself is under the same pressure as the cuff and bellows and a valve permits the blood pressure to affect the bellows alone. Motion of the bellows is transmitted to a marking pen through a thin, warped, steel diaphragm.

A number of psychologists have been interested in motor control but few have approached the problem with crime detection in mind.<sup>131</sup>

<sup>131</sup> An apparatus for measuring changes in body posture, constructed by Renshaw and Weiss at Ohio State University and reported in *Amer. J. Psychol.* 37:261-267 (1926), is too intricate for criminological application. H. V. Gaskill of Iowa State College reported in 1933 on "The Objective Measurements of Emotional Reactions," *Genet. Psychol. Monog.* 14:177-280 (1933), demonstrating in well-controlled research the changes of blood pressure, respiration, pH of saliva, and arm movements during emotional excitement. D. M. Olson and V. Jones found significant "preliminary reactions" in their adaptation of the Luria technique: "An

Other possibilities exist for the criminologist interested in recording deception. As Moore said in 1917,<sup>132</sup> *fear* can be the most disintegrative influence of all thought stimuli; and so it should not be too difficult to detect if only we are sufficiently interested. For years we have known how fear robs the human voice of its normal even tenor; now we can measure objectively its influence on the voice.<sup>133</sup> We have even come recently to inspect the electrical activity of the brain;<sup>134</sup> indeed, Obermann of the University of Iowa reports success in detecting lies by means of brain potential patterns.<sup>135</sup> And, although we may never be able to objectify the shifting tension and relaxation of the facial musculature, many have tried it, some even for deceit.<sup>136</sup> Today, furthermore, we are able to employ drugs such as scopolamine, sodium amytal, and chloroform in a number of therapies, but there is only a limited opportunity in the use of narcotics for crime detection.<sup>137</sup> Further research in the criminological applications of scopolamine may make this specific use of the drug more general. Today, however, the varying reactions to it of individuals to whom it has been given, and

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Objective Measure of Emotionally Toned Attitudes," *J. Genet. Psychol.*, 39:174-196 (1931). I. C. Young reported "A Study of Tremor in Normal Subjects" in the *J. Exper. Psychol.*, 16:644-656 (1933). W. C. Langer described a varied form of the Luria apparatus in "The Tremograph: An Improved and Modified Form of the Luria Apparatus," *J. Gen. Psychol.*, 15:445-461 (1936). J. W. Gardner published "An Experimental Study of the Luria Technique for Detecting Mental Conflict," *J. Exper. Psychol.*, 20:495-506 (1937). G. S. Speer used personality test items to arouse emotions and his results may be reviewed in "The Measurement of Emotions Aroused in Response to Personality Test Items," *J. Psychol.*, 3:445-461 (1937). Martin L. Reymert and Geo. S. Speer (of the Mooseheart Laboratory for Child Research, Mooseheart, Illinois) have a recent article entitled "Does the Luria Technique Measure Emotion or Merely Bodily Tension? A Re-Evaluation of the Method," *Char. & Person.*, 7 (3) 192-200 (March, 1939). G. L. Freeman writes on "Postural Tension and the Conflict Situation," *Psychol. Rev.*, 46:(3) 226-240 (May, 1939).

<sup>132</sup> Moore, H. T., "Laboratory Tests of Anger, Fear, and Sex Interest," *Amer. J. Psychol.* 28:390-395 (1917).

<sup>133</sup> Seashore, C. E., "Phonophotography in the Measurement of the Expression of Emotion in Music and Speech," *Sci. Mo.* 24:463-471 (1927); Metfessel, Milton, "What Is the Voice Vibrato?" *Psychol. Monog.* 39 (2):126-134 (1928).

<sup>134</sup> Davis, H., "Electrical Activity of the Brain," *Amer. J. Psychiat.* 94 (4) (Feb., 1938); also, "Brain Waves! What Are They?" *Short Wave and Television* (July, 1938); also, Cazzamalli, F., "Electromagnetic Phenomena of the Human Brain," *Archives Internationales de Neurologie* 3:116-126 (1935).

<sup>135</sup> Obermann, C. E., "The Effect on the Berger Rhythm of Mild Affective States," *J. Abnor. and Soc. Psychol.*, 34:(1) 84-95 (Jan., 1939).

<sup>136</sup> Landis, C., "Studies of Facial Expression in Deception," *J. of Compar. Psychol.* 4 (1924).

<sup>137</sup> Muehlberger, C. W., "Criminal Confessions Under Narcosis," *J. Criminal L. and Crim.* 26 (3):449-451 (1935); Mosier, M. M., and Hames, E. R., "The Identification of an Amnesia Victim by the Use of Scopolamine—An Experiment," *J. Criminal L. and Crim.* 26 (3):431-437 (1935).

the difficulty of recognizing when the subject is in the right stage for questioning, makes its extensive use unjustified.<sup>138</sup>

Theoretically, still other measures may be found for detecting deception. And the more means we have at hand to objectify our interviews with lie-suspects, the more we may expect to come to a correct interpretation of their status. For some people react under emotional stress in one way, some in another, and we have not yet advanced to the point where we can predict which of the body processes of any person will be most disrupted by emotion. If we could, our investigations would be easily and quickly concluded, for we could then select the weak spot in the system for analysis.<sup>139</sup> We are at least certain today that fear of detection may in one person heighten the blood pressure, yet not disturb respiration or the electrodermal responses; in another person, it may effect only the respiration, or only the electrodermal reaction. Still others under tension may be able to look the examiner straight in the eyes without blinking, yet reveal their emotion by repeated coughing or movement.

The use of any one method in the detection of lies is inadequate. We no longer can tell the liar by observing him "rubbing the great toe along the ground," as did the ancients; neither can we by a blood pressure test alone. We have many criteria today. Even the average man on the street uses a host of ways to detect lies: he observes liars shutting the eyes, turning away the eyes or the head, making "slips of the tongue," having delayed or quickened responses, simulating deafness or blindness or sickness, exhibiting unusual or unorganized body movements, showing insincerity by tension and hollowness in the voice, flushing or paling, breathing irregularly, giving themselves away by obvious pulsations in the right carotid artery of the throat, being monosyllabic or stereotyped

<sup>138</sup> House, R. E., Editorial, *Texas State J. Med.* (Sept., 1922), reprinted under the title, "The Use of Scopolamine in Criminology," *Amer. J. Pol. Sci.* 2 (4):328-336 (1931). House stated that under the influence of scopolamine "the stimulus of a question can only go to the hearing cells. In pursuance of their functions, the answer is automatically sent back, because the power of reason is inhibited more than the power of hearing." See also: Inbau, F. E., "Scientific Evidence in Criminal Cases," *J. Criminal L. and Crim.* 24 (6):1153-1158 (1934). Inbau discusses the applications of scopolamine, sodium amytol, and hypnotism, demonstrating the utility of the former by description of a case investigated at the former Scientific Crime Detection Laboratory of Northwestern University School of Law.

<sup>139</sup> A similar opinion was expressed by Soma Weiss, M.D., of the Thorndike Memorial Laboratory (Harvard), whose studies of fear and other emotional influences are found in *Emanuel Libman Anniversary Volumes* 3:1181-1198 (1932). Page 5 of reprint, "The Interaction Between Emotional States and the Cardiovascular System in Health and in Disease."



in replying to questions, or revealing profuse perspiration on the palms or elsewhere with attempts to wipe it off.<sup>140</sup>

It is to be hoped that the passing of the day of the pioneers in this field will be only a stimulus for a fresh approach. We have had much quibbling heretofore as to who was the inventor of the "lie detector" and as to who has the best method. We now realize that there is no one "best method," no one inventor, but many methods and many "inventors." The scientific approach, the analysis, sifting, and classification of evidence derived under controlled circumstances, utilizing actual criminal suspects as case material, will encourage new workers to enter the field.

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<sup>140</sup>The Supreme Court of the United States in 1933 rebuked a trial judge for telling the jury that "wiping the hands during testimony is almost always an indication of lying." See *Quericia v. United States*, 62 Fed. (2d) 746, 289 U. S. 466, 53 Sup. Ct. 698 (1933).