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A HISTORY OF LIE DETECTION

PAUL V. TROVILLO†

The interrogation of criminal suspects may not be easier today than formerly, but it is at least on a more objective basis. Objectivity on the part of the examiner requires, however, not alone a scientific method and technique, but also discernment of the psychology of the suspect. Each of these three factors—scientific method, scientific technique, and psychological insight—were lacking in most of the ancient and medieval attempts to determine the truth. Indeed, in many parts of the world there are still employed the methods of the Ordeal and of Torture. Nevertheless, we have come a long way, and in this paper we record chronologically some of the outstanding episodes in the history of psychological interest in the lie.

It is the unexpressed intention of the liar to mislead. And since people generally dislike to be misled, one who lies is apt to find his word contested and himself punished. For thousands of years, therefore, the liar has been penalized by law. Exceptions have been noted, however. Thus, an interesting example of group acceptance of the lie is to be found in one of the most ancient collections of books of law, manuscripts of which appeared among the Hindus around 900 B. C.-600 B. C. In one of these "books," the Dharmasastra of Gautama, the judge is permitted to rely implicitly upon the testimony of witnesses and to adhere to the principle that "no guilt is incurred in giving false evidence in case the life of a man depends thereon."¹ Also, the Vasishttha Dharmasastra states that "Men may speak an untruth when their lives are in danger

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¹ Lea, H. C., *Superstition and Force* (1892) 268 (First Edition, 1866).

or the loss of their whole property is imminent."² Westermarck related cases wherein lying is applauded and recognized as a difficult art;³ and Oscar Wilde in some of his essays, satirized the dull, serious fellow who is too conscientious to lie.⁴

In one of the papyrus Vedas written about 900 B. C. there are specific instructions for detecting poisoners by their behavior, and thus it would seem that poisoners, at least, were hunted out with some care:

"A person who gives poison may be recognized. He does not answer questions, or they are evasive answers; he speaks nonsense, rubs the great toe along the ground, and shivers; his face is discolored; he rubs the roots of the hair with his fingers; and he tries by every means to leave the house"⁵

By the time of Erasistratus, the celebrated Greek physician and anatomist (300-250 B. C.), we find very definite attempts to detect deceit and these, interestingly enough, appear relatively objective in method (i. e., feeling the pulse). One such attempt is related by Plutarch and others.⁶ It concerned the love of Antiochus for his step-mother, Stratonice, and his efforts to conceal it from his father, Seleucus I of Syria, surnamed Nicator. Nicator, formerly a general in the conquering army of Alexander the Great, had married the beautiful Stratonice. Sometime after this marriage, Nicator's son (of a former wife), Antiochus, began to lose weight and to languish in an unknown disease. Nicator, whose associations with Alexander the Great had made him familiar with Alexander's respect for learning, decided to patronize learning himself and to look about for a capable physician who could cure his son's ailment. He called to his court Erasistratus, who had gained renown for his discussions of the functions of the brain and nervous sys-

² *Supra* note 1.

³ Westermarck, E., *Origin and Growth of Moral Ideas* (1908) 2: 72.

⁴ Wilde, O., "The Decay of Lying," *Complete Writings of Oscar Wilde* (1909).

⁵ The Ayur-Veda, the date for which has been set by some historians as about 900 B. C., translated some of the early Sanskrit medical writings. Commentaries thereupon were made in the Shastras of Charaka and Sushruta (B. C. 600), and these were translated in 1845 by T. A. Wise in his "Commentary on the Hindu System of Medicine," published in Calcutta, India. See this work, page 394, for the quotation referred to. Wise translated this quotation from the *Mitákshara shástra*.

⁶ Plutarch is not the only one who mentions Erasistratus. Pliny (23-79 A. D.) mentions him in his *Historia Naturalis*. Angelo Mosso, in his book "Fear" (1896), at page 108, referred to the physician. See translation of 5th edition of "Fear" from the Italian by E. Lough and F. Kiesow. (Longmans, Green and Co., London, New York, and Bombay, 1896.) For brief biographical accounts of the persons referred to, see "Universal Pronouncing Dictionary of Biography and Mythology" by Joseph Thomas (1887).

tem. When Erasistratus arrived at the court he acted on the current suspicion that Antiochus may have developed a consuming passion for the beautiful woman his father had married. In discussing with Antiochus the virtues of Stratonice he found occasion to feel Antiochus' pulse, and its tumultuous rhythm made him sure of his suspicions. Consequently Erasistratus informed the monarch that Antiochus was infatuated by Stratonice. Indeed, significant circumstantial evidence was to support this diagnosis: the second Stratonice was begotten of the intimacies of Antiochus and the Queen.

The Method of the Ordeal

It is significant that, with few exceptions, the historical accounts of deception-detecting from the days of Christ, through the Middle Ages, are the history of the Ordeal.⁷ Superstition so swayed the minds of people that it was the rule for them to ask for the Ordeal to prove their innocence. The accuser was not looking, evidently, for suspicious clues in the face or actions of the individual, for apparently the psychology of deceit did not exist. Even the religions of Europe, as late as the 16th Century, taught that proof of innocence or guilt would be furnished from on High in a variety of mystical modes. People did not consider that proof lay within or on the surface of the suspect himself. The brief comments of the early Sanskrit writers which have come down to us in the various Vedas are hardly an exception to this statement, as the evidence of psychological understanding is most meagre.

Lea, in his treatise on "Superstition and Force," which appeared in 1866, discussed at great length the many forms of the Ordeal used throughout the ages to aid in the detection of deception. It will be noted that in many instances of the Ordeal, the Ordeal technique is not based on any peculiar insight into the psychological processes underlying awareness of guilt. Rather, it arises out of superstition and religious faith. Nowadays one would give little credence to such miraculous tales as we refer to here, yet the stories have been multiplied so many times in the last 2,000 years that acquaintance with representative examples is desirable.

The Red-hot Iron Ordeal. This form of trial was used among the hill tribes of Rajmahal in the north of Bengal, where the accused was apt to be told to prove his innocence by applying his tongue

⁷ For a further account of the methods of ordeal, torture, the "third degree," etc., refer to Larson, J. A., *Lying and Its Detection* (1932) 65-93.

to a red-hot iron nine times (unless burnt sooner). If burned, he was put to death. (Perhaps a sense of guilt made the mouth dry; although fear would do the same.)

Not only have accused people been forced to lick hot iron to prove their innocence, but they have been made to carry it in their hands. It is doubtful that the Ordeal arose upon the basis of observations of physiological changes occurring in deception; for if this were so, many false observations must have been made. Nevertheless, the ordeal of the red-hot iron was acknowledged thousands of years ago when, according to Persian historians, Zoroaster convinced King Gushtasph of the truth of his revelation from Hormazd;⁸ and 700 years ago it was used when Adurabad converted the Mazdeans. Adurabad, a missionary of note, while eating a repast with King Harold Blaatand, zealously pronounced the local deities to be lying devils. The King challenged the remark and Adurabad proved his God was superior to the Danish gods by holding the hot iron dauntlessly, or as one legend states, he drew on a red-hot iron gauntlet, thus converting Denmark to Christianity.⁹

The Ordeal of the Balance. Lea stated that the practice of testing the veracity of the accused by placing him on one scale of a balance arose in India where it was practiced as early as the Institutes of Vishnu (600 B. C.). It was merely this: in one scale the accused was placed; in the other, a counterbalance. ("The nicety of the operation," according to Lea, "is shown by the prescription that the beam must have a groove with water in it, evidently for the purpose of detecting the slightest deflection either way.") The accused then stepped out of the scale, listened to a judge deliver an exhortation to the balance, and got back in. If he were found to be lighter than before, he was acquitted.¹⁰ (We know today that the metabolic research of physiologists shows the human body undergoes a constant loss of weight of about 12 grams per hour. A long exhortation, therefore, should have freed the accused!)

The Boiling Water Ordeal. As a test for deception this ordeal is in use in modern Africa. An account of its application is related by Hubbard.¹¹ During explorations in British Africa a Barotse

⁸ Lea quotes Hyde Relig. Vet. Persar. Cap. XXIV—(1760) 320-1.

⁹ Lea quotes Widukindi Lib. III. cap. 65.—Sigebert. Gemblac. Ann. 966.—Dithmari Chron. Lib. II. cap. VIII.—Saxo. Grammat. Hist. Danic. Lib. X.

¹⁰ Op. cit. supra note 1 at pp. 334-335.

¹¹ Hubbard, M. C., African Gamble (1937) 129-131.

native in her retinue stole some calico cloth from her supplies, and to find the thief she allowed the natives to employ a test which had previously been outlawed along with local witchcraft. According to this explorer:

"The whole lot of sixty-odd natives with the wives, girl friends and children who were along, were lined up and our head boy explained the situation. There was a thief and the boiling water test was to be applied to find him. There was not one dissenting voice. All agreed it was a fair test, so a fire was built and on it settled a huge pot of water. Solemnly we watched it come to a boil, then boil furiously. A smaller pot of cold water was placed near the boiling pot, and when the water was turning over in huge rolls the test began.

"Men, women, little children and big ones stepped forward one by one, each plunged his right arm into the cold water, then into the boiling pot to the elbow, and stepped into line on the other side of the fire. Everyone took the test without a murmur and when all was finished they were told to return at the same time the next afternoon. The one who, by that time, had lost some skin or showed a blister would be proved the thief.

"In single file they returned, every last one of them, passing before us, right arm bare and outstretched for an examination. Out of that small army one alone showed blisters and peeling skin. No other had any sign of a burn. And he confessed to the crime and returned the calico."

Modern Africa also has its methods for "smelling out" liars! Gatti, in a recent article,¹² describes the antics of the African Medicine Man. The lean and emotionally taut exorcist assembles all suspects in a circle about him, then goes into a trance, from which he violently rouses himself, throwing himself at the neck of the first suspect within reach and smelling him. He then lapses into another brief trance, breaking the spell by a blood-curdling shout and another feverish smelling of a suspect. This continues around the circle and may last for hours; but in the end the guilty suspect, in ninety-nine out of one hundred cases, is smelled out and confesses! Gatti attributed confession to the extreme emotional tension experienced by the suspect.

The Ordeal of Rice Chewing. Many of the ordeals in use during the Spanish Inquisition, and by Europeans throughout the Dark Ages, were borrowed from India and adapted to suit local purposes. By 1150 A. D. the Roman Catholic clergy had made full use of the Indian practice of rice chewing. In the two following quotations

¹² Gatti, A., "Witchcraft in Africa," *Esquire Magazine* (January, 1939).

from Mackay's "Extraordinary Popular Delusions" we see how ineffective it could be in the hands of the initiated:

"Of all the ordeals, that which the clergy reserved for themselves was the one least likely to cause any member of their corps to be declared guilty. The most culpable monster in existence came off clear when tried by this method. It was called the *Corsnaed*, and was thus performed. A piece of barley bread and a piece of cheese were laid upon the altar, and the accused priest, in his full canonicals, and surrounded by all the pompous adjuncts of Roman ceremony, pronounced certain conjurations, and prayed with great fervency for several minutes. The burden of the prayer was, that if he were guilty of the crime laid to his charge, God would send his angel Gabriel to stop his throat, and he might not be able to swallow the bread and cheese. There is no instance upon record of a priest having been choked in this manner.

"An ordeal very like this is still practiced in India. Consecrated rice is the article chosen, instead of bread and cheese. Instances are not rare in which, through the force of imagination, guilty persons are not able to swallow a single grain. Conscious of their crime, and fearful of the punishment of Heaven, they feel a suffocating sensation in their throat when they attempt it, and they fall on their knees, and confess all that is laid to their charge. The same thing, no doubt, would have happened with the bread and cheese of the Roman Church, if it had been applied to any others but ecclesiastics. The latter had too much wisdom to be caught in a trap of their own setting."¹³

In India the *Corsnaed* took still another form:

"The ordeal is performed with a kind of rice called *sathce*, prepared with various incantations. The person on trial eats it, with his face to the East, and then spits upon a peepul leaf. If the saliva is mixed with blood, or the corners of his mouth swell, or he trembles, he is declared to be a liar."¹⁴ A slightly different form is described for cases in which several persons are suspected of theft. The consecrated rice is administered to them all, is chewed lightly, and then spit out upon a peepul leaf. If any one ejects it either dry or tinged with blood, he is adjudged guilty."¹⁵

The Ordeal of the Red Water. In a wide region of Western Africa the ordeal of the red water or "sassy-bark" is used. For this the accused fasts for twelve hours, swallows a small amount of rice, then imbibes of the bark-colored water (sometimes as much

¹³ Mackay, C., *Memoirs of Extraordinary Popular Delusions* (1852) 2: 266.

¹⁴ Ayeen Akbery, II., 498.

¹⁵ Ali Ibrahim Khan (*Asiatic Researches*, I) 391-392.

as a gallon). If this acts as an emetic and the suspect ejects all of the rice, he is considered innocent of the charge; otherwise the accused is judged guilty. Lea says Livingston found the natives eager to use this test on themselves when they were accused, having great faith in it and feeling that only the guilty would suffer. Their explanation is that a fetish of the victim enters the mouth with the emetic red water, examines the heart of the drinker, and, if it finds him innocent, brings up the rice in evidence. Sometimes, however, an opposing philosophy holds, so that after an accused chews a piece of odum wood and drinks a pitcher of water, and suffers no ill effects, he is judged guilty and put to death; if he becomes sick the accuser is put to death in his stead!

It is apparent that these relatively modern practices of the African natives differ but little from the European Ordeals of the Middle Ages. In either case, psychological insight is conspicuously absent.

Early Objective Measures of Pulse and Blood Pressure

It is unfortunate from the historical standpoint that we can find few clear-cut early descriptions of symptoms of deceit. One remarkable observation, however, is found in the book "Gesta Romanorum."¹⁶ During the Middle Ages it is related that a nobleman suspected his wife of infidelity, and told his suspicions to one of his advisers, who agreed to make a test to determine the facts. At a dinner he sat next to the nobleman's wife, casually laid his hand upon her wrist and conversed with her. During a brief conversation he mentioned the name of the man suspected by the nobleman, whereupon the lady's pulse immediately quickened; he later brought up the name of the husband but perceived no similar response. It is said a confession was later elicited.

How widely known was this idea of determining deceit by feeling the pulse cannot be ascertained. Perhaps other physicians of the pre-Christian eras, besides Erasistratus, had such information, but of this we cannot be sure. Erasistratus' technique may have been preserved, and brought to light hundreds of years later; at least this conclusion seems apt when we read of Boccaccio's story of how the illness of the Count of Antwerp was diagnosed.¹⁷ Boccaccio (1313-1375) is commonly suspected of availing himself of all

¹⁶ "Gesta Romanorum," translated from the Latin by The Reverend Charles Swan (1906) 75.

¹⁷ Angelo Mosso gives credit for this story to Boccaccio. See Mosso. Fear, *op. cit. supra* note 6 at p. 107.

the common traditions which were floating about in his time and it may be that the following story is based on the early success of the physician Erasistratus to whom we have previously referred. It is said that the physician called in to diagnose the illness of the Count felt the young man's pulse at the wrist. Meanwhile, the Count's sweetheart, Giannetta, entered his room and his pulse began to beat violently. When she left it subsided. The physician, acting on a hunch, recalled the girl to the room and again observed the pulse quicken. Subsequently he reported to the young man's parents that the health of their son could not be restored by a physician, but only by Giannetta.¹⁸

Clendening, in an article entitled "The History of Certain Medical Instruments,"¹⁹ calls attention to the early history of pulse counting, and although he makes no mention of its early application to deception, we should state at this point that, according to Clendening, Galileo (1581) must be given the credit for first inventing an objective way to count the human pulse. Galileo proved his apparatus by trying it out on himself under varying conditions, and also on a young and on old persons under various conditions, but he apparently did not use it to detect deception. Galileo's "pulsilogium," or pulse watch, was constructed so that a pendulum could be connected to a wheel behind a dial, the pendulum being a weighted string which could wind around the wheel. When this pendulum was set to swing synchronously with a person's pulse, the pointer would indicate the pulse rate.²⁰

The 18th Century, although it gave us no experiments of importance in the detection of deceit, produced a great wealth of interesting observations on the significance of the pulse rate. To the student interested in the psychology and history of deception it

¹⁸ According to De Lint, Cleyer demonstrated that the Chinese have been interested for thousands of years in feeling the human pulse and assigning a variety of reasons for its varying behavior. Whether the Chinese used the pulse in detecting deception is not indicated. De Lint, J. G., *Atlas of the History of Medicine (Anatomy Section)* (1926) 18.

Another practical demonstration of the value of noting pulse changes may be found in the autobiography of Benvenuto Cellini, in which he observes regarding his father: "I was ill about two months, during which time my father had me most kindly treated and cured, always repeating that it seemed to him a thousand years till I got well again, in order that he might hear me play a little. But when he talked to me of music with his fingers on my pulse, seeing he had some acquaintance with medicine and Latin learning, he felt it change so much if he approached that topic, that he was often dismayed and left my side in tears."

¹⁹ Clendening, L., "The History of Certain Medical Instruments," *Annals of Int. Med.*, 4: 176-189 (1931).

²⁰ Hart, I., *Makers of Science*.

may be amazing that the pulse characteristics could be considered significant of almost everything else except lying.²¹

The celebrated Roman court physician, Lancisi, who in 1728 wrote "De Motu Cordis," conceived that emotion may be produced through the close dependence of mental functions upon the nerves, ganglia, and the coronary vessels of the heart. Emotions are produced, he thought, by more or less forceful heart action. From this he inferred that the characteristics of the mind derived from the structure and physical changes going on in the body. Such a theory formed an admirable basis for much of the later physiological experimentation on the action of the heart during deception, and the function of the body during other emotional experiences.

Aside from measuring the pulse, however, objective research on heart action in deception awaited development of suitable instruments. One such instrument was the sphygmomanometer. Clendening²² traces briefly the history of the development of the sphygmomanometer, and although he makes no reference to its use in detecting deception, we take from his account some of the essential features of the development of this instrument. According to Clendening, a clergyman of the Church of England, by the name of Hales, is supposed to have been the first to study the measurement of blood pressure. Hales began experiments on dogs, and in 1733 he recorded further observations on horses and on a doe. He inserted a tube into the left crural artery of a horse and watched the blood rise in the tube to a height of eight feet, three inches, above the level of the left ventricle of the heart. But he did not translate this rise into units of measurement. In 1828 Poisenille, in a doctorate dissertation in medicine, described a "hemodynamometer," but he followed Hale's method of direct insertion, using a mercury column instead of a column of blood. In 1847 Ludwig developed a float for the top of the mercury column and had it write the pressure level on a recording drum. In 1856 Faivre, by the direct method, made the first measurement of the blood pressure in man. But in 1855, Vierordt (and later Marey) measured the blood pressure indirectly by obliteration of the pulse. Subsequently, Von Bosch, Potain, Zadek, and others made refinements in technique. In 1896 Riva-Rocci developed the rubber cuff-

²¹ Mitchell, S. W., "The Early History of Instrumental Precision in Medicine," *Transactions of the Congress of American Physicians and Surgeons* 2: 159-198 (1891).

²² *Op. cit. supra* note 19.

manometer method; and in 1897 Hill and Barnard added to this method a means of calibrating pressure.

In 1904, Erlanger,²³ an American, described an instrument patterned after the fundamental principles of Riva-Rocci of 1896. Four years later, in 1908, Munsterberg²⁴ was proposing that courts utilize the blood pressure test for gauging deception, and although Wigmore²⁵ in 1909 vigorously criticized too early application of the method, Marston²⁶ began some excellent investigations of the possibility of applying the test to everyday problem situations. To this work and that of subsequent investigators we will return later.

Observations in the Nineteenth Century

With the development of suitable apparatus for gauging emotions, many significant studies became possible, and there was a growing interest in the concrete problems of deception. The early years of the 19th Century, however, provided no startling innovations. In 1811, Mahon,²⁷ in a book on legal medicine, related that Galen, a Greek medical writer (131-201 A. D.), detected deceit in an individual who complained of a violent colic on being summoned to attend an assembly of the people. According to Mahon, Galen suspected feigning and prescribed "only a few fomentations, although this same person had not long before been cured of the same complaint by the use of philonium." In 1814, Hill,²⁸ a medical surgeon, wrote an essay "on the rules for detection of pretenders to madness." Although both Mahon and Hill were interested in simulation, they appear to be concerned only with subjective symptoms. So, too, was Beck,²⁹ an instructor in a medical college, who, in 1825, referred to "a very curious work published at New Haven in 1817 under the title of 'The Mysterious Stranger, or Memoirs of Henry More Smith.'" Herein was described the case of a prisoner who contrived to seek attention and escape by striking

²³ Erlanger, J., "A New Instrument for Determining the Minimum and Maximum Blood Pressures in Man," *Johns Hopkins Hospital Rep.* 12: 53 (1904).

²⁴ Münsterberg, H., *On the Witness Stand* (1933) 118-133. First edition 1908.

²⁵ Wigmore, J. H., "Professor Münsterberg, and the Psychology of Testimony," *Ill. Law Review*, 3: 399-445 (1909).

²⁶ Marston, W. M., "Systolic Blood Pressure Symptoms of Deception," *J. Exper. Psychol.*, 2 (2): 117-163 (1917); "Reaction-Time Symptoms of Deception," *J. Exper. Psychol.*, 3 (1): 73-87 (1920); "Psychological Possibilities in the Deception Tests," *J. Criminal L. and Crim.* 2 (4): 551-570 (1921); "Studies in Testimony," *J. Criminal L. and Crim.* 15 (1): 5-31 (1924).

²⁷ Mahon, P. A. O., *Medecine Legale, et Police Medicale*, 3 vols. (1811).

²⁸ Hill, G. N., *An Essay on the Prevention and Cure of Insanity; With Observations on the Rules for the Detection of Pretenders to Madness* (1814).

²⁹ Beck, T. R., *Elements of Medical Jurisprudence* (2d. ed., 1825).

his elbows on the cell floor to vary his pulse and thus trick the authorities by a simulated illness!

In the two decades between 1870 and 1890, both Galton and Wundt were very active in the development of "association" tests, and made brief references to the possibilities of their use in ascertaining emotions connected with deceit. Although these ideas led to some practical applications by other workers, we should first call attention to the significant work of Mosso, an Italian physiologist of that era.

Mosso, like many other workers in the field of the emotions, did not invent a "lie-detector." However, he, and others to be mentioned, did make many observations which subsequently formed the basis for detection techniques. (Lie detection came about through the application of a method or methods to a specific end; it was never a first act in the growth of an idea. Rather it should be considered the fruit of centuries of germination, some of which, indeed, was plucked before it was ripe.)

Mosso was encouraged in his studies of the emotions by Lombroso, his tutor and contemporary. His work is of unusual interest to the student of deception, particularly his studies of fear and of its influence on the heart and respiration. As early as 1875³⁰ Mosso demonstrated, by means of a "plethysmograph" (an instrument for measuring blood pressure and pulse changes) periodic undulations in man's blood pressure caused by the respiration cycle;³¹ and his ingenuous studies of the circulation of the blood in the brain³² opened up new avenues for the study of the influences of fear. In 1895 he described a new device³³ for measuring blood pressure, giving credit to Vierordt for first measuring man's blood pressure, from the outside, in 1855. Many of the current workers in the deception technique might well study some of the carefully recorded observations of this Italian physiologist. One, of especial interest, was made on a woman whose brain, as the result of a disease, had been partially exposed through an opening in the skull. We see here the disrupting nature of fear—specifically concern for one's own security:

"In order to give an instance of the delicacy of the appara-

³⁰ Mosso, A., *Supra un nuovo metodo per scrivere i movimento dei vasi sanguigni nell'uomo* (Turin, 1875).

³¹ Mosso's research was preceded by that of K. Vierordt: *Die Lehr vom Arterienpuls* (1855); and Traube: *Centralb. f. m. Wiss* (1865).

³² Mosso, A., *Sulla circolazione del sangue nel cervello dell'uomo* (1879).

³³ Mosso, A., "Sphygmomanomètre Pour Mesurer La Pression Du Sang," *Archives Italiennes De Biologie* 23:177-197 (1895).

tus, and to prove the accuracy of our investigations, I mention the following circumstance. One day we were assembled in the laboratory of Professor Giacomini, intent on studying the brain of the patient, who was sitting in her arm-chair, and seemed absent-minded. There were a few spectators in the room, who were told to remain quietly behind the patient's back. In solemn silence we observed the curve marked by the cerebral pulse on the registering apparatus. Suddenly, without any external cause, the pulsations rose higher, and the brain increased in size. This striking me as strange, I asked the woman how she felt; the answer was, well. Seeing, however, that the circulation in the brain was very much altered, I examined the instrument carefully, to see whether it was all in order. Then I asked the patient to tell me most minutely what she had been thinking about two minutes before. She said that, as she had been looking absent-mindedly into a bookcase standing opposite to her, she had caught sight of a skull between the books, *adding that it had frightened her by reminding her of her malady.*"³⁴

One of the earliest of Mosso's observations of the effects of fear on blood pressure relate to a plethysmographic record made September 27, 1877, on a young man by the name of Bertino, whose brain had been made accessible for study by a large fracture. From the observations and records made in this case, Mosso concluded:

*"The variations which appear in the circulation of the brain during fear are far greater [than those resulting from the effect of mere noises and sounds]. The reproofs and threats which I uttered to Bertino when he was hindering my experiments by moving his head or hands, the disagreeable things which I sometimes purposely said to him, were always followed by very strong pulsations; the brain-pulse became six, seven times higher than before, the blood-vessels dilated, the brain swelled and palpitated with such violence that physiologists were astonished when they saw the reproductions of the curves, published in the tables of my researches on the circulation of the brain."*³⁵

Since fear is an essential element of deception, that is, the fear of being detected, Mosso's pioneering work on this emotion should not be neglected. He not only performed many carefully controlled experiments on blood pressure and pulse in emotion, but his observations of pallor and blushing, of respiration, of trembling, of facial expression, and of maladies produced by fear are all of unusual significance to research in deception.

One of the most unusual and elaborate attempts ever made to

³⁴ *Op. cit. supra* note 17 at pp. 66, 68. (Italics added.)

³⁵ *Op. cit. supra* note 17 at pp. 77-81.

measure the influence of fear was performed by Mosso when he devised his "scientific cradle." It was designed to measure the flow of blood as it became concentrated first in one part of the human body and then in another.

In reviewing his experiments with emotion and fear, Mosso stated that of two records of pulsations presented to him for analysis he could distinguish "that of one who is afraid and that of one who is tranquil."⁸⁶

Many experimenters in police laboratories, who investigate criminal suspects, no doubt have noticed that some individuals under strong emotions write on the polygraph records a respiration pattern which appears to echo the staccato beats of the heart. It

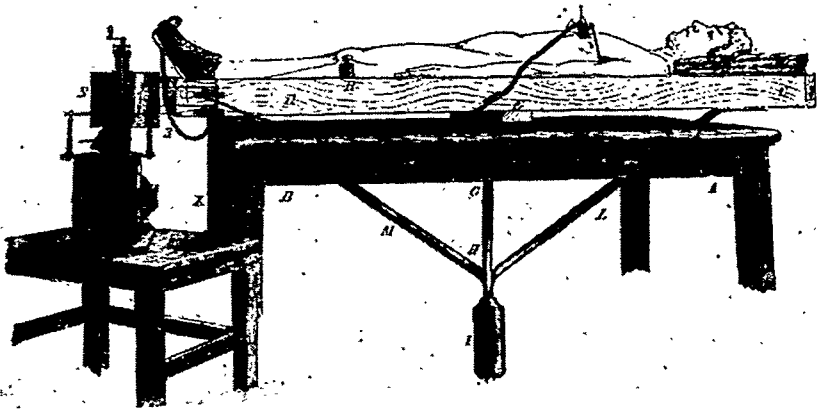


FIGURE 1

Mosso's Scientific Cradle

This "cradle" was so constructed that a person remaining quiet on it would reveal emotional or other disturbances by the tilting of the plank on which he lay. The top of the table rested on a delicate knife-edge fulcrum (E) and equilibrium of the body was essentially determined by moving the weight (R) to proper setting. To prevent constant swaying of the balance with every small oscillation of respiration, Mosso attached a heavy metal counterpoise (I) which could be screwed up or down (on GH), being fixed vertically in the middle of the plank (DC) and secured by the bars (ML). Thus the smallest oscillations were compensated by the counterpoise, and the balance remained sensitive enough even to "teeter-totter" to the rhythm of respiration. During emotion the blood would "rush to the head" and throw the bed out of balance. This movement would be written on the revolving smoked drum (S) appearing in picture at left. The rubber cuff about the foot was attached by the tube to a tambour, recording pulse fluctuations. A similar recording was obtained by a modest "cardiograph" attached on the chest over the heart.

⁸⁶ *Op. cit. supra* note 17 at pp. 92-101.

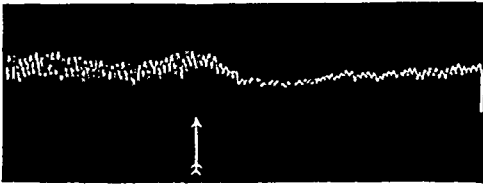
seems that the unusually heightened blood pressure, or pulse amplitude, is reflected not alone in the blood pressure curves but in the respiration also. Mosso had observed this some time prior to 1896.³⁷

Another early worker with an early type of sphygmomanometer was Kiesow.³⁸ Kiesow worked with Mosso and for awhile was in the psychological laboratory of Wundt in Leipzig.

Regarding the psychological influences on blood pressure Kiesow said:

"The question may perhaps be formulated thus: Are the changes in blood pressure caused by purely intellectual activity, or are they produced by the excitation of the sense organs, or, again, are they to be considered simply as the effects of emotions and the accompanying sensations? According to my experience, it seems that the last alternative is the most acceptable.³⁹

FIGURE 2



The graph reproduced here is illustrative of one of Kiesow's observations of the change in blood pressure-pulse pattern when the experimenter shouted unexpectedly at a subject connected to the sphygmomanometer. Note the increased pressure at the arrow, with subsequent evidence of contracting blood vessels: a typical reaction to sudden fear.

Today's lie detection experts are not the first to note that certain people are emotionally unresponsive. Kiesow wrote:

"It is necessary to distinguish different types of people. Those whose emotions are readily expressed, show the most distinct changes (in blood pressure and pulse), which does not appear in people of calm disposition. In the first case, practice decreases the effect. The individual differences are explainable, not alone by temperament, but also by the different occupations of each person. A mathematician will be less emotional in mental problems which are common to his profession than one not permitted to employ himself in this manner."⁴⁰

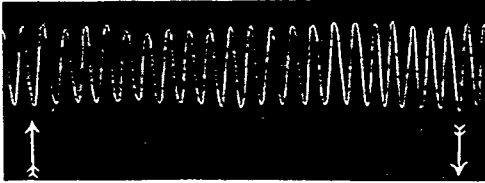
³⁷ *Op. cit. supra* note 17 at pp. 143-144.

³⁸ Kiesow, F., "Expériences avec le Sphygmomanomètre de Mosso sur les changements de la pression du sang, chez l'homme, produits par les excitations psychiques." *Archives Italienne De Biologie* 23:198-211 (1895).

³⁹ *Supra* note 38 at p. 207.

⁴⁰ *Op. cit. supra* note 38 at p. 208.

FIGURE 3



To demonstrate the fact that some people are emotionally unresponsive on the blood pressure-pulse test, Kiesow referred to his record of the responses of "subject P." In this reproduction the first arrow marks the point in the graph where the subject was given a painful pinch. The two arrows mark the period of the action. Note that almost no change is apparent.

One of the outstanding criminologists of the era was, of course, Lombroso—Mosso's tutor. Although Lombroso's work cannot be fully accepted by current investigators, and although criminological schools still argue about the merit of Lombroso's many contributions, the fact remains that this one man did more than any of his contemporaries to put to practical application some of the observations made by predecessors. In fact, Mosso, Kiesow, Wundt, and practically all other physiologists and psychologists of the day were limiting their experimental work almost exclusively to laboratory investigations. Lombroso, however, several times assisted the police

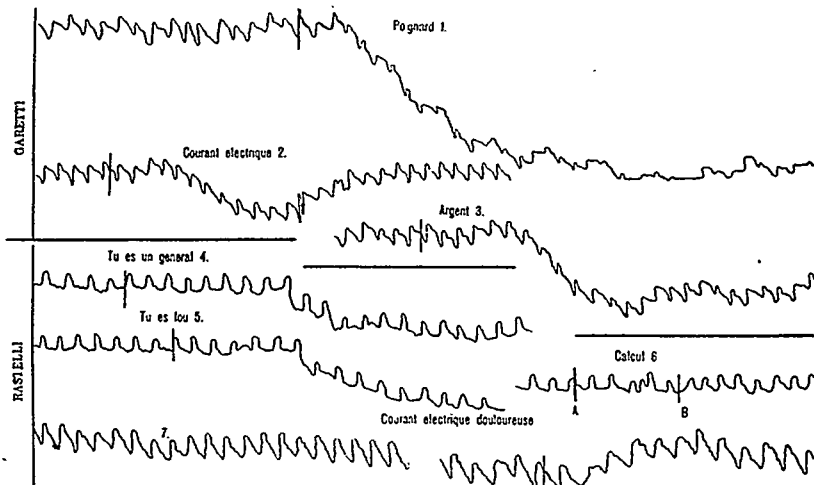


FIGURE 4

These of Lombroso's records, and others not reproduced, show the influences on the pulse patterns (and actually also the blood pressure) of several individuals under a variety of stimuli; picture of a woman, painful electrical shock, sad music, mathematical calculation, sight of a dagger and sight of a gun, questions about fear of the magistrate, sight of stolen money, etc.

in identifying criminal suspects through the use of blood pressure-pulse tests. In his celebrated work, "L'Homme Criminal," (1895) he discusses the applications of a sphygmograph and a plethysmograph to the interrogation of criminals.⁴¹ He also refers to some experiments with a hydrosphygmograph, and illustrates records obtained with the instrument.⁴²

Further description of some of the apparatus Lombroso employed in the interrogation of criminals and others appeared in several works,⁴³ but for a brief review of his contributions one should consult the English translation of "The Criminal Man," by Lombroso's daughter, Gina L. Ferrero.⁴⁴ His daughter states:

"My father sometimes made successful use of the plethysmograph to discover whether an accused person was guilty of the crime imputed to him, by mentioning it suddenly while his hands were in the plethysmograph or placing the photograph of the victim unexpectedly before his eyes."

She also related the use by her father of the plethysmograph for detecting deception in March, 1902. A girl six years of age had been murdered and a coachman by the name of Tosetti was suspected. The anthropological examination of this man by Lombroso indicated his innocence, but Lombroso went further:

"To obtain stronger proof, my father adopted the plethysmograph and found a slight diminution of the pulse when Tosetti was set to do a sum; when, however, skulls and portraits of children covered with wounds were placed before him, the line registered showed no sudden variation, not even at the sight of the little victim's photograph. The results of the foregoing examination proved conclusively that Tosetti was innocent of a crime."

Lombroso himself refers to his use of the hydrosphygmograph in proving that a suspect while innocent of a robbery of 20,000 francs from a railroad was guilty of stealing certain documents and passports.⁴⁵ There was a fall of fourteen millimeters of mer-

⁴¹ Lombroso, C., *L'Homme Criminel* (2nd French ed., 1895) 336-346. The first Italian edition of *Criminal Man* (1876) makes no reference to use of the sphygmomanometer or plethysmograph in the interrogation of criminals.

⁴² Lombroso, C., *L'Homme Criminel*. (Atlas) (2nd ed., 1895). See Plates 17 and 18 of the Atlas in this book.

⁴³ Lombroso, C., *Arch. di psichiat.* 23:539 (1902); Lombroso, C., *La Perizia Psichiatrico-Legale* (1905).

⁴⁴ Ferrero, G. L., *The Criminal Man* (1911) 303-304; 262.

⁴⁵ Lombroso, C., *Crime, Its Causes and Remedies* (Translated by H. P. Horton, 1912).

cury (indicating reduced blood pressure) when the latter theft was mentioned. The conclusion was later verified.

In the original work of Lombroso, "La Perizia Psichiatrico-Legale," is a discussion of the measurement of emotion, with a brief presentation of the hydrosphygmomanometer and the plethysmograph of Mosso and of Fik. Lombroso refers to the works of Dastre and Morat,⁴⁶ of Mosso,⁴⁷ of Binet and Courtier,⁴⁸ and of Patrizi.⁴⁹

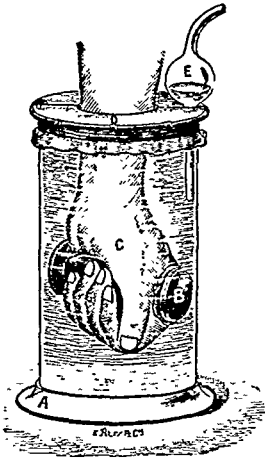


FIGURE 5

The measurements of emotion by means of Lombroso's tank or hydrosphygmograph (modified after the plethysmograph invented by Francis Franke) were recorded on a revolving smoked drum. This diagram illustrates the use of the water-filled tank, into which the fist of the suspect could be placed. The immersed fist was sealed across the top of the tank by a rubber membrane. Pulsations of blood in the fist were transferred to the water, and the changes in water level were carried over into an air-filled tube, which in turn recorded the pulsations on the revolving smoked drum.

In 1891, Delbrück⁵⁰ in Germany and others elsewhere were becoming considerably interested in the psychology of the lie and of its psychopathic manifestations. In this country, in 1892, Harris,⁵¹ who was not particularly interested in the psychology of the liar but rather in the law, developed an elaborate conception of kinds of liars as they could be observed on the witness stand giving deceptive testimony: witnesses who are flippant, dogged, hesitating, nervous, humorous, cunning, canting hypocrites, positive, etc. It is possible to analyze these types critically and to condemn the classification because the author makes a person's actions, by implication, always fit a certain temperament; thus, a flippant witness is just that, and

⁴⁶ Dastre and Morat, *Récherches sur le système nerveux vaso-moteur* (1884).

⁴⁷ *Op. cit. supra* note 32.

⁴⁸ Binet and Courtier, "Circulation capillaire de la main dans ses rapports avec la respiration et les actes psychiques," *Année psychologique* (deuxième année Paris, Alcan, 1895).

⁴⁹ Patrizi, *Riflessi vascolari*, in *Rivista sperimentale di freniatria* (1897). For a further description by Lombroso of the Patrizi-Mosso hydrosphygmograph glove on criminals, see *Archivio di Antropologia Criminale* 23:539 (1902).

⁵⁰ Delbrück, *Die pathologische Lüge und die psychisch abnormen Schwindler* (1891).

⁵¹ Harris, R., *Hints on Advocacy* (1892) 65, 107.

not hypocritical. This is the common criticism of the characters devised by Shakespeare and by Dickens. Harris' scheme is neither logical nor psychologically sound. Those interested in further classifications of liars should refer to Robinson,⁵² and Plowden.⁵³ We turn now to specific studies of deception.

Word Association

Just as there is "more than one way to kill a cat," so there are many ways to catch a liar. And the technique of word association is one of the most subtle of all. Probably no other one technique developed by psychologists has been so widely applied or so acclaimed as that of word association. The basic practice is to present, orally or visually to a subject, a group of words, each word sufficiently separated in time from the others so that the subject's responses to it may be noted. The subject may be instructed to reply orally to the word stimulus by calling out the first thing of which he is reminded; or, by giving a word which satisfies a pre-arranged relationship. In any examination to determine a person's criminal guilt, a large majority of the words used are chosen as neutral stimuli, a few words being inserted, among the others, which are pertinent to the crime situation. If the offender is normally conscious of his legal violations, and strives to reply to the stimuli with words which will seem to have no connection with the crime, certain evidence of mental conflict becomes apparent: delayed reaction time, quickened reaction time, repetitions of stimulus words; stereotyped or identical responses to several different words, blocking of response, informative nature of the response, or uncoordinated physical movements. The essential element in a typical word-association test is that one word or idea is reminiscent of another word or idea, and the expression of their association forms a meaningful picture.

The word-association test itself is a modern development, and we have no evidence that it was used among the ancients as they used the feeling of the pulse. In the *Phaedo*,⁵⁴ however, we find this idea: "Do you not know, then, that lovers when they see a lyre, or a garment, or anything else which their favorite is accustomed to use, are thus affected; they both recognize the lyre

⁵² Robinson, W. C., *Forensic Oratory; A Manual for Advocates* (1893) 126.

⁵³ Plowden, A. C., *Grain or Chaff; The Autobiography of a Police Magistrate* (1903) 225.

⁵⁴ Quoted by M. D. Eder in the translator's preface to C. G. Jung's "Studies in Word Association" (1919).

and receive in their minds the form of the person to whom the lyre belonged."

No doubt Galton in 1879⁵⁵ was the first to record experiments on association of ideas. Wundt, in 1880, Wertheimer and Klein in 1904, Jung, in 1906 and 1910,⁵⁶ and others, later developed the principle in a variety of ways, especially applying it to the unconscious mental processes. Speaking of recorded word associations, Galton said: "They lay bare the foundations of a man's thoughts with curious distinctness, and exhibit his mental anatomy with more vividness and truth than he would probably care to publish to the world."⁵⁷

Galton recorded his informal experiments with such conscientious care that many men were quick to see that in his method lay a new promise for psychology.⁵⁸ Gross and countless others have made many practical applications of the basic idea, and the following story which he related in his well-known book on "Criminal Investigation"⁵⁹ demonstrates the immediate value of the association principle.

"The following anecdote told of Count Sandor, a person well-known for his jokes and eccentricities, proves how easy it is to get oneself arrested. About the year 1830 the Count made a bet with the Chief of Police of Vienna that he would get himself arrested without having done anything in the least reprehensible. He disguised himself as a vagabond and drank in a disreputable drinking shop a glass of brandy which he paid for with a genuine thousand gulden note; ten minutes afterwards he was arrested."

Thus it would appear that fifty years before Galton took his long walks by himself and made exact notes on the associated ideas which passed through his mind, a clever French nobleman was entertaining himself and his friends with practical association experiments. A contemporary Count Sandor would find it remarkably easy to get himself arrested by playing on police knowledge that

⁵⁵ Galton, F., "Psychometric Experiments," *Brain* 2:149-162 (1879); also, *Inquiries Into Human Faculty and Its Development* (1883) 182-203.

⁵⁶ Jung, C. G., "Diagnostische Assoziationsstudien," *Beitrage zur experimentellen Psychopathologie* (1906); "The Association Reaction Method," *Amer. J. of Psychol.*, 21:162-167 (1910).

⁵⁷ Galton, F., "Psychometric Experiments," *Brain* 2:162 (1879).

⁵⁸ Among the many early disciples of the association technique were (1) Edward Claparède, who wrote "L'Association des Idées" in Paris in 1903; (2) Charles Féré, author of "The Pathology of the Emotions" in 1899.

⁵⁹ Gross, H., *Criminal Investigation* (1907) 685.

a "n'er-do-well's" attire and thousand dollar bills do not make a logical association.

In 1908 Munsterberg⁶⁰ urged the practical application of the experimental methods of psychology, advocating the forensic application of the word association technique for diagnosing guilt. His efforts did much to stimulate further interest in the United States, and his published works are a source of much stimulation for all students of the lie. Indeed, in many ways his ideas for applying psychological principles have not been superseded.

About this same time in France, Duprat⁶¹ made application of some of the principles of association to the psychology of the lie and the classification of lie suspects. But Duprat was not satisfied with employing word associations alone and neglecting the personality of the lie-suspect. He believed that types of associations should be looked for which would indicate the affective tendencies of the individual. That is, we all perceive only that which interests us, and we respond to a dominant tendency. Our mental syntheses, including our mendacious inventions, are determined by fixed desires or repulsions. Thus each lie is based on a tendency. He reminds us of Ribot's idea: "All forms of the creative imagination imply affective (emotional) elements." Then he showed that there is a connection between those cerebral regions serving the emotional life and those serving ideation and imagination.

From this idea Duprat proceeded to set up a "type" conception of liars. (We mention it here because, contrary to the types of Harris, Robinson, and Plowden, it makes possible a technique for detecting liars.) Not only is there relation between tendencies, emotions, belief, and ideation, but this is exemplified further when we see a person of a certain temperament led into certain kinds of lies, "in proportion as that trait or temperament is more favorable to excitation or depression. A mendacious denial is easy to people of calm, apathetic, or melancholy disposition, given to slow movements. A mendacious affirmation is easy to persons inclined to rapid movements—to an activity, if not disorderly, at least multi-fold and varied. Literature has often drawn the contrast between these two opposed temperaments—the calm, cold one, and the lively daring one; and almost always the latter has been taken as the type of the liar. . . . But alongside of this temperament we must also

⁶⁰ *Op. cit. supra* note 24.

⁶¹ Duprat, G. L., *le Mensonge: etude de psychosociologie* (2nd ed., 1909).

point out its opposite, the smooth-tongued, soft-speaking personality, a radical enemy of truth, the type of hypocrites of all degrees."⁶²

Although Jung, Binswanger, Freud, and a host of others⁶³ utilized the technique of word-association in the practical applications of psychotherapy and psychoanalysis, they were not concerned with its utility in criminological investigations. Some experimentation of a casual nature was carried on, largely as demonstrations in psychology classes in several universities in the United States, and in 1920 Langfeld of the Harvard University Psychology Laboratory published a paper which demonstrated the value of word-association reaction time tests of deception.⁶⁴ In the same year Marston, who had been busy for five years developing the "discontinuous blood pressure test," advanced the theory⁶⁵ of the "negative type liar" who may not react. Marston's careful work at this time did much to emphasize the practicality of several tests proposed earlier by his teacher, Munsterberg.⁶⁶

In 1923 Goldstein⁶⁷ summarized her work in this field, and eight years later Crosland and Beck⁶⁸ described in elaborate detail their applications of the reaction-time experiment. Crosland was able to apply the association principle in concrete deception situations involving dishonesty of university students,⁶⁹ but the extreme complexity of his statistical calculations, involving forty criteria of guilt, was sufficient to frighten away most of the criminologists who were looking for objective measures of guilt. Although he showed the method to be statistically valid and reliable, he also demonstrated that there are other quicker means for determining the guilt of suspects. The continuous registration of blood pressure and pulse is especially suitable for police investigation, as indicated

⁶² For a more complete consideration of Duprat's treatment, refer to Wigmore, J. H., *The Science of Judicial Proof* (1937) 353.

⁶³ See bibliography in Jung, C. G., *Studies in Word Association* (1919).

⁶⁴ Langfeld, H. S., "Psychophysical Symptoms of Deception," *J. Abnorm. Psychol.*, 15:319-328 (1920).

⁶⁵ Marston, W. M., "Reaction Time Symptoms of Deception," *J. Exper. Psychol.*, 3:72-87 (1920).

⁶⁶ *Op. cit. supra* note 24. See also Münsterberg, H., "Die Psychophysische Grundlage der Gefühl," *Proc. Int. Cong. of Exper. Psychol.* (1892).

⁶⁷ Goldstein, E. R., "Reaction Times and the Consciousness of Deception," *Amer. J. Psychol.*, 562-581 (1923).

⁶⁸ Crosland, H. R., "Measurements of Emotion by a Method Which Combines the Word-Association, Reaction-Time Technique With the Psychogalvanic Technique," *Psychol. Bull.* 28:575 (1931); Crosland, H. R., and Beck, L. F., "Objective Measurements of Emotion," *Univ. of Oregon Publ., Psychol. Series 1* (3):129-202 (1931).

⁶⁹ Crosland, H. R., "The Psychological Methods of Word-Association and Reaction-Time as Tests of Deception," *Univ. of Oregon Publ., Psychol. Series 1* (1) (1929).

elsewhere, although Hunt, Landis and others have shown that an effective combination is the association experiment and the psychogalvanic skin response.⁷⁰

Perhaps the most effective use of reaction-time is in the modern polygraph technique, wherein split-second records of verbal or manual responses constitute only one of several indicators of emotional tension.

Blood pressure, pulse, and Respiration Measures

A variety of techniques have been developed for measuring blood pressure and pulse characteristics, but investigators are not in agreement as to exactly what is responsible for the changes observed. Some workers rely on blood vessel dilation and contraction, recording volume changes in a water or air medium joined to an actuating and recording device. Volume changes of the finger tip, of the hand, or of the forearm, are thus obtainable without applying excessive air or water pressure to the parts. Other workers rely on stricture of the vessels, enclosing a limited area of the upper arm, leg, foot, or wrist, in a hollow rubber cuff inflated with an air pressure equivalent (usually) to a mean blood pressure—a point midway between the systolic (maximum) and the diastolic (minimum) blood pressure. Attempts are thus made to tap such varying factors as venous and arterial pressure, venous and arterial volume, and dilatation and contraction of the tissues involved. Other cardiac measures include heat measurements of the blood as it courses through the veins or arteries, utilizing a thermocouple apparatus; electrocardiographic recordings; and tracings of the duration and latent periods of action currents of the heart.⁷¹

As we have already indicated, Munsterberg, Marston, and others have been recent workers in blood pressure tests for deception and their published works explain the criteria in use. A theoretical background for this work had already been prepared and the stage was set for practical application of existing tools, not only for examining blood pressure and pulse changes, but for tracing the significance of respiratory patterns.⁷² Marston, following the leader-

⁷⁰ 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).

⁷¹ Whitehorn, J. C., Kaufman, M. R., and Thomas, J. M., "Heart Rate in Relation to Emotional Disturbances," *Arch. of Neurol. and Psychiat.* 33:712-731 (1935).

⁷² Binet, A., and Vaschide, N., "Influence du travail intellectuel des émotions et du travail physique sur la pression du sang," *L'Année psychol.* 3 (1896); Lowinsky, V., "Zur Psychologie der wissenschaftliche Taueschung," *Zeit. f. Ange-*

ship of Munsterberg, published in 1917 the results of his specific work on blood pressure symptoms of deception.⁷³ Marston's work was carefully done and his zeal led gradually to application of the technique by other workers. The "discontinuous" technique of reading the systolic blood pressure, which he long favored over others, involves the often repeated inflation of a pressure cuff to obtain readings at intervals during an examination for deception.⁷⁴ His early work is noteworthy, and readily accessible to the student. However, such careful work as that of his early years is no longer seen in his recent publications and activities.⁷⁵

Benussi⁷⁶ reported in 1914 partial success in detecting deception by the "inspiration-expiration" ratio; that is, he measured the recorded respiratory curves from a pneumograph and found that if length of inspiration were divided by length of expiration the ratio was generally greater before truth-telling than afterwards, and greater after lying than before lying.

Burt, an earnest worker who early became interested in the work of Benussi, did considerable experimental work on respiratory patterns in deception. The publication of Benussi's study of inspiration-expiration ratios, led to partial confirmation by Burt of Benussi's idea that deceit could be detected in patterns of respiratory inhibition or lack of inhibition. However, even though Burt eventually devised mechanical means of speeding up the measurement of his graphs, he found that systolic blood pressure has a greater diagnostic value than breathing. In one series of simulated crimes, the interpretations of a lie about the crime were correct in 91% of the cases when blood pressure was the criterion; when breathing was the criterion the interpretation of a lie was correct in only 73% of the cases.⁷⁷ The two criteria were found to

wandte Psychol. u. Psychologische Sammelforschung," 8 (1914); Benussi, V., "Die Atmungssymptome der Lüge," *Archiv. f. d. ges. Psychol.* 31:244-273 (1914).

⁷³ Marston, W. M., "Systolic Blood Pressure Symptoms of Deception," *J. Exper. Psychol.* 2 (2):117-163 (1917).

⁷⁴ Marston, W. M., "Psychological Possibilities in the Deception Tests," *J. Criminal L. and Crim.* 11 (4):551-570 (1921); "Studies in Testimony," *Ibid.* 15 (1): 5-31 (1924).

⁷⁵ Marston, W. M., "The Lie Detector Test" (1938). For a critical review of this book see the review by Inbau, F. E., *J. Criminal L. and Crim.* 29 (2):305-308 (1938). The same issue of the Journal, on pp. 287-291, carries a critical survey of the legal admissibility of deception tests. The author is Jordan, H. W. For advertisements illustrating Marston's recent interests see *Time Magazine* (Oct. 17, 1938) 29, and *Look Magazine* (Dec. 6, 1938) 16-17.

⁷⁶ Benussi, V., "Die Atmungssymptome der Lüge," *Archiv. f. d. ges. Psychol.* 31:244-273 (1914).

⁷⁷ In this connection see Klemm, O., "Ueber die Atmungssymptomatik bei Untersuchungsgefangenen," *Neue psychol. Stud.*, 5 (1929). According to Ruck-

correspond appreciably more than half the time and when effort was made to quantify the measures the correlation was about 50%. In summary, Burt's study of inspiration-expiration ratios was, according to his own terminology, "inconclusive."⁷⁸

Larson, when a young medical student in the employ of Vollmer, Chief of the Berkeley, California, Police Department, read an article written by Marston on "Possibilities in the Deception Tests." This was in the spring of 1921. The blood pressure test excited his curiosity and he decided to do some pioneering work with it. He employed the test to discover losses in a girls' dormitory of the University of California, and his initial success in discovering the girl thief led him to carry the experiments into more detective work. Larson assembled a polygraphic apparatus in portable form and employed it extensively, under the enthusiastic encouragement of Vollmer. But, of course, this cannot be considered as an invention of a lie-detector.

Larson's many published reports are more available than those of some workers and he should be credited with doing more than many later workers to inform the public of the application of the deception test.⁷⁹ The value of these various contributions, extensive as they are, is not to be disputed; like the works of Lombroso, one sees in Larson's earnest efforts an honest desire to place the facts before an interested public and to educate them to accept the principles of a new development. With a record of more publications than any other worker in the field, Larson has assumed a commanding position. His readers, nevertheless, are sometimes in doubt as to his own confidence in the applicability of deception tests and of their future possibilities. His technique of questioning, explained by himself and others, is readily accessible to the average reader, and will not be elaborated upon here.

mick, Klemm worked "with six prisoners on trial, under well-controlled conditions, repeating Benussi's technique in connection with the ratio of respiration. His results do not confirm those of Benussi because the process of lying and truth-telling was overlaid with a variety of concomitant emotional attitudes which were equivocal in their total significance." See Ruckmick, C. A., *Psychology of Feeling and Emotion* (1936) 318.

⁷⁸ He has since made several contributions to the polygraph technique in the study of deception. Burt, H. E., "The Inspiration-Expiration Ratio During Truth and Falsehood," *J. Exper. Psychol.* 4:1-23 (Feb., 1921); "A pneumograph for inspiration-expiration ratios," *Psychol. Bull.* 15:325-399 (1918); "Further Technique for Inspiration-Expiration Ratios," *J. Exper. Psychol.* 4 (2) (April, 1921).

⁷⁹ See especially the following: Larson, J. A., "Modification of the Marston Deception Test," *J. Criminal L. and Crim.* 12 (3):390-399 (1921); "The Cardio-Pneumo-Psychogram and Its Use in the Study of Emotions, with Practical Applications," *J. Exper. Psychol.* 5 (5):323-328 (1922); "Lying and Its Detection,"

The work of Blatz in 1925⁸⁰ is pertinent to laboratory investigations of deception, although fear was the emotion which Blatz attempted to isolate. The study, made under Carr in 1925, was well-controlled and led to definite conclusions regarding simultaneous effects of sudden fear on heart, respiratory, and galvanic reactions. The technique was to drop a subject's chair suddenly backward, under varying conditions; the apparatus consisted in part of (1) a Hindle electrocradiograph, and (2) an electrical pneumograph. The latter was especially constructed with two magnets for separate measure of inspiration and expiration, and measured the beginning and duration of the two phases, but did not measure amplitude or latent periods. Time also was recorded. Blatz found that sudden arousal of fear, by falling, revealed (1) cardiac indices: immediate acceleration followed by decided retardation, then a less marked but more prolonged gradual retardation; initial increase in force of heart beat; marked irregularity of cardiac rhythm; (2) respiratory indices: immediately retarded rate in nine out of eleven records, an inspiratory stimulus during falling, in all cases; (3) electrical index: increased development of electromotive force. Other conclusions which he presents may interest the research worker, although some workers may wish to point out that later researches partially invalidate direct comparison between Blatz' fear criteria and the anticipatory fears involved in concealing the truth.⁸¹

Landis and his associates⁸² have developed, through the methods of Bonussi, Burt, Marston, and Larson, control studies on the effectiveness of the various blood pressure and respiration methods in detecting deceit. They experimented also with electrodermal responses, reaction-time, hypnosis, and scopolamine, and although they found the measure of systolic blood pressure the most diagnostic of all methods, they were only moderately optimistic about the "experimental evidence that deception can be detected by heart and breathing changes." "Just at present," they state, "and prob-

Univ. of Chicago Press (1932); "The Lie Detector: Its History and Development," *J. Mich. State Med. Soc.* (Oct., 1938).

⁸⁰ Blatz, W. E., "The Cardiac, Respiratory, and Electrical Phenomena Involved in the Emotion of Fear," *J. Exper. Psychol.* 8 (2):109-132 (1925).

⁸¹ A fundamental analysis is that of Darrow, C. W., "Differences in the Physiological Reactions to Sensory and Ideational Stimuli," *Psychol. Bull.* 26 (4):185-201 (1929).

⁸² Landis, C., and Gullette, R., "Studies of Emotional Reactions: IV. Systolic Blood Pressure and Inspiration-Expiration Ratios," *J. Compar. Psychol.* 5:221-253 (1925); Landis, C., and Wiley, L. E., "Changes of Blood Pressure and Respiration During Deception," *J. Compar. Psychol.* 6:1-19 (1926); Landis, C., "Detecting the Deceiver," *Indust. Psychol.* 244-249 (May, 1927); Landis, C., "Blood Pressure Changes in Deception—A Reply," *J. Compar. Psychol.* 10 (4):437-439 (1930).

ably for several years to come, the practical significance of this evidence will be of somewhat questionable importance."⁸³

The controversy which developed between Landis and Chappell⁸⁴ led to a reanalysis of the nature of the blood pressure responses and a critical inspection of terminology. Chappell summarized his own findings as follows: "(1) The continuous method developed by Larson and later used by Landis does not record or indicate any known blood pressure; (2) The apparatus (of Larson and of Landis) is a high pressure plethysmograph and, as such, may cause venous rupture; (3) The volume and the pressure changes in the arm are relatively independent, and one may not be used as an index of the other."

In a personal communication to the author, Chappell recently stated that in an experiment made under his direction for a college thesis, comparisons were made of the so-called continuous method used by Larson and Landis, and simultaneous readings of the can type plethysmograph, with the result that there appeared no more comparison between the readings than he had previously found between lateral or systolic pressure and the continuous readings. Terminology, however, may safely be neglected at present and so long as we agree on the significant indices of deception.

Many investigators who use a polygraphic method for criminal interrogation insist that an exact indication of absolute systolic or diastolic pressure is not needed; that for all practical purposes it is the relative changes which occur as one proceeds from insignificant to crucial questions that are the criteria of deception. Nevertheless, Darrow, of the Institute for Juvenile Research of Chicago, who occupies a preeminent position in the polygraphic determination of physiological changes, including blood pressure, has demonstrated a way of determining absolute readings which would eliminate the complicating factors of inflation and release of air pressure.⁸⁵

Aside from argumentation about the value of absolute blood pressure readings in deception one of the outstanding deterrents to

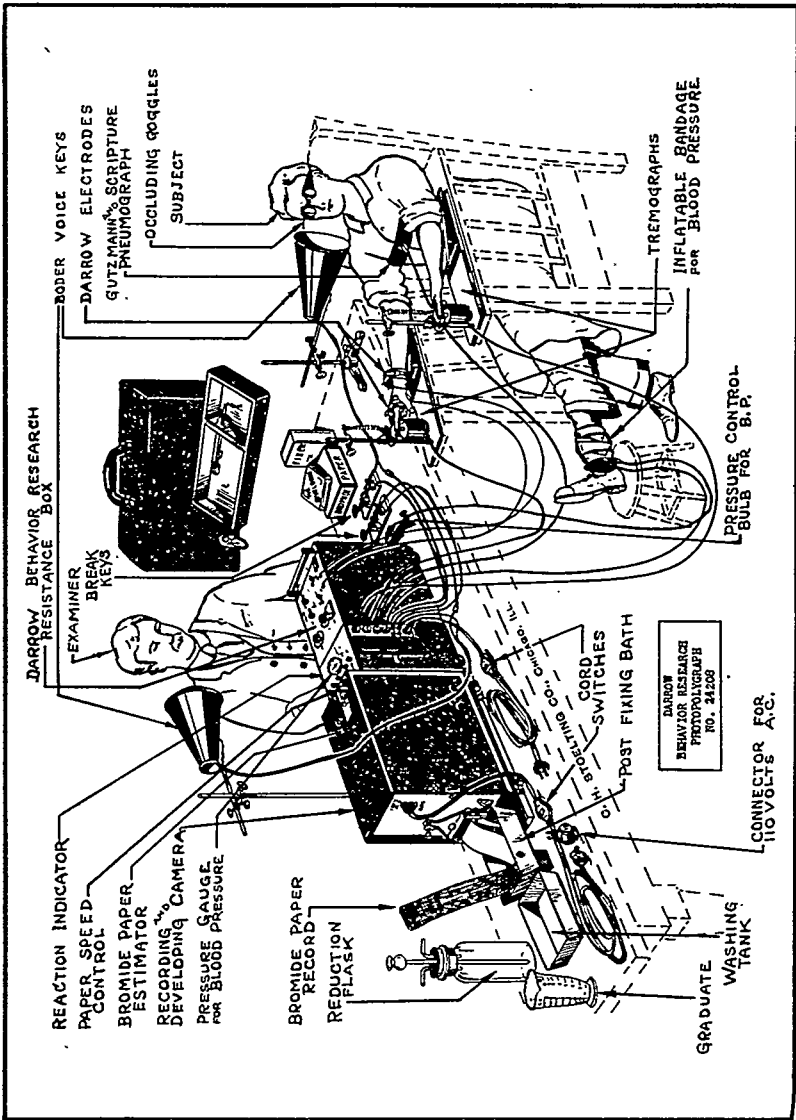
⁸³ *Supra* note 82, "Detecting the Deceiver," 244-249.

⁸⁴ *Op. cit supra* note 82, "Blood Pressure Changes in Deception." Chappell, M. N., "A Comparison of Blood Pressure Methods," *J. Genet. Psychol.* 39:398-403 (1931).

⁸⁵ Darrow's method for determining absolute pressure is described in his "Continuous Records of Systolic and Diastolic Blood Pressure," *Arch. Neur. and Psychiat.* 38:365-370 (1937). See also C. T. McCormick's review of some of the tests for deception current in 1927, for he calls attention impartially to certain inherent weaknesses in the methods. *Infra* note.

Figure 6

The "Behavior Research Photopolygraph" devised by Darrow, of the Institute for Juvenile Research, in Chicago, is here shown in a diagram (furnished through the courtesy of the distributor, C. H. Stoelting Co., Chicago). This apparatus records photographically the galvanic skin reflex, blood pressure, pulse, respiration, signal marks, time between verbal stimulus and verbal response, involuntary tremors of one hand and voluntary reactions of the other hand (as it is keyed to the subject's verbal responses). The "tremographs" for the hands were designed to record the reactions described by Alexander Luria of Moscow. The Stoelting Co. reports that a ground glass observation screen permits the observer to watch the movements of all indicators during the photographic recording.



research in deception by academic workers is inaccessibility of criminal suspects. Bryan pointed this out in a master's thesis at Columbia University in 1930.⁸⁶ Due to the relative inaccessibility of this work, we present here some of the highlights of her research. She used a Tycos sphygmomanometer attached to a Becton Dickinson mercury manometer with a millimeter scale, together with a conical stethoscope. Employing the auscultatory method, she attempted to extend and check Chappell's work. Although she used only thirty-two young women as subjects, she shows an acute discernment of complicating factors. Feeling that Chappell had erroneously introduced an element of "rivalry" by deliberately stimulating some of his subjects to beat him at his own game, she decided to try to measure rivalry-free or "unemotional" deception. When she had finished she had to confess that she believed there may be no such thing as "unemotional lying," and therefore that not only her experiments but also those of Chappell and of Landis and Gulette, were unsuccessful in inducing deception. (Chappell reported 87% accuracy in blood pressure measures of deceit, and Bryan, 69% accuracy.) Those who are compelled to use an academic laboratory for research in deception, without the availability of criminal suspects as subjects, might be interested in first consulting Bryan's thesis, for she admirably illuminated some of the worst pitfalls.

The former Scientific Crime Detection Laboratory of Northwestern University School of Law—now a unit of the Chicago Police Department—founded at the same time Bryan was writing her thesis,⁸⁷ was fortunate in having an opportunity to try out current tests on hundreds of criminal suspects. Keeler, who had gained first-hand experience as a high school student with the polygraph interrogations of Larson in the Berkeley Police Department and who subsequently devised, with the assistance of Woolsey and Miles of Stanford University, an improved polygraph of his own, was then (1930) with the Institute for Juvenile Research in Chicago. He became a member of the staff of the Laboratory, and for eight years utilized the blood pressure, pulse, and respiration patterns for detecting criminal guilt.⁸⁸ He and his former associates,

⁸⁶ Bryan, Alice I., "Blood Pressure Deception Changes and Their Use as an Index of Personality," M. A. Thesis (Psychology Dept.), Columbia Univ. (1930).

⁸⁷ A vivid description of the events leading to the foundation of this Laboratory in 1930, with photographs, is that of its first director, Calvin Goddard, in "The Valentine Day Massacre: A Study in Ammunition Tracing," *Amer. J. Police Science* 1 (1):60-78 (1930).

⁸⁸ Refer to section on the psychogalvanometer for review of the Laboratory's use of electrodermal reactions.



FIGURE 7

In this photograph of a test situation (in the acoustically treated interrogation room of the Chicago Police Scientific Crime Detection Laboratory) the writer and an office employee, Miss Hilleve Lantz, demonstrate the application of apparatus to lie-detection. The Keeler Polygraph unit appears in the foreground, the right-hand man facing the apparatus.

Wilson and Inbau, reported success in diagnosing deceit in experimental cases 85% of the time, and in obtaining confessions from criminal suspects in 75% of the cases in which the polygraph records indicated deception.⁸⁹

Keeler, like Larson and others, did not invent a lie-detector. He modified existing apparatus to be applied to the discovery of emotional complexes. His position is that:

"To begin with, there is no such thing as a 'lie-detector.' There are no instruments recording bodily changes, such as blood pressure, pulse, respiration, or galvanic reflex, that deserve the name 'lie-detector' any more than a stethoscope, a clinical thermometer, or a blood count apparatus with a microscope can be called an 'appendicitis detector.'

"However, deception, guilt, or innocence can be diagnosed from certain symptoms just as appendicitis, paranoia, or any other physical or mental disorder can be diagnosed. In every case, the examiner must make his diagnosis from tangible symptoms, using whatever mechanical aids he has at his disposal."⁹⁰

Keeler's instrument,⁹¹ as did Larson's, records relative changes in blood pressure, pulse, and respiration patterns. The inked record issues continuously from a drum driven by a synchronous motor. Volume changes within a blood pressure arm-cuff and a pneumograph tube circling the chest of the subject are transferred in heavy walled rubber tubes to the flexible metal stacks constituting the tambours. Mechanical actuating devices connect the tambours to small fountain pens. The chief difference between Keeler's apparatus and that of Lee, described below, is in the tambour and actuating mechanism. Both instruments, now improved through several years of revision, are durable and adapted to continuous usage.

The contributions of Keeler to the psychological science of criminal-interrogation are of far-reaching importance. The training he has given students in his own technique of investigation constitutes an effective share in the contributions made to the field of new police science. Of particular importance is his method of re-

⁸⁹ Keeler, L., "A Method for Detection Deception," *Amer. J. Police Science* 1 (1):42 (1930); Inbau, F. E., "The 'Lie-Detector,'" *Scientific Monthly* 40:83 (1935).

⁹⁰ Keeler, L., "Debunking the 'Lie-Detector,'" *J. Criminal L. and Crim.* 25 (1):153 (1934).

⁹¹ Keeler, *op. cit. supra* note 89 at pp. 40-44. Keeler's was the first such instrument to make use of metal tambours; their use produced a pressure curve, the changes in which were proportional to the blood pressure changes of the body. This desired result could not be obtained with the earlier Marey tambours used in conjunction with rubber diaphragm pressure reducers.

checking the responses of suspects by one or more control tests. In any scientific endeavor control tests are now considered essential; for the field of criminal investigation, Keeler and associates have consistently employed, with suspects, such control tests (with the polygraph) as the card test and other "peak of tension" tests, designed to disclose otherwise unknowable factors of criminal guilt.

Physicians continue to make mistakes in diagnosing illness. They err sometimes in taking blood pressure readings. It is the same with operators of polygraphs. Mistakes, however, provided they be relatively few in number, deter neither the physician nor the lie expert.⁹² In the former Scientific Crime Detection Laboratory of Northwestern University, for example, 2171 subjects were examined on the polygraph between January 1, 1935, and June 1, 1938. Of this number twelve mistakes in diagnosis of innocence or guilt have been verified. Of this total, therefore, the errors amount to five hundredths of one per cent; if the errors were ten times this number, and eventually they may be found to be, they would still be a relatively small proportion of the total.

Lee, a former Captain of Detectives of the Berkeley, California, Police Department, was especially interested in the work of Larson and others and by 1936, after several revisions of apparatus (including experimentation with an electrical system for recording pulse waves), he was able to develop improved instrumentation for pneumatic transmission of pulse waves, blood pressure changes, and respiration. Although Lee is not in a position to carry on research in interrogation, several Lee Polygraphs are employed in routine investigations of deceit.

Lee's apparatus is employed by Lyon in his examination of juvenile delinquents at the Chicago Juvenile Detention Home, connected with the Institute for Juvenile Research. Lyon, long a staff member of the Institute, employs polygraphic tests for deception in conjunction with other psychological tests.⁹³ In his work, an exceptional and a unique situation exists, whereby the results of his tests for deception are considered by the judge of the Juvenile Court, along with all other evidence involving the delinquent child.

⁹² The technique used in an early case is reported in detail by L. Keeler in "The Canary Murder Case," *Amer. J. Police Science* 1 (4):381-386 (1930); see also an article by a Wichita (Kansas) police investigator employing the Keeler Polygraph: Jaycox, T. H., "Scientific Detection of Lies," *Scientific American* 156:370-373 (June, 1937); and "Wichita's Use of the 'Lie-Detector,'" *American City* 51:91 (Dec., 1936).

⁹³ Lyon, V. W., "New Deception Tests," *Police* 13-13 (Mar., 1935) 11; "Deception Tests With Juvenile Delinquents," *J. Genet. Psychol.* 48 (3):494-497 (1936).



FIGURE 8

The "Berkeley Psychograph," or Lee Polygraph, is a compact, portable unit. It has a novel arrangement of rubber tambours, and a manually operated stimulus-response key. In this picture can be seen the pens for recording respiration, blood pressure and pulse, and stimulus-response. The pressure cuff is at the right, the pneumograph tube for receiving respiration changes is in the foreground, and behind it is the hand bulb for inflating cuff, and to the rear of this is the stimulus button.

(For this particular court the conventional rules of evidence do not apply and therefore no legal question arises regarding the admissibility of the test results.) In this manner, the evidence may include psychological tests, data gathered in informal interviews, medical and psychiatric examination.⁹⁴ Fifty per cent of Lyon's cases involve sexual delinquencies.

Many police departments throughout the United States now employ one polygraph or another in investigation of criminal suspects.⁹⁵ The accompanying photographs illustrate several modern

⁹⁴Larson, J. A. (now of the Detroit, Michigan, Recorder's Court) is likewise engaged in many applications of the polygraph technique to delinquency, personality disorders, and crime. See Larson, J. A., Canty, A., and Broom, C., "La Verdad Acerca Del Indicador De Mentiras," *Archivos Chilenos de Criminologia* (1938) 58-65. See also, Selling, L. S., "The Medico-Legal Aspects of the Polygraph or 'Lie-Detector'," *J. Mich. State Med. Soc.* 37:897 (1938).

⁹⁵As an indication of the trend toward the application of the polygraphic

instruments applicable to the measurement of deception, although a number of others are available.

Wigmore, McCormick, and Inbau have commented upon the admissibility of "lie-detector" evidence in court. Wigmore has pointed out that the legal status of such evidence is dependent upon the degree of recognition accorded the instrument and the technique in the field of science. In discussing the general application of psychology in law and legal proceedings, Wigmore states that "The courts are ready to learn and to use, whenever the psychologists produce it, any method which the latter themselves are agreed is sound, accurate and practical." But, "There must first be proof of general scientific recognition that they [the methods] are valid and are feasible."⁹⁶ We know, of course, that such recognition has not yet been accorded scientific methods for detecting deception. And, primarily for this reason, the courts have consistently refused to accept the results of tests of this nature.

McCormick, summarizing the results of a questionnaire he sent to eighty-eight members of the American Psychological Association in 1926, indicated that "The scientific view being still one of suspended judgment, the courts must obviously wait for further verification and wider acceptance of the validity of these tests before

apparatus in police investigation and research in emotions, this list of polygraph users is significant:

(1) The Keeler Polygraph. Some of the police organizations using it are: The police departments of Wichita (Kansas), Cincinnati (Ohio), East Cleveland (Ohio), Chicago (Illinois), Indianapolis (Indiana), Toledo (Ohio), Buffalo (New York), Evanston (Illinois), Kansas City (Missouri), Berkeley (California); the state police of Michigan, Indiana, Pennsylvania, and Rhode Island; and the Department of Justice, Washington, D. C.

(2) The Darrow Photopolygraph. This is being used at the Juvenile Research Institute of Chicago where it was developed; for police investigation at the Recorder's Court, Detroit (Michigan); and for investigations of emotions at Western Reserve University; University of Kentucky; University of Chicago; the Department of Mental Hygiene of the Polish government in Warsaw, Poland; the Federal Penitentiary of Lewisburg, Pennsylvania; Narcotic Farm, Lexington, Kentucky; Randolph Aviation Field; Tsinghua University, Peiping, China; University of Missouri; and the Psychopathic Hospital of Blackfoot, Idaho.

(3) The Berkeley Psychograph. Now in use in the police departments of the cities of Honolulu, St. Paul, Ft. Worth; in the Oregon State, New Jersey State and Texas State (Rangers) Police Departments; in the Cuban Government; in the Recorder's Court, Psychopathic Clinic, Detroit; in the Recorder's Court, Traffic Violators' Clinic, Detroit; in the Juvenile Court of Cook County, Ill.; in the University of Oregon; and the Police School of San Jose State College, San Jose, California. In addition it is employed by such psychologists and criminologists as George Lacy of Houston, Texas; L. J. Leonard of Minneapolis, Minn.; Wm. Moulton Marston of Rye, N. Y.; V. A. Leonard of Ft. Worth, Texas; Howard G. Robinson of Newark, Ohio; and T. G. Cooke of Chicago.

⁹⁶ Wigmore, J. H., *Evidence* (2d ed., 1923) 2:3875. See also Wigmore, J. H., *The Science of Judicial Proof* (2d ed., 1937) 450.

relying upon their results as evidence."⁹⁷ His review of the status of deception tests is one of the most open-minded and encouraging comments upon the current scene.

Inbau, a lawyer with scientific training and experience, who for five years was an associate of Keeler, and who is now Director of the Chicago Police Scientific Crime Detection Laboratory, has expressed the following opinion upon the subject:

"The possible 'complications and abuses' constitute a constant source of concern on the part of those persons actively engaged in this field. They realize, from the data and information already at hand, that the results of a detection of deception test with a suitable instrument recording pulse wave, blood pressure and respiratory changes, and perhaps other physiological reactions, when conducted and interpreted by a competent and honest individual are worthy of consideration as evidence for or against the defendant in a criminal trial, but they also realize, and only too well, that once given unlimited judicial approval the entire field immediately lends itself to prostitution by unethical and incompetent examiners. The fact that the method is nothing more nor less than a diagnostic technique, the value of which depends to a very considerable extent upon the competency of the examiner, and certainly to the same degree upon his integrity, entirely justifies the conservative position taken by the courts. In this field, more than in any [other phase of scientific evidence], the remuneration for quackery is unlimited. With this consideration in view, it is proposed that there be only a conditional and restricted use of an instrument of this nature for court purposes—at least for the time being, and perhaps for quite some time to come. The prerequisite to the admissibility of such evidence should be a stipulation or agreement between counsel or prosecution and defense, made prior to the expert's examination, that the results and the expert's interpretation thereof are to be admitted without objection and regardless of whether they favor the cause of prosecution or defense. This, of course, presupposes an agreement between counsel upon the expert himself. In this way the probability of incompetent and unethical practices would be reduced to a minimum."⁹⁸

[*To be concluded in next issue*]

⁹⁷ McCormick, C. T., "Deception Tests and the Law of Evidence," Calif. L. Rev. 15:484 (1927).

⁹⁸ Inbau, F. E., "The Admissibility of Scientific Evidence in Criminal Cases," Law and Contemporary Problems (Oct., 1935) 502. The admission, as evidence, of deception, tests, is well covered in the following papers by Inbau: "Scientific Evidence in Criminal Cases. II. Methods of Detecting Deception," J. Criminal L. and Crim. 24 (6):1140-1158 (1934); "Detection of Deception Technique Admitted as Evidence," *Ibid.* 26 (2):262-270 (1935); "Self-Incrimination—What Can an Accused Person Be Compelled to Do?," *Ibid.* 28 (2):261-292 (1937).