

Deception-Tests and the Law of Evidence¹

"The best test of truth is the power of the thought to get itself accepted in the competition of the market Every year if not every day we have to wager our salvation upon some prophecy based upon imperfect knowledge."—*Mr. Justice Holmes.*

FEW of us would doubt, or need any evidence other than experience, that conscious lying produces in the ordinary man emotional disturbances. These may be thought of by the liar as shame, fear, embarrassment, or the like. Whether or not they are anything more than objective physical changes in the body, it is clear and all-important for our present purposes that these physical changes in the functioning of the body do occur whenever the subject would describe himself as afraid, ashamed, or embarrassed. These bodily changes are very far-reaching. Seemingly one of the first in the series of changes is the release by one or more of the internal glands of secretions (adrenalin, for example) into the blood-stream. This secretion, as it is carried to the heart, the lungs, and the superficial blood-vessels, brings about notable changes in the functioning of these parts of the human mechanism.² When the face of a person observed turns pale, or his breath comes quickly, or he swallows repeatedly, or his voice trembles or assumes an unnatural tone, or he breaks out in a "cold sweat," the existence of emotion is apparent to us laymen. Observation and, again, introspection teach us that frequently these latter outer visible signs of inner disturbance do accompany conscious lying. So much so, that if no other cause than lying appears for the emotional changes, we think them strongly persuasive that one who accompanies his assertion with such demeanor is a liar, and the truth is not, to this extent, in him, or if in him has not found an outlet.

So also we know, or think we know, from the experiences of living, that one who fabricates a conscious lie in answer to a question for which he has not prepared in advance, takes more time before

¹ The substance of this paper was given as a part of the proceedings of the remedies section of the Association of American Law Schools at the meeting held December 30, 1926. The supporting investigation has not been carried beyond that date.

² *Op. cit.*, Appendix, xxx, p. 15, citing W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage* (N. Y. 1915).

replying than one who, speaking truth, feels free to answer unguardedly.

Judges and juries habitually and with sanction of law consider and give weight to their interpretation of these changes of appearance, expression, voice, respiration, etc., in passing judgment of truth or falsity upon the witness' testimony.³ Obviously such an interpretation must be a crude and inaccurate one, for which the courts have developed no rules or science, nor could they be expected to do so.

If, on the other hand, the psychologists have worked out a scientific method by which these emotional indicia may be adequately evaluated and interpreted, so as, with substantial accuracy, to identify conscious lying as such, there is every reason why the courts should welcome the scientists' measurement and analysis of those factors which the courts have, for want of some better test, been accustomed to use as the basis for rough guess-work.

Is there such a scientific technique? To be adequate it would need, seemingly, (a) to isolate the emotional changes produced by conscious lying or concealment of truth from similar changes flowing from other causes, such as fear or excitement produced by the test itself, and (b) to identify the lying statement by its connection with the significant emotional reaction.

In the seventies and eighties, beginning with Francis Galton and Wundt, scientists commenced the active exploration of a fertile field of research, the field of association experiments. One of the methods used was the "free association-test." This of course consists usually in calling off to the person tested a list of words and requiring him after each word called to give as a response the first word that comes to his mind. The analysis of the character of these responses has been the constant and fruitful source of much psychological discovery. From it as a chief source has emerged the science, or pseudo-science, of psycho-analysis, for example.

But it was not for two decades after the first active use of such association-tests that their direction was turned towards the discovery of guilt or deception in testimony. Wertheimer and Klein in Austria in 1904, and Jung in Switzerland in 1905 suggested such use. The methods suggested were these: in the series of stimulus-words, designedly neutral in character, used to evoke the responses, were interspersed certain "key" or "crucial" words (as "strychnine," "dagger,"

³ Wigmore, *Evidence* (1923, 2d ed.) §§ 273, 274, 946, 1395(2); *Boykin v. People* (1896) 22 Colo. 496, 45 Pac. 419, 34 A. L. R. 147.

"diamond") pointing to elements of the crime, or fact inquired into. The responses to the crucial words were studied chiefly in two aspects. First, qualitatively, i.e., the response-word would be minutely analyzed as to whether from it could be traced some, perhaps hidden and obscure, indication of knowledge by the person of the fact inquired about. Second, and more objectively, the time-intervals between the crucial words and their responses were compared with the corresponding intervals between the neutral or non-significant words and their responses—the so-called "reaction-time method." Naturally it was inferred that where there was a knowledge of the facts which would prompt a significant response to the key-word, the time necessary to reject the first response and invent another not revealing knowledge of the crucial facts would be greater than in the case of the innocent and uncontrolled response to the neutral word.⁴

As most of us recall, these methods were sensationally championed by Professor Münsterberg of Harvard a few years after their first suggested application to the testing of the veracity of witnesses, when in 1907 and 1908 he issued a series of popular magazine articles on the subject and published his book, "On the Witness Stand".⁵ He likewise sharply arraigned the legal profession for its failure to make use of these methods. But in 1909 Dean Wigmore answered the attack by a humorous but powerful article,⁶ in which he smashed the thesis of Dr. Münsterberg by pointing out the recency of the discovery of the technique suggested, its want of sufficient verification by experiment, and the general opinion of psychologists themselves that it was not ripe for court-house use. More specifically, and by way of counter-attack, he assailed the accuracy of these methods. He thought them dependent too largely upon the individual vagaries of judgment of the person who determines that the responses are or are not significant of guilty knowledge. Likewise he denied the practicability of their use as against criminal defendants, in that the accused could not be compelled to submit to the test without infringing the constitutional privilege against self-crimination, and that no guilty man would waive the privilege. Obviously, it was the first objection, that the tests were being picked before they were ripe, that was offered as the principal one, for the fact that the individual skill and judgment and even intuition of the operator condition the

⁴ See *op. cit.*, Appendix, i, p. 410, and *op. cit.*, Appendix, xx, pp. 4, 5, for summaries of the history of the tests.

⁵ *Op. cit.*, Appendix, v.

⁶ *Op. cit.*, Appendix, i.

success of the tests is not conclusive against them any more than it is against the operation for appendicitis, and, as to the objection for the want of practicality, subsequent experience tends to show, as we shall see, that even a guilty man hesitates to refuse to take such a test.

Dean Wigmore's counterblast did not, and of course was not designed to, check the progress of the psychological experimentation in deception-tests; but on the contrary his controversy with Münsterberg seems to have stimulated interest, scientific as well as popular, in the subject. It seems to have caused, or at least been followed by, two distinct tendencies of the scientists. In the first place, they are inclined to be ultra-cautious in asserting the availability of their technique in legal proceedings, and in the second place they have concentrated upon more objective and mechanistic methods, and have sought to measure and interpret definite bodily changes, rather than to build inferences upon hypothetical hidden meanings of response-words or upon hesitation in responding.⁷

Illustrating this latter tendency is the work of Benussi,⁸ announced in 1914, who developed the plan of observing and measuring the breathing of the person examined when the crucial or key words were given. His rather complicated technique involved the ascertainment of the ratio of the time of intake of breath to the time consumed in breathing out, called the inspiration-expiration ratio. He found that where the response is false the intake and out-breath are more nearly of the same length (the "gasping" effect) after the response, whereas if truthful, the incoming and out-going breaths are more nearly the same in length before the response.⁹ Using a technique similar to Benussi, Dr. H. E. Burtt, of Ohio State University, confirmed his results to the extent of showing that there was some correspondence between this ratio and falsehood. His experiments were performed with students who were given cards with certain symbols (circles,

⁷ The unreliability of the association-word and reaction-time method advocated by Münsterberg was disclosed by elaborate experiments made by Dr. H. W. Crane, now of the University of North Carolina. He had certain of a group of University students perform secret mysterious "stunts" calculated to give a feeling approaching guilt. Though previously entertaining high hopes of these tests, he was unable to detect by them, with any useful degree of dependability, the "guilty" from the "innocent." *Op cit.*, Appendix, x.

⁸ V. Benussi, *die Atmungssymptome der Lüge* (1914) 31 *Archiv für der gesamte Psychologie*, 244-273.

⁹ See *op. cit.*, Appendix, xvii, p. 1, and *op. cit.*, Appendix, xix, p. 17. ("Benussi states that this change is due to the fact that after falsehood the innervation of the inspiration is relatively stronger than it is after truth. That is, we gasp slightly after lying.")

squares, etc.) imprinted on them but differently arranged on each card. Some of the cards were so marked as to show that questions concerning them were intended to be answered falsely, but which cards were so marked was unknown to the questioner and to the audience. The student was instructed to lie about these cards, but to give truthful answers to all the rest, and the "game" was for the questioner and the audience to ascertain which cards he had lied about. Similarly, accounts of imaginary crimes were prepared, as to which the student could either "lie," i.e., draw on his imagination when asked questions about incriminating "facts," or "tell the truth," i. e., give the explanation to each fact provided along with the description of the crime, if he held a "truth" card. Again the questioner and the audience were ignorant whether the particular card containing the crime was a "lie" or a "truth" card. With the symbol card, the breathing-ratio correctly diagnosed truth or falsity in seventy-one per cent of the cases. With the "crime" cards, it correctly diagnosed in seventy-three per cent of the cases, whereas it is interesting to note that a "jury" who watched the witnesses was able from their observed demeanor to detect truth or falsity correctly in only forty-eight per cent of the cases.¹⁰ Nevertheless, it is apparent that the percentage of correct judgments with the breathing-test as sole criterion is not remarkably high, though presumably it might yield more significant results if actual instead of make-believe states of facts and crimes were inquired about where the stake of the witness in some result would give him greater emotional tension. In making these experiments, however, Burt likewise, for purposes of comparison, used another deception-test, now to be described, which gave a much higher percentage of correct results, to-wit, ninety-one per cent.¹¹

This method is that of measuring the effects of heart-action, such as changes in the rate of pulse or in blood-pressure. It was early suggested by Ferri and Lombroso.¹² But the pioneer in its development by actual experimentation, in this country at least, is Dr. W. M. Marston, who is unusually qualified in being both a psychologist and a member of the bar. In 1915 at Harvard, working under Professor Münsterberg, he was able to detect deception by noting changes in blood-pressure. He describes his method as follows: "The sphygmomanometer (instrument used to measure blood-pressure) is attached to the subject's left arm above the elbow, the subject seated

¹⁰ *Op cit.*, Appendix, xvii.

¹¹ Landis and his co-workers, however, got better results with the breathing measurement than with blood-pressure. *Op cit.*, Appendix, xix, xx.

¹² *Op. cit.*, Appendix, i, p. 410, n. 20.

comfortably before a table with his left arm resting on the top within easy reach of the operator, who then proceeds to take the subject's blood-pressure from time to time while the witness is being cross-examined either by the blood-pressure operator, or, preferably, by a second operator who may be called the examiner. The effectiveness of the test depends almost entirely upon the construction and arrangement of the cross-examination and its proper correlation with the blood-pressure readings, a system of signals between examiner and b. p. operator being necessary. Other tests of the nature of which the subject is ignorant, as well as periods of rest and series of questions upon irrelevant and indifferent subjects are also interjected into the examination of the subject in such a way as may, in each particular case, best enable the operator to determine the normal blood-pressure plus the fixed increase presumably present throughout the whole examination due to the excitement caused by the test or by court procedure. The form of the blood-pressure curve as correlated with the cross-examination is then carefully studied by the operators, and is found to indicate with surprising accuracy and minuteness the fluctuations of the witness' emotions during the tellings of the story. It was found that in the cases of actual defendants it was of great practical advantage to request the person to tell his entire story first in his own way without either prompting or questions from the examiner. Irrelevant matter was next imposed, and the cross-examination could then be built up with great effectiveness upon the elements of the defendant's own voluntary story."¹³ The importance of the individual skill in cross-examination of the person giving the test is apparent from this quotation. The possibilities of the method so appealed to the National Research Council that Dr. Marston while in the army was encouraged to continue his experiments. Using simulated crimes he tested thirty-five soldiers. He was able to form correct judgments in ninety-four per cent of the cases. Other soldiers untrained in the method were able to use it to perform correct judgments in seventy-four per cent of their attempts.¹⁴ He likewise gave his technique the acid test of application to actual offenders. In Boston he examined twenty persons arrested for minor offenses, such as drug-using, liquor-selling, prostitution, drunkenness, and reported that his judgments as to the truth or falsity of the statements made by these petty criminals, based upon blood-pressure fluctuations, were

¹³ *Op cit.*, Appendix, viii, pp. 553, 554.

¹⁴ *Op. cit.*, Appendix, viii, pp. 567-569.

one hundred per cent accurate.¹⁵ The Psychology Committee of the National Research Council on the face of these results recommended that they be tried out in practical use by the Army Intelligence Department, but this was never done.¹⁶ In 1919-1921, in studying the effects of emotion upon blood-pressure, without special reference to deception, he concluded that the range of fluctuation of blood-pressure in women is much greater than in men,¹⁷ and that rises in the blood-pressure of men, though less in range, persist longer than in women,¹⁸ and, curiously enough, that women are comparatively more responsive to anger and less to fear than men. He suggested, therefore, that the interpretation of blood-pressure changes must allow for sex difference.¹⁹

One of the most important results of the pioneer work of Marston was the adoption and refinement of his method by a later worker, Dr. John A. Larson. He conceived the idea of combining those of the tests which he deemed the most practical and reliable by concentrating them all upon the supposed liar at the same time and securing a continuous graphic chart of the result.²⁰ Under his plan the subject—victim, I had almost said—is given a series of questions, some indifferent, some bearing on the crucial facts inquired into, all calling for "yes" or "no" answers. In addition, a series of association-words

¹⁵ The following is an example of his case reports:

"CASE No. 17. MAN (WHITE). AGE 46 YEARS

"Record of case given to examiner previous to Deception Test.

"White, 46 years of age. Defendant arrested for larceny. (Examiner given no further details.)

"B. P. Judgment.

"Although defendant tells most improbable story about having found a pair of shoes in the hold of ship whereon he was working, B. P. shows his story to be clearly truthful.

"Verification.

"Police discover that several other longshoremen, working on the same ship (which was being loaded with relief supplies for Halifax), had been systematically stealing the supplies and it was further found that one of these men had taken the shoes in question, but had been obliged to drop them into the hold in question to avoid detection. Defendant's companions testified that he was badly intoxicated at the time he took the shoes and that he shouted up to the foreman in charge of the crew that he had found a pair of shoes in the elevator pit. Defendant has no criminal record and Officer C., who has known defendant for eight or nine years, testifies to his previous good character and clean record, both at Eastport, Me., and in other ports." —Op. cit., Appendix, viii, p. 564. The verification of the correctness of his judgments was often rather insubstantial as in case 16. Op. cit., Appendix, viii, p. 564.

¹⁶ (1919) 26 Psychological Review, 134-136.

¹⁷ Op. cit., Appendix, xxi, pp. 409-411.

¹⁸ Op. cit., Appendix, xxi, p. 412.

¹⁹ Op. cit., Appendix, xxi, p. 414.

²⁰ The method is described in op. cit., Appendix, vi, p. 622, and op. cit., Appendix, xviii, p. 261.

with "key" words interspersed are also given,²¹ and the subject called upon for response-words as under previous methods. During the examination instruments are attached to the person examined which register and trace in three separate lines, arranged parallel to each other on a continuous strip of paper, first, the course of fluctuation of the rate and volume of breathing; second, the reaction-times, i.e., interval between word or question and the subject's response; and third, the variations in the blood-pressure. The strip, which may be thirty to fifty feet long, dependent on the length of the examination, is marked so as to reveal at which point the particular words or questions were given, and then forms a graphic continuous²² record of changes in heart and lung action, and in speed of response, of the person during the course of the test. Rises in blood-pressure and irregularities in breathing and reaction-times are (judging by the specimens reproduced as illustrations to Larson's articles²³) quite apparent on inspection to the layman. While retaining the breathing-curve as a check, Larson seems to omit in his later tests the association-words and the records of reaction-time, and places his chief reliance upon the blood-pressure curve. With his method, called in police parlance the Berkeley Lie Detector, and by Dr. Larson the Cardio-Pneumo-Psychogram, or Polygraph, Dr. Larson has carried the deception tests from the necessary first state, of experiment upon artificial "make-believe" guilt and lying, to actual application to the stories of those actually charged with murder, robbery, burglary, larceny and the like. What Marston tried upon a few petty offenders, Larson has for several years done by wholesale upon hundreds of suspects, juvenile delinquents, and convicted criminals. His first work was done in the Research Department of the Berkeley, California, Police Department, and for the past several years in the Department of Public Welfare of the State of Illinois. He reported that of 861 persons tested he was able to verify, by confessions or other reliable data, the correctness of findings based on the deception tests, as to 528 of these persons.²⁴ Since going to Illinois he has tested some 600 men in the penitentiaries. He is thus accumulating a large amount of data bearing upon the reliability of the tests under actual working conditions. He reports that his methods have likewise been successfully used in the Police Departments of Los

²¹ Op. cit., Appendix, vi, p. 624.

²² Marston had simply taken blood-pressure readings, at intervals.

²³ Op. cit., Appendix, vii, viii.

²⁴ Op. cit., Appendix, xviii, p. 257.

Angeles, Oakland, Duluth, and Evanston.²⁵ His writings indicate that he is thoroughly convinced of the significance and value of the tests in detecting guilt and deception, and certainly there is no one else whose experience of the actual trial of the tests so well qualifies him to judge of their value.

Many other devices for registering various other manifestations of bodily disturbance, due to emotion, have been tried or suggested for use in testing veracity. None of them seem as reliable or diagnostic as the blood-pressure curve.²⁶ Among them are the measurement of those variations in resistance of the skin to electric currents occurring during emotional disturbance and attributed to changes in the activity of the sweat-glands. These variations may be measured with a great deal of exactness, and a New York psychologist, Dr. D. Wechsler, who has experimented with this method, extensively, considers it a useful index of deception, especially in view of the lack of control of the subject over such changes.²⁷ But Marston²⁸ and Larson²⁹ found that its very sensitiveness to minor emotional changes made it difficult to interpret. X-ray or fluoroscopic studies of the heart action have been suggested,³⁰ and also the measurement of the changes in the adrenalin content of the blood,³¹ measurement of the eye-movement,³² and of slight striped-muscles responses,³³ and of the rate of the body's combustion of oxygen. So far these have not been shown to have any advantage over the far simpler process of measuring blood-pressure changes. Nevertheless, any one of them may be so developed and perfected in the future as to displace all others in this field, where all is yet experimental.

Still another approach to the problem of detecting deception, from an entirely different angle, has been made by a Texas physician, Dr. R. E. House. In his practice in many hundreds of cases of child-

²⁵ Letter from Dr. Larson to the writer, dated December 10, 1926.

²⁶ I am here adopting the views of Burt, Marston, and Larson, whose experience seems to carry more weight. Many psychologists would give preference to others of the methods described, e.g., Landis, see *supra*, n. 11.

²⁷ David Wechsler, *Researches on the Psycho-Galvanic Reflex*, Archives of Psychology, Columbia University, N. Y., No. 76; Whately Smith, *The Measurement of Emotion*, Harcourt Brace & Co., N. Y.; Articles in New York Herald Tribune, part II, p. 5, by E. E. Free, Ph.D., and by the same author in Popular Science Monthly, Dec. 1926, Strange New Crime Remedies.

²⁸ *Op. cit.*, Appendix, ix, p. 55.

²⁹ *Op. cit.*, Appendix, xvi, p. 39; also (1922) 5 Journal of Experimental Psychology, 321.

³⁰ *Op. cit.*, Appendix, vii, p. 422.

³¹ *Op. cit.*, Appendix, xviii, p. 268.

³² Letter from Dr. Henry T. Moore, referring to a discussion by A. R. Gilliland and H. T. Moore (1921) Journal of Applied Psychology.

³³ Letter from Dr. C. H. Griffiths of the University of Michigan.

birth he administered scopolamin to the mothers, to produce the once-famous "twilight sleep." While the mothers were in the state of semi-unconsciousness induced by the drug he discovered (so he reports) that they would answer questions correctly and that after regaining normal consciousness they would not recall questions or answers. The readiness and truthfulness of the answers led him to the belief that at a certain stage in the influence of the drug the subject has no such control of the will as to enable him to resist telling the truth as his memory serves it up. Dr. House reports repeated instances of administration of his drug to those who, for test purposes, were instructed to lie, and who under the drug gave consistently truthful answers. He likewise reports cases of convicts who volunteered for the test to prove their innocence, who, under the drug's sway, admitted not only the crimes for which they were convicted, but others. The administration of this test requires a special skill and experience (as yet only acquired by Dr. House himself) both in administering the drug and in the recognition of the particular stage of returning consciousness where the hearing and memory have emerged but the will has not yet returned, assuming that Dr. House is correct in his belief that such a stage exists. The great superiority of this method, if valid, is that it directly elicits truth, and not merely signalizes falsehood, and even more important, its results are not dependent upon any question of interpretation, as are records of emotional changes—here the truth springs forth full-armed. The great draw-back, the fly in the "truth-serum," is that it has never received tests adequate to enable a judgment to be passed upon it. The scanty experimentation of its originator, Dr. House, is suggestive merely, but in view of the revolutionary possibilities for good which the verification of the method would open up, it is surely sufficient to call for the furnishing to Dr. House of the facilities for the most extended clinical trials of his method, so that its value may be determined by experts in the light not of theory but of results.³⁴

In describing the principal deception tests and the reports of favorable experience by their principal advocates, I do not wish to leave the impression that they have been without critics in the house

³⁴ Articles on, or discussions of, the Scopolamin methods may be found in 42 *Medico-Legal Journal*, 138-148; *The Police Journal* for February and for October, 1926; also the article by Dr. Free, *Strange New Crime Remedies* (Dec. 1926) *Popular Science Monthly*, 14. Dr. House has made addresses on the subject before the American Research Anesthetist Association, the Medical Association of the Southwest, the Texas Medical Assn. (see [Sept. 1922] *Texas State Journal of Medicine*), and the Orleans Parish Medical Society (see 16 *New Orleans Medical and Surgical Journal*, No. 9). He lives at Ferris, Texas.

of their friends, the psychologists. It is argued that guilt or deception has no characteristic emotional reaction which can be distinguished from reactions due to extraneous causes. No changes from a type that cannot be produced from fear or anger seem to have been found to accompany guilt or deception, but that seems no reason to doubt that significance may be attached to those changes in a particular case when they are elicited by words or questions which could probably have no emotional effect except those produced by guilt or deception. Thus where a thief steals a box containing money and a broken pair of scissors, the phrase "broken scissors"³⁵ is likely to cause no emotional effect at all upon one who knows nothing of the theft, and if it produces changes in blood-pressure the person so responding is not necessarily the thief, but the response is a circumstance rendering that influence a more probable one than it was before the response. True, such "key" words are not always to be found, especially when the newspapers have broadcast the details so that innocent as well as guilty know them. This might limit but would not condemn the tests. So also, if the test be sufficiently extended, it is possible, at least under experimental conditions, though some of the words may cause disturbances due to "complexes" having nothing to do with the crucial facts, to reach a correct diagnosis of truth or falsity from the results.³⁶ And Marston and Larson report that such fairly persistent conditions as abnormal blood-pressure due to excitement produced by the fear of the examination itself,³⁷ or due to a bad heart,³⁸ may be discounted by taking the heightened level as the standard or "norm" for the examination and considering only changes from that level as significant. Some conscious control can be exerted over blood-pressure and over respiration and reaction-time, but it would be difficult to distort them all over an extended examination. Larson reports that old offenders who try to "beat the game" offer no greater difficulties than others.³⁹ Obviously, a pathological liar unconscious of deception would not be susceptible to the tests, but such condition would doubtless usually be known or apparent.⁴⁰

After all, the vital question is, do the tests work? The affirmative results of Marston, Larson, Langfeld, Burt and others have not been obtained by all workers. Thus Landis and his co-workers reported in

³⁵ An actual case, related by Dr. English Bagby of the University of North Carolina.

³⁶ *Op. cit.*, Appendix, xxi, p. 411; *op. cit.*, Appendix, xv, p. 323.

³⁷ *Op. cit.*, Appendix, xviii, p. 262.

³⁸ *Op. cit.*, Appendix, vii, p. 439, fig. 9.

³⁹ *Op. cit.*, Appendix, xviii, p. 262.

⁴⁰ *Op. cit.*, Appendix, vi, p. 626; *op. cit.*, Appendix, xvii, p. 262.

1925⁴¹ and again in 1926⁴² that they were unable to diagnose truth or falsehood under experimental, "make-believe" tests using Burt's method heretofore described, by the blood-pressure curve in more than thirty to fifty per cent of the cases. Nevertheless he reports slightly positive results with the Benussi breathing test, and even his lack of results with the blood-pressure curve does not prevent him from saying:

"However, we are of the opinion that the blood pressure method of detection of falsehood is what Marston originally claimed for it, 'highly diagnostic,' if all conditions are favorable. The thing that is badly needed is an extensive and detailed experimental investigation of the conditions which effect diagnostic efficiency of the blood pressure record."⁴³

Likewise, Miss H. G. Jefferson, a graduate student in the University of California failed to secure significant indications of deception from blood-pressure readings of experimental "liars."⁴⁴ Her technique is criticized by Larson.

These reports pro and con contained in the psychological journals referred to do not enable a lawyer to answer with confidence the all-important question, what is the consensus of opinion of psychologists as to the value of these deception tests? So rather than indulge in a guess as to this, I have taken a canvass. A questionnaire has been sent to eighty-eight members of the American Psychological Association, selected by a psychologist⁴⁵ as being likely to be interested in this field, asking for their opinion upon the question of whether deception-tests combining the measurement of reaction-time, respiratory changes, and blood-pressure changes furnish results of sufficient accuracy as to warrant consideration by judges and jurors of such results in determining the credibility of testimony given in court. Of those who replied to this question eighteen ans-

⁴¹ Op. cit., Appendix, xix, p. 25.

⁴² Op. cit., Appendix, xx, p. 18.

⁴³ Op. cit., Appendix, xx, p. 17. And in an article which is to appear in *Industrial Psychology*, and of which he has courteously given me a copy, he says: "... there is good experimental evidence to the fact that deception can be detected on the basis of cardiac and respiratory responses. Just at present, and probably for several years to come the practical significance of this evidence will be of somewhat questionable importance. A large amount of carefully controlled experimentation must be done before anyone, even the most skilled operator, will be justified in basing a judgment concerning the guilt or innocence of a suspect on the basis of these responses alone. They are however valuable aids even at present to the police, the examining magistrate or the prison authorities when used by one skilled in the methods and when their significance is properly evaluated."

⁴⁴ Op. cit., Appendix, viii, p. 7.

⁴⁵ Dr. J. F. Dashiell, University of North Carolina.

were yes, with varying qualifications;⁴⁶ thirteen answered no;⁴⁷ and

⁴⁶ Among those who so answered were: Drs. Walter D. Scott, Northwestern University; Samuel E. Fernberger, University of Pennsylvania ("Yes, if handled by an expert only."); Harold E. Burt, Ohio State University ("Yes, should be administered by psychologists with laboratory training. Not fool-proof enough for laymen. Should go in with the other expert testimony."); William M. Marston, New York City ("No. Emphatically not if the judges and jurors themselves are to interpret them. Yes, if the records are used as basis of expert testimony." "I should think the admission of expert testimony on deception one of the greatest steps toward *real* justice, toward eliciting *real* confessions, and toward deterring crime that ever has been made in court procedure. But I should expect the tests to become rapidly discredited if they were admitted as a sort of 'patent medicine,' a fortune-telling, penny-in-the-slot answer to whether the witness or defendant were telling the truth or not, or as a record which judge, jury, or anybody else could tell the meaning of as well as the trained legal-psychologist. Also, mere psy. training should have less value, I think, in qualifying the expert than legal, or criminological training in investigation and examining of witnesses."); A. P. Weiss, Ohio State University ("Yes, if not given too exclusive value. I regard them as supplementary. Much more experimental work needs to be done."); Charles H. Judd, University of Chicago ("Yes. I do not recommend reliance on the tests as *sole* evidence, but do regard them as very useful confirmatory evidence *when administered by competent people.*"); Hulsey Cason, University of Rochester ("Yes; they should be considered. But psychologists themselves would not conclude from these tests alone. None of them [the tests] are wholly reliable. However, they are being improved."); Robert M. Yerkes, Yale University ("I do. I consider present methods promising, but their use requires extreme care, caution, skill, and their application demands extreme conservatism. No jurist can safely accept results of such methods without the advice of competent psychologists."); M. R. Trabue, University of North Carolina ("I do, in most cases."); R. S. Woodworth, Columbia University ("Yes, not of course with 100% certainty, but with a considerable preponderance of correctness."); Joseph Peterson, Peabody College, Nashville, Tenn. ("Yes; certainly to warrant *consideration*, but one should not be convicted on such tests alone."); F. Kingsbury, University of Chicago ("Yes, when administered and interpreted by *competent psychologists*. My answer does not imply my belief in their infallibility; but that they are of equal or superior value to the prevailing accepted types of evidence."); Max F. Meyer, University of Missouri ("They should be considered, yes—as contributory evidence, not as absolutely establishing the credibility of the witness. Here as elsewhere in social progress one should follow such rules as 'Nec temere, nec timide' or 'Festina lente.'"); Ralph Gundlach, University of Illinois ("Yes, if properly given."); C. H. Griffiths, Ann Arbor, Mich. ("Under certain conditions. Particularly when the details of the crime are known only to the guilty person. Tests must be given and the results interpreted by one with considerable experience."); David Wechsler, 1291 Madison Ave., New York City ("Under certain conditions and with certain perfections of technique. Yes."); Harry T. Moore, Saratoga Springs, N. Y. ("Incidental consideration only.").

⁴⁷ Including: John B. Watson, 244 Madison Ave., New York City ("No. All this is a thing for the laboratory for another 25 years. They might under favorable circumstances be *indicative*.—No more."); David Mitchell, 160 West 85th St., New York City ("No. A member of the Section of Consulting Psychologists of the A. P. A. using such tests as described could get suggestive leads but no formal test result would have the validity necessary for a court of law."); Edwin G. Boring, Harvard University ("No. I do not believe that any tests of deception are *per se* reliable or admissible directly in court. It seems to me probable that there may be experts on the detection

seven answers were of doubtful classification.⁴⁸ Of those who ans-

of deception whose evidence might be admitted as other expert opinion is admitted (perhaps after the degree of expertness of the person had been established by tests). I should expect such an expert to *make use of tests*, to interpret them according to his mature judgment, and to accept or reject their results accordingly. I can not avoid the conviction that Marston's success with the tests mentioned is more the success of Marston as an expert using the tests than of the tests themselves in any hands."); English Bagby, University of North Carolina ("Should not be used in court or in testimony before court. Used by detectives to establish possible guilt."); Herman C. Stevens, M.D., Elyria, Ohio ("No. (1) Because of the possibility of voluntary substitution of a response-word by a clever criminal. (2) Respiratory and circulatory changes are too variable even within normal limits. This negative attitude does not mean that reliable methods may not eventually be achieved. But I think one ought to be perfectly frank as to the *present* status of this method."); William Healy, 40 Court St., Boston ("Certainly not at present. Much more work in investigation needs to be done before such tests should be accepted."); John E. Anderson, Minneapolis, Minn. ("I do not, not because the tests themselves are of no value, but because the situation in court is so complex as compared with a laboratory situation. The tests are measures of emotional responses. In court there are likely to be many emotions in addition to those connected with deception."); E. B. Skaggs, 16575 Lawton Ave., Detroit ("Not at present—not optimistic as regards the future."); Morton Prince, Tufts Medical School ("No. All these tests only show an emotional reaction, and it is always a question of interpretation and inference. They justify suspicion of guilt, not evidence."); June E. Downey, University of Wyoming ("I believe the matter is still in the experimental stage."); Charles Bird, University of Minnesota ("I think the tests under rigid experimental conditions, and in one case, that of Larson at Berkeley, Cal., have yielded results which have been more accurate than those obtained from student juries. Yet I should hesitate to recommend their use to representatives of law because we actually need many more trials of the methods under law-court conditions. I think some research institute, co-operating with the police department, should make much more rigid tests under controlled conditions where the subjects are criminals. The results of Marston and those of Larson seem to supplement each other and psychologists who have used, in the psychological laboratories, the association tests have been successful in detecting simple deception to an extent far beyond that of a jury composed of students. Yet I think the time is not reached when these experiments warrant their use in the courts. If your report can stimulate the co-operation of the lawyers to institute an experimental investigation under actual court conditions much of value would result.").

⁴⁸ Including: Drs. H. A. Carr, University of Chicago ("You raise the question of 'sufficient accuracy.' If this means 100% accuracy, the answer is no. This raises the question of the degree of accuracy or rather the probability of accuracy in a given case that will justify their use, or rather the degree of credence given to them relative to other lines of testimony. This will always be a matter of good judgment, and indicates that any such tests would need to be employed as a *supplementary* device to other lines of evidence, rather than as a *crucial* bit of evidence."); Herbert S. Langfeld, Princeton University ("Although I have seen some excellent results with blood pressure tests, I should not advocate this use as yet before a jury, especially if the jury believed such tests entirely reliable."); J. B. Miner, University of Kentucky ("Positive responses would show that the witness was emotionally disturbed by certain facts. This might be useful if the witness had never heard of the facts. I believe that such tests are still in an experimental stage and that the opinion of an expert based on such an examination would be more useful to the court or jury than the test facts

wered yes, eight limited their approval to evidence of experts giving their opinions interpreting tests made out of court. Some of those who answered no may have been merely intending to express disapproval of the actual conducting of the tests in court. Three volunteered the view that the evidence could properly be used by judges but not by jurors, eight that further experimentation was desirable. Five emphasized the thought that the tests should be used as the *sole* basis for a decision. Not more than seven of the replies could probably be interpreted as indicating lack of belief in the substantial value of the tests for any purpose.

So far as these replies reflect professional opinion they indicate a preponderance of belief in the scientific significance to some degree of the tests, but a fairly evenly divided opinion on the question of whether they are suitable for consideration by courts.

The scientific view being still one of suspended judgment, the courts must obviously wait for further verification and wider ac-

themselves"); W. V. Bingham, 40 W. 40th St., New York, N. Y. ("... in my opinion, the deception tests which you mention are scientifically sound in theory. At the same time, it must be recalled that they require a great deal of ingenuity and insight on the part of the experimenter in preparing the list of association-words so that the findings will be clear-cut. Whether the time has arrived for their actual use in judicial procedure, I am in doubt. I do believe very firmly, however, that further experimentation in this direction on the part of courts and psychologists working in co-operation, should be strongly encouraged."); Carl E. Seashore, University of Iowa ("... it would seem to me that it could be made a very valuable tool for the purpose of gaining a lead in the prosecution or defense, rather than to use it as final testimony."); H. D. Kitson, Columbia University ("Possibly by the most enlightened judges, but surely not by judges of little intelligence. By the average jurors not at all. I cannot answer 'yes,' but I must admit that to a psychologist acquainted with the methods of psychoanalysis such tests as those you mention give significant indications of guilt. Since the mathematical demonstration is not perfect, however—by that I mean the probable error is large—I doubt if they could be considered as proof of the undeniable sort required by law."); Christian A. Ruckmick, University of Iowa ("I do not think they are all on the same level of accuracy. Those reflexes, like the psychogalvanic, which are least under voluntary control would be much more indicative. In the final analysis, no one but a competently trained psychologist should be called upon to interpret the results."); L. L. Thurston, University of Chicago ("I am favorably impressed by the experimental work on deception. I have not personally done such experimental work. If the validity of these procedures has not already been demonstrated with perfection they are pretty close to it. The Jung association test method has always been successful whenever I have seen it tried. The galvanic skin reflex (psychogalvanic reflex), the blood pressure technique and the Jung association method are useful in bringing about confessions. The tests are not yet ready for adoption as legal procedures."); Warner Brown, University of California ("No. But a judge (not a jury) would be justified in considering the non-partisan opinion of an expert psychologist when the opinion is based on such tests.").

The foregoing quotations are not complete nor always representative of the entire view expressed, but selected as especially suggestive portions.

ceptance of the validity of these tests before relying upon their results as evidence. This is the holding in the only decision on the point that has come to my attention.⁴⁹ Meantime, however, an inquiring and open-minded attitude on the part of the legal profession is a becoming one. Conscious perjury is too often triumphant in our courts under our present methods of ascertaining truth⁵⁰ for us to assume too complacent a confidence in the sovereign remedy of cross-examination. It is not always the weakling who is being cross-examined, nor the soul-searching terror to evil-doers who is conducting the examination. Successful exposure of the lie from the liar's lips requires cleverness and intuition in the cross-examiner which is all too often not forthcoming. If science bids fair to furnish a fairly effective technique for the exposure of deception we should not merely

⁴⁹ *Frye v. U. S.* (1923) 293 Fed. 1013, decided by the Court of Appeals of the District of Columbia, opinion by Van Orsdel, J., and annotated in 34 A. L. R. 147, (1924) 33 Yale Law Journal, 771, (1924) 37 Harvard Law Review, 1138, (1925) 28 Law Notes, 64, (1924) 24 Columbia Law Review, 429, 2 New York Law Review, 162. This was a prosecution for murder. The defendant, a negro, had confessed, but had repudiated his confession, and had before trial been examined by Dr. Wm. H. Marston as to the crime, and his blood pressure reaction recorded, and Dr. Marston had concluded, contrary to his previous belief, that the prisoner was innocent (letter from Dr. Marston). The defendant offered Dr. Marston as an expert witness to testify to the results of the test, but the evidence was excluded by the trial court, partly on the ground (printed record, pp. 12-13) that it was an attempt to show the truth, not of defendant's testimony in court, but of a statement made out of court, i.e., at the time of the test. The judge also held that the soundness of the tests was not sufficiently of "common knowledge" to render their results admissible. The ruling was sustained on appeal, in the following language:

"Just when a scientific principle or discovery crosses the line between experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

"We think the systolic blood pressure test has not yet gained such standing and scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments thus far made."

⁵⁰ Some psychologists have made comparisons of the accuracy of juries' verdicts with judgments based upon the tests, with suggestive results. Thus Burt made 91% of correct judgments in blood pressure, whereas a jury passing on the same statements and judging truth or falsity from the witness' demeanor judged correctly in only 48% of the cases. *Op. cit.*, Appendix, xvii, pp. 14, 15. Likewise, Dr. Marston (*Studies in Testimony* (1924) 15 *Journal of the American Institute of Criminal Law and Criminology*, 5-31) recounts some interesting experiments as to comparative accuracy in assessing testimony of trained judges and of juries. It is clear that our assumptions as to the power of juries to reach truth by common sense are going to be put to the test of scientific experiment.

welcome it when it comes, but stimulate and encourage efforts to speed its coming.

Experimentation under laboratory conditions has carried deception testing far, but the great present need is for the continuation and extension of such work as Larson's with actual suspects and criminals in police and detective departments, and psychological research bureaus attached to courts, and in penitentiaries. Criminal court judges, district attorneys, public defenders, can often interest the authorities to undertake the trial of such methods. Law teachers can interest these judges, prosecuting officers and others in the tests and their possibilities.

The comments of some legal writers seem tacitly to assume that the deception-tests must be shown not only to be scientifically accepted as evidential or significant, but that they must be demonstrated to be error-proof.⁵¹ But it is apparent that no capacity for anything like a hundred per cent correctness of results is required. The emotional curve is to be admitted merely as circumstantial evidence of a truthful intent or the reverse. If the test results are shown by scientific experience to render the inferences of consciousness of falsity or truth substantially more probable, then the courts should accept the evidence, though the possibility of error in the inference be recognized.⁵² The admission of evidence that blood-hounds have followed a trail from the crime to the whereabouts of the accused,⁵³ of evidence of similarity of foot-marks,⁵⁴ and of conduct to show insanity,⁵⁵ are all striking examples of the fact that conclusiveness in the inference called for by the evidence is not a requirement for admissibility.

⁵¹ A law teacher's influence may have been felt in the decision in *Frye v. U. S.*, supra, n. 49, for in the prevailing brief for the government an expression of opinion of Professor Chafee ((1922) 35 *Harvard Law Review*, 309) adverse to the present availability of Marston's test for court house use was quoted and relied on.

⁵² "But yet the competency of a collateral fact to be used as the basis of legitimate argument is not to be determined by the conclusiveness of the inferences it may afford in reference to the litigated fact. It is enough if these may tend, even in a slight degree, to elucidate the inquiry or to assist, though remotely, to a determination probably found in truth. Indeed, to require a necessary relation between the fact known and the fact sought would sweep away many sources of testimony to which men daily recur in the ordinary business of life; and that cannot be rejected by a judicial tribunal without hazard of shutting out the light." Bell, J., in *Stevenson v. Stewart* (1849) 11 Pa. (1 Jones) 307, quoted in 1 *Wigmore, Evidence* (1923) § 38, p. 254, and in *Smith v. U. S.* (1920) 267 Fed. 665, 668, *Williamson v. U. S.* (1908) 207 U. S. 425, 451, 52 Sup. Ct. Rep. 278, *Holmes v. Goldsmith* (1893) 147 U. S. 150, 164, 37 Sup. Ct. Rep. 118.

⁵³ *Wigmore, Evidence* (1923, 2d ed.) § 177.

⁵⁴ *Idem*, § 415.

⁵⁵ *Idem*, § 228.

Assuming that the tests prove, to the satisfaction of scientists, capable of furnishing definite and reliable data as to veracity, what will be their functioning in the administration of justice?

In the first place, their value will be inestimable as a method for the preliminary investigation of crime. With a crime-detection force generally without professional standards of training or security of tenure, faced by an insistent and impatient public demand, stimulated by the press for results in the form of definite charges against someone for all spectacular crimes, the inevitable line of least resistance is the forced confessional. The sweat-box, the rubber hose, the electric battery are but grosser forms of a process, which, in more refined form, is torture still.⁵⁶ We demand results and are unwilling to pay for them by securing training and independence for the police, and we prove that we are holier than the Inquisition by pointing to our laws, common, statutory, and constitutional which forbid such practices. We should be as horrified if the laws were obeyed as if they were repealed. Certainly the introduction of scientific deception tests would be a move for the better. Their effective use calls for the expert, the trained psychologist. There is little or no temptation, seemingly, to the use of force to compel the prisoners to submit, as Larson's experience indicates that practically all suspects where it is established as routine will submit rather than incur the suspicion which is aroused by refusal.⁵⁷ The test, even though its results are not expected to be used as evidence in court often brings the state of mind which leads to confession, and where it indicates guilt in one of a number equally suspected gives the investigating officer a lead to the obtaining of usable evidence, as by search of the suspect's room for stolen goods. Furthermore, it tends to the speedy release of innocent persons held on suspicion, a form of detention often abused.

Secondly, as to their use as evidence in court. At the outset it may be doubted whether it will ever be practicable, at least as long as juries are retained, to conduct the tests themselves in court. While something is gained in the heightening of the emotional reactions accompanying conscious deception by the presence of judge, jury and audience, yet the undue consumption of the time of the tribunal and the danger of hasty misinterpretation of the results under these conditions, seem to render such use undesirable. In their present form, the tests should be administered before trial, and the results used in

⁵⁶ For an example of torture by repeated questioning of a sick man, see *Ziang Sung Wan v. U. S.* (1924) 266 U. S. 1, 69 Sup. Ct. Rep. 131.

⁵⁷ Only three out of eight hundred and sixty-four refused. *Op. cit.*, Appendix, xviii, p. 257.

evidence only in the form of the opinion-testimony of an expert reporting and interpreting them. While the jury's interpretation of the record, unaided by the expert's explanation and opinion, would be worthless, the jury can very readily recognize and distinguish the variations and irregularities in the curves when pointed out by the expert and can form some judgment as to the extent of their significance.

Since the association-word responses and even the answers to questions incident to the test are not used testimonially, i.e., as statements of facts to show their truth, there would seem to be no legal obstacle to compelling by court order the submission to the test before, or even during trial, on the ground of immunity from compulsion to confess, or privilege against self-crimination. The analogy is rather to the forced giving of finger prints, specimens of handwriting, or the like. In the case of the scopolamin method, however, the statement of the subject is used testimonially and could not, therefore, under present law be compelled in court, and would doubtless be an unlawful violation of personal immunity if administered involuntarily before trial. As the drug is not dangerous, though it may produce nausea and discomfort, if it became accepted as a reliable eliminator of deception the courts could, and would, it is believed, admit confessions obtained under its influence, for it is the factor of unreliability that chiefly bars the forced confession under present conditions, and the individual interest of bodily security should yield to the public interest in eliciting the truth as to criminal charges.

As to the purposes for which the evidence of the results of the tests and the expert's interpretation of them would be receivable: their immediate purpose is to show a *state of mind* of the subject on the occasion of the test, the state of *knowledge* of the fact of the crime or other transaction in issue or *ignorance* of it. Emotional disturbance tends to show *knowledge* (the inference being from *emotion* to *suppression*), lack of it, *ignorance*. *Knowledge* may be the basis for the further inference of *acts*, i.e., criminal acts may be inferred from knowledge that only the criminal would be likely to have. *Ignorance* of facts which would be known by the criminal similarly may found the inference of non-participation in the crime. Similar inference as to conduct in civil issues would be theoretically possible, but less often available, because the issue usually would not be reduced to one of conscious lying, though sometimes it may, e.g., in cases of fraudulent concealment of assets by the bankrupt, or of disputed identity of the driver of an automobile causing a personal injury. The foregoing considerations apply whether the subject of the test goes on the stand or not. If he does become a witness at the trial, the results of

the tests, so far as they disclosed suppression-reaction, or failed to do so, with respect to the matters testified about later in court, would be admissible in impeachment or corroboration of the testimony, and if valuable at all they would seem much more significant than our present types of attacking or supporting evidence.

In conclusion: (1) Deception tests based upon measurement of bodily disturbances accompanying the response to test-words or questions seem to be accepted by psychologists generally as being based upon a sound underlying theory.

(2) The use of drugs to produce a state wherein conscious suppression is impossible has not won acceptance even in theory.

(3) The deception tests mentioned in (1) are not generally regarded by psychologists as having been sufficiently proven as to reliability of technique to warrant courts in accepting their results in evidence at the present time.

(4) Lawyers, judges, and law teachers should encourage and open-mindedly observe the progress of experimental investigation of the tests in police departments and prisons upon actual suspects and criminals, in order that whatever value they may prove to have for the judicial ascertainment of truth may be promptly utilized by the courts.

C. T. McCormick.

School of Law,
University of North Carolina.

APPENDIX

List of articles dealing with the subject. Those of special importance or interest to lawyers are in black face type. This, of course, does not purport to be a complete bibliography.

i. John H. Wigmore, Professor Münsterberg and the Psychology of Testimony (1909) 3 *Illinois Law Review*, 399-445. This provides a very full bibliography of the literature on the topic in English and foreign language, up to that time.

ii. Editorial comment on *Frye v. U. S.* (1923) 293 *Fed.* 1013. *The Use of Psychological Tests to Determine the Credibility of Witnesses* (1924) 33 *Yale Law Journal*, 771-774, a brief but illuminating summary of scientific opinion and applicable legal theory.

iii. John H. Wigmore, *Evidence* (1923, 2d ed.) §§ 875, 990.

iv. Edwin S. Oakes, Annotation to *Frye v. U. S.*, *Physiological and Psychological Deception Tests* (1925) 34 *American Law Reports*, Annotated, 147, 148.

v. Hugo Münsterberg, *On the Witness Stand, Essays on Psychology and Crime*, with foreword by Charles S. Whitman (1908, reprint 1925, Clark Boardman Co., Ltd., N. Y.), especially the chapters on *The Detection of Crime* and *The Traces of Emotions*.

⁵⁸ See Wigmore, *Evidence* (1923, 2d ed.) § 2263; (1924) 37 *Harvard Law Review*, 1138.

vi. John A. Larson, *The Berkeley Lie Detector and Other Deception Tests* (1922) 47 *American Bar Association Reports*, 619, 628.

vii. John A. Larson, *The Cardio-Pneumo-Psychogram in Deception* (1923) 6 *Journal of Experimental Psychology*, 420-454. This is the most informative of Larson's many articles on the subject, especially interesting for its numerous reproductions of curves or graphs recorded by the "lie-detector." It is reprinted as a Bulletin by the Department of Public Welfare of Illinois, 907 South Lincoln Street, Chicago.

viii. John A. Larson and Herman M. Adler, *A Study of Deception in the Penitentiary*, with numerous illustrations on deception charts (1925). Bulletin of Department of Public Welfare of Illinois.

ix. William M. Marston, *Psychological Possibilities in the Deception Tests* (1921) 11 *Journal of American Institute of Criminal Law and Criminology*, 551-570.

x. Harry W. Crane, *A Study in Association Reaction and Reaction-Time* (1915) 18 *The Psychological Monographs*, No. 4.

xi. William M. Marston, *Systolic Blood Pressure Symptoms of Deception* (1917) 2 *Journal of Experimental Psychology*, 117-163.

xii. William M. Marston, *Reaction-Time Symptoms of Deception* (1920) 3 *Journal of Experimental Psychology*, 72-87, advancing the theory of the "negative type" liar who may not "react."

xiii. Eva R. Goldstein, *Reaction-Times and the Consciousness of Deception* (1923) *American Journal of Psychology*, 562-581.

xiv. William M. Marston, *Negative Type Reaction-Time Symptoms of Deception* (1925) 32 *Psychological Review*, 241-247.

xv. Herbert Sidney Langfeld, *Psychological Symptoms of Deception* (1920) 15 *Journal of Abnormal Psychology*, 319-328.

xvi. John A. Larson, *Modification of the Marston Deception Test* (1921) 12 *Journal of American Institute of Criminal Law and Criminology*, 390-399.

xvii. Harold E. Burtt, *The Inspiration Expiration Ratio During Truth and Falsehood* (1921) 4 *Journal of Experimental Psychology*, 1-23.

xviii. John A. Larson, *Present Police and Legal Methods for the Determination of the Innocence or Guilt of the Suspect* (1925) 16 *Journal of American Institute of Criminal Law and Criminology*, 219-270.

xix. Carney Landis and Ruth Gullette, *Studies of Emotional Reactions (III) Systolic Blood Pressure and Inspiration-Expiration Ratios* (1925) 5 *Journal of Comparative Psychology*, 221-253.

xx. Carney Landis and L. E. Wiley, *Changes of Blood Pressure and Respiration During Deception* (1926) 6 *Journal of Comparative Psychology*, 1-21.

xxi. William M. Marston, *Sex Characteristics of Systolic Blood Pressure Behavior* (1917) 2 *Journal of Experimental Psychology*, 387-419.