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WILLIAM MOULTON MARSTON

A Selection of His Writings

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WILLIAM MOULTON MARSTON

- BIOGRAPHY -

William Moulton Marston, Consulting psychologist. Born 5 May 1893 at Cliftondale, Massachusetts; son of Fred William and Anne Dalton (Moulton) Marston. Education: A.B. Harvard 1915, LL.B Harvard Law School 1918, Ph.D. Harvard Graduate School 1921. Married Elizabeth Holloway of Abington, Massachusetts September 16, 1915, daughter of William G.W. and Daisy Bothwell Holloway. Children: Moulton Bryse Holloway Marston, Don Richard Marston, Olive Ann Marston.

Military Service: Lieutenant, Psychology Division, Sanitary Corps (now the Medical Corps), U.S. Army, 1917-1919.

Experimental Psychological Assistant, Radcliffe College 1915; Attorney, Boston Legal Aid 1918; Professor of Legal Psychology, American University, Washington, D.C. 1922-1923; Psychologist, National Commission on Mental Hygiene 1924; Staten Island School Survey; Texas Penitentiary Survey; Assistant Professor of Psychology and Philosophy, Head of Psychology Department, Director of Student Clinic, Tufts College 1925-1926; Consulting Psychologist 1925 -; Lecturer in Psychology, Columbia and New York University 1926-1929; Lecturer in Psychology, University of Southern California 1929-1930; Professor of Psychology and Acting Head of Psychology Department, Long Island University 1931-1932; Vice President, Hampton Weeks and Marston Advertising Agency, 1931-1932; Lecturer in Psychology, New School of Social Research and Rand School 1933-1934; Lecturer in Psychology, Catherine Gibbs Second School 1941-.

Phi Beta Kappa; American Psychological Association; Fellow of the American Association for the Advancement of Science; Honorary Life Member of the American Association of Criminal Law and Criminology; Orthological Institute of London; Harvard Club; New York Writers Club; Vice President, Board of Directors, Brunswick School, Greenwich, Conn.

Died, May 2, 1947.

Biographical notes: See, Who's Who in America, Who's Who in American Education, 1945-1946, Who Was Who, 1947, Young Men of America.

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* * * * *

SYSTOLIC BLOOD PRESSURE SYMPTOMS OF DECEPTION

By

William M. Marston

1. Introduction.

The investigation on the galvanic effects of hidden ideas which have proved of interest both from a psychological and from a legal point of view have turned attention to the general problem of the physiological facts of the mental attitude in deceiving. The special problem suggested to me in the Harvard psychological laboratory was an investigation of the changes in blood pressure resulting from an effort to hide the truth. Just after we had begun the work, Benussi reported an experiment which in a parallel way studied the effect of lying on the changes in respiration.[1] He found a characteristic ratio of inspiration to expiration symptomatic of what he calls "internal excitement" caused by lying, and furthermore found this internal excitement to be much stronger in clever liars than in those easily detected, while, in the case of the latter, such excitement often tinged and modified the truthful records. Benussi, however, did not attempt to explain or analyze this "internal excitement," and his work leaves us with several troublesome questions in the answering of which this and similar methods of investigation might be invalidated. Is the "lying complex" sufficiently uniform in different individuals to be experimented upon as a unit? Through what physiological mechanism are symptomatic bodily changes effected? What, psychologically, is the nature of this "internal excitement"? Until these questions are at least partially answered we have in hand only a sort of psychological patent medicine, the ingredients of which, being unknown, may work as well one way as another under new conditions. Since, however, no definite emotional tests have yet been established, a method similar to Benussi's seems inevitable in opening up a very complicated field. Benussi's results, indicating as they do great definiteness of lying symptoms, are sufficient to warrant the assumption of the uniformity of the deceptive consciousness as a working hypothesis. It will be the purpose of the present paper, in reporting the results of research on effects of this deceptive consciousness upon systolic b.p.[2] to analyze the data with a view of determining the physiological and psychological mechanisms involved.

2. Chief Physiological Factors of B.P. and Possible Psychological Influences Upon These Factors

The blood, starting in the left auricle of the heart, is forced by the successive contractions of both auricles and ventricles into the aorta, or arterial stem. Thence the squeezing of the heart muscle forces the blood through the smaller arteries, and finally through the arterioles and capillaries into the veins, whence it returns under constantly diminishing pressure to the heart. In order to study psychic influences upon the b.p. it is necessary to bear clearly in mind the normal pressure conditions throughout the closed blood circuit. The pressure in the aorta

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is, of course, highest, and the broad channel of this artery offers comparatively little resistance to the blood flow; but as the smaller arteries are reached the factor of the friction with the arterial walls becomes more and more manifest, the side pressure and velocity pressure become less and less, and by the time the capillaries are reached the wall resistance is the dominating factor. The four chief factors in determining the arterial pressure at any given time may be said to be: (1) Heart-beat. It will be noted that the rate of the beat, and the force of the beat are two distinct functions; the former often increasing in inverse proportion to the b.p. while the pressure always increases in direct proportion to the force of the beat. (2) Constriction of the arteries, and especially of the arterioles and capillaries, usually called "peripheral resistance." (3) Changes in elasticity of arterial walls. (4) Loss of blood. Since the last two factors are caused only by disease or by contingencies impossible of occurrence during the time occupied in taking any b.p. record, we need not consider them here.

Both the increase of heart beat and the increase of peripheral resistance, however, are factors to which we must look in accounting for any centrally caused changes. The systolic b.p. is peculiarly symptomatic of change in heart beat, while the diastolic becomes the crucial criterion if the changes we wish to study are brought about through changes in peripheral resistance.[3] Should both of these factors prove of essential value, then we must determine the pulse pressure, or ratio between systolic and diastolic. In order, then, to fix upon that aspect of arterial pressure which is the true indicator of that psychological complex which we wish to investigate, we must first glance briefly at the innervation of heart and capillaries, as well as at the psychological elements which have been found to substantially effect their functioning.

The rate and force of the heart beat are the algebraic sum of the cardio-inhibitory and accelerator nerve fibers. Thus a severing of the vagus nerves, or an inhibition at the cardio-inhibitory center will increase the heart beat as strongly as will a strong stimulation of the accelerator nerves. The latter seem to contain two groups of fibers capable of independent functioning, one group increasing the rate of beat, and the other increasing the force of the beat. It is only, however, through a reciprocal b.p. mechanism that the two groups function separately, central impulses seeming to set both groups in action. In the same way the peripheral resistance may be said to be the algebraic sum of the vaso-constrictor, and vaso-dilator nerves. Here, however, we must not think of peripheral resistance as a single organ or unit, but must remember, for instance, that the capillaries of the splanchnic area may be contracted while those of the skeletal muscles may be dilated. While, then, it is true that a strong vaso-constriction of an important area will immediately modify the diastolic b.p. of any artery above that area in the blood circuit, it will only be a very general vaso-constriction which will have a significant effect upon the systolic pressure.

Since Professor Cannon recently definitely correlated six emotions with branches of the autonomic nervous system,[4] it will be well to further note the effects of these branches upon mechanisms regulating the heart beat and vaso-motor systems. The cranial division of the autonomic stimulates the cardio-inhibitory nerves, and the vaso-dilators of the

stomach and digestive organs. The sacral division does not, in itself, innervate the heart, but only stimulates the vaso-dilators of the external genital organs and regulates the functioning of the excretory organs. When the excitement of the sacral system becomes sufficiently intense, the impulse passes over into the sympathetic. The thoracico-lumbar, or sympathetic, acts most uncompromisingly upon the accelerator nerves of the heart, and secondarily it inhibits the action of the digestive organs, contracting the blood vessels of these organs, and thus driving the blood to the skeletal muscles and outer parts of the body. The adrenalin released by the sympathetic impulses accentuates and prolongs this effect.

What emotions, then, will express themselves by heart acceleration, and which by vaso-constrictions? The answer is far from definite. The point first to be noted, however, is the uncertainty of any emotional influence through the vasomotor apparatus upon b.p. The mild appetitive emotion is registered in the cranial division of the autonomic, and, consequently, has a vaso-dilator effect which, with the cardio-inhibitory action of this division, would be expected to diminish b.p. Yet, through a peculiar inhibition of the cardio-inhibitory center, a slight increase of pressure actually occurs. In the same way sex-emotion and relief, expressing themselves through the sacral division, would seem to tend to lower diastolic pressure through vaso-dilations, yet early in the development of sex excitement the sympathetic is aroused, and, until the climax is nearly reached, the effect upon systolic b.p. is scarcely discernible. Again, pain, according to Cannon, is one of the three major emotions normally expressing itself through the sympathetic division, and should, therefore, both increase the heart-rate and contract the blood-vessels in large visceral areas. There is no reason to doubt that such vaso-constrictions occur, yet Binet early reported,[5] and his report is confirmed by the vivisectionists, that only the diastolic pressure is significantly altered by pain, that the heart is slowed in rate, and if there is any increase in systolic pressure it apparently is produced by the compensatory b.p. mechanism which operates to increase the force of the beat when the rate is diminished. Thus far, then, we have seen that the expression of emotion in vaso-motor modifications has little or no significance in determining the b.p. which would seem to be much more strongly and significantly controlled by the heart under normal conditions.[6] The one striking exception to this general rule forms the final argument for the choice of the systolic in testing the deceptive consciousness. Binet found that intellectual work at high concentration increased the diastolic b.p. 20, 30, and even 40 mm. The explanation is clear when considered in a teleological light. All the blood is required by the brain, and consequently, through vaso-constrictions, it is driven away from almost all other parts of the body. Yet, as I will indicate a little later, the systolic b.p. is not increased, nor is it significantly modified by even 40 or 50 minutes of mental concentration on study.[7]

The foregoing summary of the effects of minor affective elements and of intellectual work on systolic and diastolic b.p. will, I believe, justify the choice of the systolic in testing the deceptive consciousness. First, the use of the systolic eliminates the local effects of minor affective states; secondly, it eliminates the important and irrelevant factor of intellectual work; thirdly, it is less susceptible to modification by physical pain than is the diastolic; and fourthly, it items to record

only the unequivocal changes in the b.p. system brought about through increase of heart-beat unimpeded by inhibitory reflexes or antagonistic functioning of the vaso-motor apparatus.

What mental processes may be expected, then, to cause an increase of heart-beat, and consequent rise of systolic pressure? We have, first, Cannon's three major emotions, rage, fear, and pain expressing themselves in the sympathetic division of the autonomic. Pain, as we have seen, has a less marked effect upon b.p. than the unobstructed operation of the accelerator nerves would seem to argue; yet it is possible that Professor Cannon had in mind not only physical pain, but also "psychic" or mental pain, which would resolve itself into an extreme degree of unpleasantness derivable from many sources. However, we may point to fear and rage as emotions which will, through the unobstructed operation of the sympathetic division, cause immediate rise of systolic pressure. It is well to note that only the smallest degree of fear or rage should, theoretically at least, be necessary to produce a rise in b.p. since the sympathetic system is the natural avenue for the expression of these emotions. Cannon also finds that sex-excitement, intense joy, intense sorrow, and intense disgust may, when they reach a sufficient level of intensity, break over into the sympathetic channels,^[8] where they are felt merely as "excitement." Thus it appears that a profound modification of systolic b.p. cannot be analyzed with respect to its ultimate psychological causes, while any persistent smaller rise may presumably be attributed to rage or fear. Of course, very slight increases of pressure (especially if this be recorded by comparatively crude methods) cannot be regarded as significant of anything, but the necessary degree of intensity for emotions other than rage or fear to break into the sympathetic would seem to be so high that a considerable range of significant modification can be regarded as attributable almost exclusively to fear and rage. Although it is impossible to fix definite boundaries for this field, I shall hope to point out its general demarcations in considering experimental results. It only remains to point out, as a preliminary caution, the strong effect of physical exertion and of any contractions of skeletal muscles upon the accelerator nerves, and consequently upon the systolic b.p. All records must be keenly scanned, and conditions carefully controlled with a view to the elimination of the influence of this factor from the results. It is, however, much easier to control and allow for the factor of physical exertion, than it would be to exclude the element of mental work were we to use the diastolic or pulse pressures in examining the deceptive consciousness.

3. Method

The b.p. measurements were taken with a "Tycos" sphygmomanometer, an instrument substituting a spring for the mercury column of the older apparatus, and having the rubber pressure bag contained in a silk envelope made to wrap conveniently around the arm of the subject. The pressure was taken in the left brachial artery, the arm being completely bared before adjusting the instrument. This method of measuring the systolic pressure depends, of course, upon detecting the pulse in the radial artery, either by sphygmograph or by tactile sensations of the experimenter. Since the latter method was employed, the experiment is open to the criticism that the pulse is often present for a time after it has become impossible to detect it by mere touch. However, it may fairly be said that mechanical

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detectors have scarcely greater sensitivity, and are, in the long run, vastly less reliable. Moreover, the correction of this crudity of method would rather tend to accentuate increases in pressure than to diminish those found. Before starting the experiment, the experimenter practiced the taking of b.p. daily, for several weeks.

Four series were run off. The first three will be treated together, having been used upon the same group of ten subjects; and the last series, which employed the same method, will be introduced later, merely as a checking series.

Series A. (Stories 1-8).--The subject came to the experiment as to an examination by a prosecuting attorney, resolved to save a friend who was accused of a crime. He sat down at a table beside the experimenter (but protected by a screen) and found on the table two papers face down; one marked "L" (Lie) and the other marked "T" (Truth). If, in saving his friend, the subject chose to lie, he turned over and read the "L" paper. This was a story prepared by the experimenter relating simple events, supposed to have been witnessed by the subject, and proving the friend guilty. At the end of the story were recorded certain facts, supposed to have been established by other witnesses, which the subject must admit in forging an alibi for his friend. He then proceeded, with these facts and the true story before him, to think out a consistent lying alibi. If the subject chose to tell the truth, he turned over the "T" paper, the contents of which were unknown to the experimenter, and found a consistent story, admitting the facts supposed to have been established, but completely exonerating his friend. This story was the truth, it was the only account he knew of the affair, and he told it as such. In either case the subject had 10 min., or until he announced he was ready, to thoroughly familiarize himself with the story he was about to tell, but was free to refer to the chosen paper any time he wished. The experimenter had prepared ten questions covering the incidents of the "L" story and an assistant had prepared the "T" story to successfully cover the questions, and the facts supposedly to have been established. (After one "T" story has been told, of course, another was prepared by one of the assistants.) Thus it was impossible for the experimenter and jury to know whether the subject was telling a story of his own, or the one composed by the assistant. The questions were then put to the subject, and the jury closely observed his manner while answering. They then rendered a "verdict" as to whether he had lied or not, basing their judgment upon the internal consistency of the story as well as upon the subject's appearance while answering questions. These verdicts were written and passed in. The jury then left the room, and the experimenter recorded his own judgment, which was based entirely upon the b.p. record. The subject gave his introspection, a final reading was taken and the instrument removed. The b.p. was recorded five times, in each experiment of Series A, (1) before the subject turned over the paper, (2) after he announced that he was ready, (3) after the fifth question, (4) after the last question, and (5) after his introspection. Complete notes of the subject's story were taken by the experimenter.

Series B. (Stories 9-10).--The method of preparing the stories, etc., was exactly the same as in Series A. In Series B, however, the subject was first allowed to tell his own story without any questioning or interruption, and was then cross-examined by the experimenter or by the jury, or

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by both. If he chose he was permitted to reply to any question that "he did not know," or that "it wasn't on the paper." The jury then rendered their verdict orally, after whispered discussion, and the experimenter delivered the b.p. verdict orally. The jury then filed out, and the subject gave introspection, or in some cases, remained quiet for some moments. The essential innovation in this series was taking pressure readings every 2 min.

Series C. (Experiments 11-12.)--In this series the subject received an envelope with instructions sealed therein. He immediately left the room, and if he chose to lie he opened the envelope, obeyed the instructions, and came back and lied about what he had done. If he chose to tell the truth, he did whatever he liked for 10 min. and came back and gave an accurate and truthful account of his actions. After his return, he was given 2 to 6 min. to get his account in mind. In No. 11 no record of b.p. was taken until the subject returned, but in No. 12 a record was taken before he left the room. Owing to the lateness of the college year several subjects left before this last series could be completed.

Since Series A, B, and C can conveniently be considered together, I have tabulated together the results of these series for each subject.

The experiment was performed in the Harvard psychological laboratory, during the academic year 1914-15. Six subjects were graduate students of psychology, and four were undergraduates of considerable psychological training. The jury varied in number from 2 to 10, and was made up of men from Professor Munsterberg's elementary course. Beside this regular panel, several research students not in the experiment sat occasionally on the jury and numerous other students of psychology frequently acted as jurors. All who took part were greatly interested in the experiment, and all the subjects took the task of deceiving the jury very seriously, doing their utmost to outwit both jury and experimenter. The subjects were instructed at the beginning to choose an equal number of "T" and "L" stories, but although a list of previous choices was kept for each subject, this instruction could not be repeated without marring the conditions of the experiment. As a result, the subjects usually chose to lie more frequently than to tell the truth.

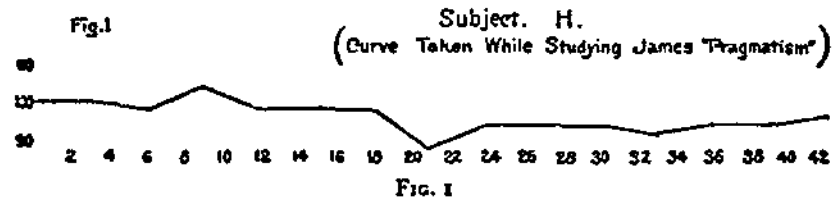
4. Results

A. Intellectual Work

In the above summary of physiological factors involved in systolic b.p. it will be remembered that the statement was there made that no one of such factors was influenced by intellectual work. This statement is substantiated by preliminary tests made upon all the subjects who took part in the experiment. B.p. records were taken while the subjects were doing arithmetical work at high concentration, while they were studying for college courses, and several extra short records were taken while inventing stories similar to the ones necessary for this experiment. A few significant variations were found, all of which could be directly correlated with some intense emotional intrusion; but during the actual mental concentration no uniform curve could be found either for all the men, or even for different records of one subject. No rise of more than 4 mm. was

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noted, and although the general tendency seemed to be a diminishing of pressure during a long period of mental work, no very significant or uniform descent of the curves could be noted. A single typical curve will present the general results on this point as clearly as would an extended tabulation.



It will be noted that this record extended over 42 min., in which time the subject covered 34 pages, with an excellent mastery of the thought therein contained, pressure being taken every three minutes. The major part of the curve is well below the initial pressure, and the single rise of 4 mm. is neither sufficiently high nor sufficiently prolonged to be significant. How then shall we account for such small, irregular fluctuations? It seems that we need not look beyond purely physiological causes. Besides the frequent minor irregularities of normal heart beat and vaso-motor adjustment, the factors of respiratory waves of b.p. and the longer waves due to rhythmical variations in the tonicity of the vaso-constrictor center under unusual conditions must be taken into account. In this light of the numerous and inevitable variations due to such constantly acting causes, it seems a safe general rule to regard no systolic variation below 6 mm., and perhaps none below 8 mm., as significant of major emotional influence. It is certainly possible that the intellectual work, besides raising the peripheral resistance and diastolic pressure, may also effect respiratory and minor chemical changes which cause systolic variations; but such physiological effects, at all events, seem to depend largely upon the temporary condition of the individual organism, and so may be dismissed as unimportant for the purposes of the present experiment. A careful study of the pressure changes during the "preparation" periods of the experiment shows a general result very similar to the preliminary intellectual work tests; while correlation of introspective reports of where intellectual work became necessary in the course of the narrative with the pressure record at such points fails to show any increases of pressure.

B. General Results of Effect of Deceptive Consciousness

In a word, a uniform and significant systolic pressure curve was established by the results, as symptomatic of the deceptive consciousness. A rather surprising secondary result was the appearance of an almost equally definite Truth curve. Before proceeding to analyze the general aspects of the significance of these b.p. modifications, it may be well to note the two most general and plausible doubts which can be advanced concerning the possibilities of significant results under the conditions of this experiment. (1) Is the necessity for deceit sufficiently vital to furnish emotional stimuli for significant rises in b.p.? (2) If a sufficiently intense emotional situation is produced, will not the presence of witnesses, etc., cause exactly similar emotional influence while the subject is telling the truth? Let us glance, in answer, at the highest lying curve obtained in contrast with the lowest lying curve obtained contrasted with the highest truth curve of that subject.[9]

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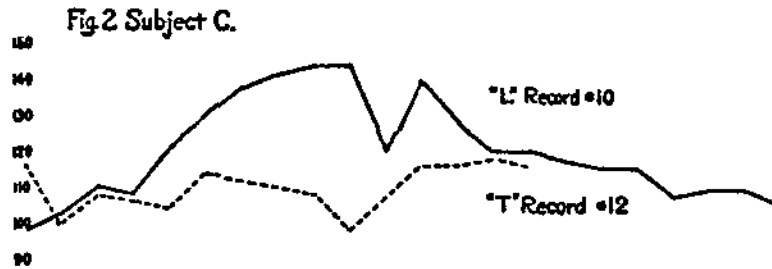


FIG. 2

The two most extreme curves, taken from the record of Subject C, conclusively indicate that neither doubt invalidated all the records taken, and the curves representing least extreme b.p. differences for truth and lying establish the significance of the pressure modifications in all the tests taken. In No. 10, Subject C, it can not be doubted that some very strong emotional situation was produced by the conditions of the experiment, since it will be noted that a total rise of 46 mm. in the b.p. was recorded. In No. 12, on the other hand, the central processes of the same subject, under the same conditions of witnesses, cross-examination, etc., caused a drop in the b.p. of 18 mm. toward the end of the cross-examination, with a return to initial pressure when the story was over, and a rise of only 2 mm. as the verdict was delivered. This and similar records seem to indicate very clearly that, during the telling of a truthful story to a suspicious and critical audience there is a more or less typical emotional (or other central) grouping of conscious factors which tend to inhibit any general emotional reactions to environment capable of increasing pressure, and which exert a positive influence over physiological conditions. How strong and consistent this influence may be can only be determined by a study of the individual results. The 8 mm. rise shown in record No. 11, Subject G, is the smallest b.p. increase recorded during deception by any subject and appears just on the edge of the field of pressure modifications significant of major emotional influence. It would seem that deception wrought little havoc in Subject G's emotions, but when we glance at record No. 4, we see that while telling the truth, G's b.p. did not rise at all, dropping 4 mm. in his highest truth record. The results, then, of this experiment unquestionably show significant b.p. changes under the influence of the deceptive consciousness.

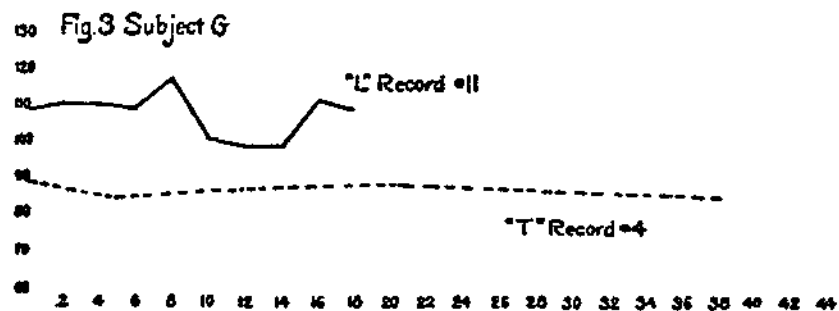


FIG. 3

But what constitutes the "significance" of a pressure curve symptomatic of deception? What differentiates such a curve from any chance rise

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of b.p. caused by the arousal of some incidental emotional complex? The answer to these questions is to be derived from a study of the above typical curves.

1. The amount of the rise is, in all "L" curves, too great to be accounted for by moderate degrees of intensity of any emotions other than fear or rage, the minimum rise being 8 mm.

2. The duration of the rise is, in "L" curves, too long to be symptomatic of a sudden and transient emotional association, the minimum duration of any rise being 8 minutes.

3. The rise of an "L" curve occurs in regular, climactic manner. The pressure starts its rise close to the beginning of the recital in every record as in the typical curve above, climbs with varying abruptness but with great consistency of movement to a definite climax, and then recedes. Subsequent questions may cause secondary climaxes, but these are patently subsidiary to the steady, persistent climb and fall of the pressure curve taken as a whole.

4. The apex of each curve is correlated very closely with that point in the subject's testimony which marks the crisis, or climax, of the whole "job" before the subject. This was determined partly by introspection, but chiefly by observations on the manner and attitude of the subject, and by noting the whole construction and plan of the false "alibi." Thus, like the other elements of "significance" in "L" curves, such correlation is capable of objective determination.

Fig. 4*

Subject.....	A	B	C	D	E	F	G	H	I	J
Av. rise in "L" curve..	12.6	14	26.7	18.5	17.3	17.2	14	15	20.8	18.2
M.v.....	2.2	4	10.2	7.7	3.3	4.9	4	1	1.7	3.4
Highest rise in "T" curve.....	+6 and -10	+8	+18 and -4	+4 and -4	+6	+14	-4	-6	-10	-6

*Since closer fractional determination would be meaningless, the averages are given as of the nearest millimeter.

The table in Fig. 4 will present a rough summary of the general results, the extremes of which have already been shown in Figs. 2 and 3.

It will be noted, from this table, that every subject's average b.p. increase during deception is well above his highest "T" curve, and that, with 2 exceptions, the highest "T" pressure mark plus the m.v. from the "L" increase is still below the average "L" rise. It is further true, although it does not appear in the above table, that, with the same two exceptions, every subject's lowest "L" curve was significantly higher than his highest "T" curve. The m.v.s. are, on the whole, low, seeming to suggest a rather fixed amount of b.p. increase for each subject, although the number of measurements is by no means sufficient to prove such a generalization.

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A total average of 16 mm. rise in b.p. during 56 deceptions, by 10 different men, all such "L" curves having the significant characteristics pointed out above, seems conclusive proof of marked modification of b.p. during deception.

C. Individual Results

In order to determine, if possible, the psychological causes of the b.p. modifications during deception, as well as to study the uniformity of a possible truthful complex, it is advisable to review the individual records, subject by subject. Only in this way can the curiously close correlations of introspection and pressure record, the individual peculiarities, and certain interesting mixtures of truth and lying be considered. I shall attempt to bring out these salient features very briefly with each set of records, summarizing, thereafter, my own conclusions as to meaning and interpretation.

Subject A.--The stories composed by Subject A were, on the whole, very poor alibis. They were rambling, indefinite, rather wild, and very improbable, yet while telling the truth this subject managed to convey, by his peculiar manner of narration, the impression that he was lying, so that the jury found it very hard to judge correctly in any case. Subject A introspected during deception, a feeling of "responsibility" and fear of questions to come. He found lying "restful," lax, and pleasant; but while telling the truth his feeling tone was "indifferent."

Notable Individual Records. No. 3.--At the 5th question subject felt "relief," and "elation" at supposed success in fooling jury. It will be noted that the pressure falls at this point, and rises during introspection when "worry" was felt lest he had not told a good lie after all.

No. 5.--Objectively, this story was a wild lie. Yet at the very first question, subject realized that he had betrayed himself to the jury and experimenter, and felt "disgust," "shame," and subsequent boredom. It will be noted that, unlike most of A's "T" records, this consciousness produced a consistent drop in pressure. The most salient characteristic of the introspection was utter lack of interest and complete relaxation. No. 6 shows a similar drop from 132 to 116 in 8 min. after subject betrayed himself, consciously, in the 10th question.

No. 8.--Subject ran hard, just previous to coming into experiment, for about a quarter of a mile. The persistence of the influence of strenuous physical exertion is to be seen in the record, 26 min. being required for pressure to return to 122 (approximately normal). A single lie, told in answer to the last question, with introspective confession of this lie, sent the pressure up again 6 mm. in as many minutes.

Subject B.--B introspected, when lying, fear of many things, and it was for this reason that he did not choose to lie more often--he feared to fear! although, when it was over, he found he enjoyed the deception more than the truth. His stories were both good, although not ample, and his manner of telling both truth and falsehood was even and quiet. B felt "tense" during both deception and truth, the lying itself being more pleasant, and keeping him more "alert." It will be noted that a majority

Subject A

T				L										Conscious of Detection		T and L			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
120	116	2 2	118 118 118	120	118	120	118	3 2 2	116 120 124 122	2 2	118 120 124					118	128		
End of preparation	←		←	←	←	←	←		←	←	←					←	←		
118	6	114	2 2 2 2	118 124 108	124	128	6	124	4	130	2 2 2 2	128 128 126	2 2 2 2 2	130 124 136 130 130 126	6	112	5	128	
End of ques. 1-5	←		End of recital	End of ques. 1-5	←	←	←		End of recital	←	←		←	End of ques. 1-5	←	←	←		
120	11	118	2 2 2 2 2	118 116 114 116 108 108	128	124	10	132	7	128	2 2 2 2 2	126 122 124 126 126	2 2 2	124 128 122	19	112	11	124	
End of ques. 6-10	←		End of cross-exam.	End of ques. 6-10	←	←	←		End of cross-exam.	←	←		←	End of ques. 6-10	←	←	←		
118	9	116	2	112	100	132	8	116	11	126	2 2	118 116	2	120	8	118	10	122 124 ¹	
End of introspection	←		Verdict given	End of introspection	←	←	←		Verdict given	←	←		←	End of questions by jury	←	←	←		
10	120	10	116	2 2	114 118	118	114	12	122	18	120	2 2	116 118	2 2	128 122	10	108	2	128
												End of introspection	←	Period of quiet	←	←	←		
												2 2	116 116	5	118	10	108	11	126

Systolic Blood Pressure Symptoms of Deception
Figure 5

¹ Number at head of each vertical column indicates which story was used in that record. Three digit numbers are mm. b. p.; and one or two digit numbers in narrow columns indicate min. s. elapsing between b. p. readings.

¹Lied

Systolic Blood Pressure Symptoms of Deception

No. 7.--Introspection revealed that for some minutes before coming into the experiment, B had been planning to deceive the jury. This would seem to have raised the initial pressure well above normal level (B had done no physical exercise), the actual lying sent it still higher, and it was still on the downward trend toward normal level when B left.

Subject C.--This subject, did a great deal of laughing, but aside from this made an excellent witness, telling very plausible complete lies. It will be noted that, nevertheless, C's blood pressure modifications were greater, during deception, than those of any other subject. He found lying "easy," but, while deceiving, he felt "like during an exam," "nervous," and "embarrassed." Nevertheless he felt more "tense" during truthful stories, and found them unpleasant, since he felt he could not make the b.p. rise. The apparent great elasticity of this subject's b.p. is to be noted.

Notable Individual Records. No. 2.--C introspects that he "worked hard" to raise the b.p. by suppressed laughter, and this is literally true. This "suppressed laughter" involved strenuous muscular contractions all over his body. Such contractions, as would be expected, sent the b.p. up, but it is to be noted that the rise did not follow the form of a lying curve. The b.p. was simply raised 8 mm. and kept there as long as that kind and amount of muscular contraction continued.

No. 7.--More laughter evidently sent the pressure up slightly; but it is probably that its initial level was not the day's norm, and that such laughter had little influence beyond initiating the return to such average level.

C made a mistake in questions 8 and 9, owing to a slip of memory, and recognized that he had made it, but did not correct it lest he be thought to have lied. It is very significant to note that such uncorrected mistake caused no rise of b.p.

No. 10.--This was highest curve obtained for any subject, and C introspected marked fear, throughout, which he attributed to the fact that he had not had time to thoroughly construct an alibi.

No. 11.--Short but strenuous physical exercise raised the initial b.p. level, but in 4 min. it had returned to 102 or about normal, from which point the "L" curve starts its steady climb.

Subject D.--The stories of this subject were largely negative and as scant as possible. D found deception pleasant, and lax, but introspected "fear as before an exam," with accompanying "contractions of the diaphragm." He also felt angry if forced with questions.

Notable Individual Records. No. 4.--In this record, D chose the "I" story, but feared from the first that it would not cover all the questions asked. This feeling seems to have led the subject to lie during questions 8 and 9, and it was only at this point that he felt "diaphragm contraction." It will be noted that at this point the b.p. rose 14 mm. in 8 min., and the experimenter was able to enter a correct judgment, based on this increase, as to the truth and deception of D's story.

Systolic Blood Pressure Symptoms of Deception

Figure 7

FIG. 7
Subject C

T					
2	4	7	11		
100	110	94	118		
End of prep- aration	←	←	C returns		
118	10	99	7	102	10 2 2 102 110 108
End of ques. 1-5	←	←	End of prep- aration		
118	11	112 ¹	10	104	2 106
End of ques. 6-10	←	←	End of recital		
118	7	110	17	104	2 2 2 116 114 112 110 100 110
End of intro- spection	←	←	End of cross- exam.		
96	18	106	15	104	2 2 118 118
					Verdict given
					2 2 120 118

FIG. 7—Continued
Subject C

L													
1	3	5	6	8	9	10	11		12				
112	104	118	115	112	2 2 2 2 2 2 2 2 2 2 2	118 120 122 124 126	2 2 2 2 2 2 2 2 2 2	100 104 112 110 122	2 2 2	130 126 102			
End of prep- aration	←	←	←	←	←	←	←	←	←	←			
120	126	9	122	8	126	8	130	2 2 2 2 2 2 2 2 2 2 2	130 140 146 136 142 136 146 146 140 136	2 2 2 2 2 2 2 2 2 2 2	132 140 144 146 146 122	2 2 2 2 2 2 2 2 2 2 2	130 138 142
End of ques. 1-5	←	←	←	←	←	←	←	←	←	←			
128	128	10	130	16	118 ¹	9	130	2 2	120 134	2 2	142 130	2 2 2	146 140 144
End of ques. 6-10	←	←	←	←	←	←	←	←	←	←			
128	134	7	124	6	122	12	126	2	138	2	122	2 2 2	130 126 122
End of intro- spection	←	←	←	←	←	←	←	←	←	←			
118	102	19	108	14	108	5	118	2 2	122 120	2 2	122 118 118 110 112 112 108	2 2 2 2 2 2 2	130 132
						Period of quiet.	End of intro- spection.				←	←	←
						16	108	2 2	122 116	2	104	2	120

¹ Suppressed laughter.

Systolic Blood Pressure Symptoms of Deception

Figure 8

FIG. 8
Subject D

T					
8		9		10	
	102	2 2 2	92 92 96 94		102
End of preparation		←		D returns?	
5	100	2 2 2 2 2 2	94 94 90 88 92 94 96	10 2 2	102 90 86
End of ques. 1-5	End of recital.			End of preparation	
7	100	2	90	2	90
End of ques. 6-10	End of cross-exam.			End of recital	
6	90	2	90	2 2 2	94 96 98
End of introspection	Verdict given			End of cross-exam.	
	90	2 2 2 2	96 94 94 94	2	90
		End of introspection		Verdict given	
		2 2	90 92	2	94

FIG. 8 (continued)
Subject D.

L											T and L						
1		2		3		5		6		7		10		11		4	
	96		90		84		90		86		90	2 2 2	102 100 88 102	2 2	110 103 100		112
End of preparation		←		←		←		←		←		←		←		←	
	102		102		84	7	90	7	102	10	108	2 2 2 2 2	110 128 116 106 96	2	126	6	110
End of ques. 1-5		←		←		←		←		←		End of recital		←		End of ques. 1-5	
	108		104		90	9	100	6	90	7	106	2	96	2 2 2 2	142 106 104 100	8	108
End of ques. 6-10		←		←		←		←		←		End of cross-exam.		←		End of ques. 6-10	
	90		98		94	4	90	8	92	10	106	2	98	2	96	8	122 ¹
End of introspection		←		←		←		←		←		Verdict given.		←		End of introspection.	
	100		98		82	18	88	8	82	15	104	2 2	100 96	2 2	100 100	10	98
														End of introspection			
														2 2	96 96		

¹ Lied in answering Ques. 8, 9.

Systolic Blood Pressure Symptoms of Deception

No. 5.--D tried to "beat the b.p.," by taking no interest in the deception, but it will be noted that the b.p. rose as usual. Also D introspected fear, and an "alertness despite himself."

No. 12.--Slight physical exertion before D came to the experiment at all may have raised the initial b.p. level some what.

Subject E.--E's stories were racy, dramatic, but inaccurate and careless. He was very suspicious of all questions and directions, and had a great desire to outwit the experimenter. While lying he introspected "nervous excitement," inhibitions of ideas due to feeling "like stage fright" and "worry" as to b.p., although he found deception very pleasant, and telling the truth uninteresting and indifferent.

Notable Individual Records. No. 4.--E added several details to the "I" story, but claimed to regard this just as "telling it in his own words," and introspected "no excitement." From his manner and story, however, he seemed to have a lurking background of vaguely conscious fear that he would be caught up on some of these details, and it will be noted that the b.p. rose very evenly to the slight extent of 6 mm., rather in contrast to its usual more erratic behavior during "I" records.

No. 11.--Initial height of b.p. is due to short, strenuous physical exercise.

No. 12.--Subject while outside after the first b.p. reading sent b.p. up by smoking furiously. He hoped thus to keep it at a high level, and fool the experimenter, but it will be noted that it fell to normal level in 2 min.

Subject F.--Less weight is to be given to this subject's records than to those of any other subject, because of the many elements which would have to be carefully analyzed out. He told wild, unconvincing stories, and his involuntary movements and stuttering should all have been recorded by a very complicated apparatus if his b.p. records were to be relied upon as a conclusive test of cerebral factors. During deception he felt "sneaky," cold, "carefree," pleasant, excited and "frightened." During "I" stories he felt the "strain" in trying to be accurate. He inhibited symptoms of extreme nervous fear during deception, such as chattering of teeth and trembling of hands.

Notable Individual Records. No. 4.--Low general level of b.p. due, apparently, to lack of sleep.

No. 6.--Although the record shows a drop of 16 mm., subject was conscious of having made uncorrected mistakes. Evidently whatever emotion accompanies this idea does not increase the b.p.

No. 9.--Here the b.p. rose to 100 or 102, and was kept there pretty consistently until the subject had entirely finished speaking, not following the form of a curve of deception, but merely exhibiting irregular increases and slight drops. This peculiar b.p. behavior is to be explained by intermittent body-shaking laughter, and bad stuttering throughout the narration and introspection.

Systolic Blood Pressure Symptoms of Deception

Figure 9

FIG. 9
Subject E

T							
1	4	5	7	12			
108	102	104	108	102			
End of preparation	←	←	←	E returns			
98	8 104	4 98	4 108	10 2 2	126 106 92		
End of ques. 1-5	←	←	←	End of preparation			
112	6 108	19 100	9 110	2	106		
End of ques. 6-10	←	←	←	End of recital			
96	15 108	7 92	15 108	2 2 2	104 102 94 104		
End of introspection	←	←	←	End of cross-exam.			
10	100	12 106	7 96	12 108	102		
				Verdict delivered			
				94			

FIG. 9 (Continued)
Subject E

L										
8	3	6	8	10			11			
99	100	94	94	2 2	90 94 114		2 2	128 114 114		
End of preparation	←	←	←	←						
100	110	3 98	5 100	2 2 2 2 2 2	102 100 98 100 106 92 100		2	114		
End of ques. 1-5	←	←	←	End of recital						
104	112 10	114	6 104	2 2 2 2 2	110 ¹ 110 ¹ 102 112 92		2 2 2 2 2	110 132 100 100 126 ²		
End of ques. 6-10	←	←	←	End of cross-exam.						
106	106	8 102	12 110	2 2	112 104		2	100		
End of introspection	←	←	←	Verdict given						
100	106	19 94	19 94	2 2	102 88		2 2 2	112 100 112		
				End of introspection						
				4 106						

¹ Confessed lying.

² Jury asked betraying question.

Systolic Blood Pressure Symptoms of Deception

Figure 10

FIG. 10
Subject F

T					L										
6		8		9		4		5	7	10		11			
	118		114	2	90		78		96		120	2	106		130
				2	92							2	108		118
				2	94							2	112		106
				2	100							2	114		
End of preparation		←		←		End of preparation		←		←		←		←	
3	110	4	108	2	102	7	104	4	102	4	138	2	118	2	108
				2	102							2	126	2	118
				2	104							2	116	2	110
				2	102							2	118	2	116
				2	102							2	112	2	110
				2	102							2	112	2	
				2	102							2	106		
End of ques. 1-5		←		End of recital		End of ques. 1-5		←		←		End of recital		←	
8	102	12	106	2	100	7	94	9	106	7	128	2	108	2	106
End of ques. 6-10		←		End of cross-exam.		End of ques. 6-10		←		←		End of cross-exam.		←	
8	108	12	112	2	100	7	84	12	90	14	112	2	102	2	104
End of introspection		←		Verdict given		End of introspection		←		←		Verdict given		←	
10	104	2	92	2	96	14	82	12	100	10	110	2	96	2	92
				2	92									4	100
				2	94										
Period of quiet		End of introspection		End of introspection		End of introspection		End of introspection		End of introspection		End of introspection		End of introspection	
		10	114	2	102									6	100
				2	96										
				2	90										

Systolic Blood Pressure Symptoms of Deception

Figure 11

FIG. 11
Subject G

T		L									
1	4	2	3	6	7	9	11				12
104	90	102	82	98	104	2	92	2	118	2	110
							94	2	112	2	112
ad of prepara- tion	←	←	←	←	←	←	←	←	←	←	←
98	5	86	110	96	3	100	3	108	2	112	112
									2	104	100
									2	104	104
									2	104	112
									2	106	100
									2	100	
End of ques. 1-5	←	←	←	←	←	←	←	←	End of recital	←	←
84	7	88	100	78	9	118	9	114	2	104	118
									2	100	102
									2	102	100
End of ques. 6-10	←	←	←	←	←	←	←	←	End of cross- exam.	←	←
94	8	90	98	90	7	96	6	118	2	100	100
End of intro- spection	←	←	←	←	←	←	←	←	Verdict given	←	←
96	18	86	108	90	13	90	20	106	2	102	112
									2	90	110
									2	90	
									End of intro- spection		
									2	84	84
									2	90	

FIG. 11 (continued)
Subject G

T and L ₂			
5	8		
88		102	
←		←	
3	88	9	96
End of ques. 1-5	←		←
10	100	9	102
End of ques. 6-10	←		←
10	100	10	100
End of intro- spection	←		←
		Ques. a. by jury	
20	102	11	112 ¹
		←	
		9	92

¹Lied to jury.

Systolic Blood Pressure Symptoms of Deception

Subject G.--Stories were very plausible, but not very complete and careful. During deception, G experienced slight inhibitions, and felt "worried" and "anxious." Telling the truth was harder and less pleasant for G than lying.

Notable Individual Records. No. 2.--It will be seen that this shows a typical truth record, and although outside the prescribed conditions of the experiment, the story told was strictly true. After reading the "T" story, G thought it was improbable. Therefore, to correct an improbable tale he narrated incidents which actually had happened to him, and which, localized at the time and place of the alleged crime, formed a simple and complete alibi. G felt throughout that he was correcting a mistake, and telling the real truth, so that this record seems fairly listed as a real truth record.

No. 5.--G read the "T" story, intending to tell the truth. The second reading shows such was his intent at the moment he finished his preparation. But, yielding to an impulse to improve upon the story given, G began to enlarge upon it, with a consequent consciousness of deception and a rise of b.p. At the beginning of the introspection he continued to lie, telling me that he thought he was to use the story given merely as a synopsis but soon laughed and confessed his deception. It will be noted that the b.p. did not fall at the end. In all probability it was much higher at that point toward the end of the introspection where he reached the climax of attempted deception of the experimenter, and had started down toward normal level when the last reading was taken.

No. 8.--This is an excellent example of a simple "T" curve broken by a single lie.

Subject H.--H took less actual interest in any sort of work than any other subject and for this reason both the number and quality of his "T" records are significant. His lack of active interest, he introspected, led him to choose the truth 7 times out of 10, and the feeling persisted throughout these "T" records. It will be noted that every one is a downward curve, varying in drop from 6 mm. to 16 mm. H found deception pleasant, but "disquieting," and "irritating."

Notable Individual Records. No. 3.--H tried to believe what he said to keep the b.p. down, but his failure is evident in the regular "L" rise of 16 mm.

H's b.p. record taken during study (see also Fig. 1) seems, on the whole, to show more irregularity, and more tendency to hover about two distinct levels than do his "T" records, while it may be said that H's study record was more consistently and evenly downward in trend than those of any other subject.

Subject I.--I's stories were very bare of detail, and told in a plain, precise manner. This was the only subject who preferred truth to deception, and he gave as the reason "that he always found any activity carrying an indifferent feeling tone more pleasant than one stirring up emotion." During deception, he introspected fear of coming questions, and "irritation" at difficult queries. He also felt "flustered" and "disgusted" during deception.

Systolic Blood Pressure Symptoms of Deception

Figure 12

FIG. 12
Subject H

T										
	1	4	5	6	7	8		11		
	106	96	98	96	106	98		2	98	
								2	98	
End of preparation	←	←	←	←	←	←			←	
	104	4 94	3 98	4 92	4 90	6 92	2	88		
End of ques. 1-5	←	←	←	←	←	←		End of recital		
	94	10 92	8 98	9 92	6 92	7 92	2	96		
							2	90		
End of ques. 6-10	←	←	←	←	←	←		End of cross-exam.		
	92	7 82	9 96	7 90	9 94	14 94	2	98		
End of introspection	←	←	←	←	←	End of ques. by jury		Verdict given		
	96	13 92	10 92	10 96	20 92	3 96	2	92		
Period of quiet						End of introspection				
10	100					14 94				

FIG. 12—Continued
Subject H

L							Record Taken During Study	
	2	3	9		10			
	92	88	3 96	96	2 108	2 92	3 102	
			2 96	96	2 108	2 90	2 102	
End of preparation	←	←	←		←		2 100	
							2 106	
							2 100	
							2 100	
					2 96		2 90	
			2 106		2 108		2 96	
			2 112		2 118		2 96	
			2 108		2 122		2 94	
			2 110		2 120		2 96	
					2 108		2 96	
					2 116		2 98	
End of ques. 1-5	←	←	End of recital		←		Total of 30 mins.	
	106	98	2 106		2 112			
			2 106					
End of ques. 6-10	←	←	End of cross-exam.		←			
	1	100	2 100		2 120			
End of introspection	←	←	Verdict given		←			
		104	2 106		2 112			
			2 106		2 106			
					2 96			
Period of quiet	←	←	End of introspection		←			
	10 86	2 104			2 92			
		2 100						

* Record incomplete.

Systolic Blood Pressure Symptoms of Deception

Figure 13

FIG. 13
Subject I

T					L						T and L		
4	6		9		5	7	8		10		11		
102	110	2	126		104	124	114	2	106	2	110		
		2	112					2	106		112		
		2	106					2	104	3	112		
		2	112					2	108				
									106				
End of preparation	←		←		←	←	←		←		←		
16	92	8	92	2	122			2	112				
				2	112	6	114	12	128	7	118	2	118
				2	110					2	118	2	110
				2	110					2	110	2	108
				2	110					2	110		
				2	110					2	104		
End of ques. 1-5	←		End of recital		End of ques. 1-5		←	←		End of recital		←	
5	102	7	108	2	116	8	114	8	130	7	116	2	108
End of ques. 6-10	←		End of cross-exam.		End of ques. 6-10		←	←		End of cross-exam.		←	
8	100	7	104	2	118	10	118	12	132	6	120	2	120
End of introspection	←		Verdict given		End of introspection		←	←	End of cross-exam. by jury	Verdict given		←	
15	104	10	102	2	116	13	106	17	120	7	118	2	108
				2	114							5	114
				2	112								
			End of introspection						Re-direct exam. ends	End of introspection		←	
			2	122					2	124	5	102	5
			2	120						Period of quiet			
			2	116					17	110			

Systolic Blood Pressure Symptoms of Deception

Notable Individual Records. No. 11.--Subject opened and read the "L" directions part way through, but changed his mind because he thought of something of his own that he wanted to do. He did not do any physical exercise to raise the b.p., and came back with a "lurking" fear he would be asked if he had read directions. As he thought it over, during the preparation period, this fear became stronger and stronger, he reported, and a corresponding rise in b.p. will be noted. When he was allowed to tell his own story he told the truth without fear, but during the cross examination he was asked if he had opened the envelope, and he replied "No." This was all, and at that point a b.p. rise of 12 mm. in 2 min. is to be noted.

This latter rise is not significant of real deceptive consciousness, but only of one of those isolated emotional associations (of fear) which may occasion abrupt rises of b.p. but do not cause the curve significant of a consistent lying attitude. Such a curve, however, is found in the first part of the record during the preparation period.

Subject J.--J's stories were plausible, consistent, but not ample; and were told in a straightforward manner. J gave the ablest introspection of any subject in the experiment. Telling the truth was unpleasant to J. He felt "restful," and "could not overcome the feeling of relaxation," but this relaxation was physical and intellectual rather than emotional. Deception was pleasant, exciting, "tense emotionally," with a "feeling of excitement near the heart," frequently "betraying its real affective quality of fear."

Notable Individual Records. No. 6.--J tried for, and thought he obtained, a "laxness of muscle and attention," but the b.p. shows a good "L" curve, nevertheless.

No. 11.--Initial b.p. was raised by short, hard physical exercise. In this record, J introduced an experiment of his own. He chose the truth, but determined to conceal his motive for doing a certain unusual act, and to lie about it if questioned. Throughout the record the b.p. shows a tendency to rise at crucial points, i.e., first, when he told of the act at the beginning of his recital, next where he told of the motive for another act at the end of the recital, and finally as he eagerly awaited the verdict of jury and b.p. curve. Nowhere did the falsehood gain sufficient importance in the story to bring about a full deceptive attitude, but it constantly tended to do so whenever the fear in the background of consciousness was touched by associations, or crept toward the focus in expression. In short, this curve represents a story told in fear that the witness will be obliged to lie, with a final fear that the single point of deception may have been detected after all.

D. Interpretation of Individual Results

Benussi, as above mentioned, made scarcely any attempt to analyze or to psychologically describe the deceptive consciousness. He does report, however, that his subjects found the work of lying hard, disquieting, and unpleasant; and that they introspected "tension of attention, excitement, and discomfort." As reported, this introspection does not seem illuminating, nor does it agree with the introspection of the subjects in this

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Figure 14

FIG. 14
Subject J

T		L								T and L			
1		5		6		7		9		10		11	
	114		100		96		100	3 2 2	118 115 116 116	2 2 2	92 92 100 96	2 2 2	114 122 112
End of preparation			←		←		←		←		←		←
9	108	5	110	4	102	9	112	2 2 2 2 2 2 2	124 130 134 124 132 124 126	1 2 2 2 2 2 2	118 96 100 100 100 102 110 102	2 2 2 2	134 106 122
End of ques. 1-5			←		←		←	End of recital			←		←
12	110	10	116	9	108	7	112	2 2 2 2	120 120 120 120	2 2 2 2	98 106 108 100	2 2	108 116
End of ques. 6-10			←		←		←	End of cross-exam.			←		←
9	110	6	112	8	108	10	118	2	112	2	102	2	118
End of introspection			←		←		←	Verdict given			←		←
2	114	13	102	12	96	18	98	2	102	2 3	110 100	2	120
Period of quiet			←		←		←	End of introspection			←		←
11	114							2 2	108 110	2 2	100 100	2	108

experiment. It will be noted in the individual results reported above, that all subjects, with the exception of Subject I, reported the lying more pleasant than telling the truth. Moreover, the pleasantness of the whole attitude, or consciousness, seems to depend upon the added interest of the whole proceeding, as an adventure is more pleasant than routine, and seems also to depend upon the success or failure of the attempt to deceive at any particular point. In this, the deceptive consciousness seems to resemble every other complex state of mind, and does not admit pleasant or unpleasant affective tone as a crucial criterion, or even as a consistent constituent. Nor does "tenseness" serve as any better indicator of deception. Seven subjects introspected tension, and four further designated this feeling as "affective tension." These four were asked, at each experiment, to record the height of this feeling and in no single instance did the "tension" climax have any correlation whatsoever with the climax of the b.p. curve. The tension element really consists of what Benussi calls "tension of attention," or, as it would ordinarily be called, concentration of attention on the task before the subject. It has been made clear by experiment in other fields that concentration of attention involves a certain involuntary setting of the muscles, and very probably general contractions of large groups of these muscles. Yet these same contractions, due to concentration of attention, occur during study, or during the other forms of mental work used in the preliminary intellectual work records, and, in fact, exactly the same sort of concentration with a feeling of "tension" was introspected during several of the "I" records. It is significant that in these "I" records the b.p. did not fall, but remained on an almost exactly even level throughout. Thus we must recognize a certain tonicity of involuntary muscles due to concentrated attention as an almost constant, if not invariable, concomitant of deception; but we must also recognize that the utmost function of such tonicity is to keep the b.p. from falling, and that concentrated attention is by no means peculiar to deception. We must then seek further for the essentially characteristic constituents of deceptive consciousness.

Fear and anger, as mentioned above, are the only two emotions which could produce moderate increases of b.p. and since the records above show just such moderate but persistent b.p. changes, it would seem probable that one or both emotions constitute the true key to the mental state during lying. It will be noted, from the individual introspection given above, that every subject introspected some complex emotional state containing the element of fear, while many designated the feeling as simple fear. "Feeling of responsibility," "fear of awkward questions," "nervousness as in an exam," "worry," "sneaky feeling," and feeling "flustered" all point inevitably to fear as the common denominator and chief factor of all introspections during deception.

Is fear, then, the sole emotional element in the deceptive consciousness? It seems probable that, during a majority of the deception, it is.

Five subjects, however, introspect "irritation" and anger at certain points in their false testimony. Outward signs of anger appeared, in all subjects, whenever they were outwitted into betraying themselves under cross-examination, when they gave their case away by careless inconsistencies, and occasionally when they considered that they were pressed too closely with questions. From the introspection of the subjects in this

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experiment, then, it plainly appears that fear always, and anger when in immediate danger of detection, are the characteristic emotional factors betraying deception through the b.p.

What, then, is the psychological organization and mode of operation of fear and anger during deception, and what is their relation to the other conscious elements then present? The stimulus to fear is, of course, a central situation mirroring a relation of danger between subject and environment. Professor Cannon substantially proved that, with regard to the primary factor of fear,[10] "the natural response is a pattern reaction, like inborn reflexes of low order, such as sneezing, in which impulses flash through peculiarly cooperating neurone groups of the central system, suddenly, unexpectedly, and in a manner not exactly reproducible by volition." [11] That this central response of fear may occur instantly in reaction to sudden danger is a matter of everyday experience, and that ensuing b.p. changes are scarcely less instantaneous is evidenced by records like No. 11 of Subject I where, at the telling of a single monosyllabic lie, the b.p. rose 12 mm. in 2 min. If, then, the b.p. response so immediately follows the creation of a dangerous situation, we would expect to find either an initial increase as great as the b.p. elasticity of the individual permitted, with b.p. remaining at this level throughout the deception; or simply a series of sharp isolated rises at each new lie. In a few of the above results we find "L" records exhibiting the last-mentioned tendency, but far more frequently we find the curve designated above as the significant lying curve. Another factor, therefore, must be at work. The introspection indicates that this factor is to be found in the attempted voluntary control of the fear impulse. The attempt took a distinctly individual form in every case, but the common factor in all the methods employed as reported by introspection was the attempted elimination of fear from consciousness by a fixation of the attention on the purely intellectual elements of the story. Thus a significant lying curve is a function of the struggle between the involuntary impulse to express fear in response to awareness of danger, and the voluntary focusing of attention to exclude the fear from consciousness. As the ideational elements of the deception become more and more complex, the awareness of danger becomes more and more firmly established in the foreground of consciousness, and, as the stimulus is thus enhanced, the "natural response" of fear becomes stronger and stronger. In some cases the fear impulse probably never entirely breaks away from the restraint imposed by voluntary inhibitions, but in other records we see evidence that, at the danger climax, the fear impulse is wholly uncontrolled. The close correlation between the height of the "L" curve and the climax of the intellectual test of deception evidentially substantiates the nature of this danger climax, and points to exactly that gradual return to normal b.p. level which actually appears in the records. This gradual decrease of fear symptoms is due not so much to strengthening of voluntary control, as to decrease in the force of the fear stimulus, *i.e.*, awareness of danger in the case of most subjects. The voluntary control seems to decrease with the necessity for such control and for this reason questions put at the very end of the cross-examination, or by the jury, may cause the fear impulse to run its momentary course unimpeded, betraying itself in short, pronounced b.p. increase. In the same way we may now explain the b.p. behavior when a subject comes to the experiment with the knowledge that he may be obliged to lie if certain crucial questions are asked concerning

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"guilty" acts. After the first question is safely past, the telling of the truthful story steadily removes the central stimulus to fear, and, correspondingly, the voluntary control is allowed to relax, with the result that if, later, the awareness of danger actually rises to the focus of attention, the resultant fear impulse is unchecked by volition (see record No. II, subject J). Exceptional subjects may, however, retain in consciousness their voluntary inhibitions to fear impulses despite the cessation of those impulses, and in such cases low, significant curves of deception take the place of short, sharp, isolated rises.

"Fear is a reaction aroused by the same objects that arouse ferocity," says James. "... the question which of the two impulses we shall follow is usually decided by some one of those collateral circumstances of the particular case." [12]

I would suggest that the collateral circumstance which always turns fear into rage is the occupation of the focus of attention by the awareness that there is no escape from the danger impending. This may occur, during deception, either by some sudden betrayal, or by the victory of fear in winning its way to conscious motor expression and so betraying the lie. In either case, the anger impulse supersedes the central fear reflex, and rage is registered in consciousness. But, since both emotions are expressed through the sympathetic nervous system, the visceral changes which have been taking place during fear continue during rage, and the b.p. level will merely depend upon the strength of the anger impulse aroused. If (as with Subject A, Record No. 5) the anger is slight, and of short duration, it will almost immediately allow the b.p. to drop as during a "T" record; if, however (as with Subject E, Record No. 10, No. 11), the anger felt is, at least momentarily, stronger than the fear previously in consciousness, a rise in b.p. will take place. In a situation such as that produced by deception in real life, it is very probable that rage at detection or at self-betrayal would be far more intense and of much longer duration than under the artificial conditions of the laboratory. Finally, there is little possibility that, in this experiment, emotions other than rage and fear were aroused to a sufficient degree of intensity during deception to break over into the sympathetic nerve channels and so affect the b.p., and probably in actual experience such contingencies would be of almost equally rare occurrence.

It may be noted at this point that, if we resolve the crucial deceptive factors into fear and rage, we have a seeming anomaly in the almost unanimous introspective report that deception was pleasant. But it was the whole experience of the deception that the subjects found pleasant, not the isolated fear, and perhaps not the actual moments when the fear was recognized as such. Men prefer bluffing at poker to playing a conservative hand, and the explanation would seem to be that excitement is more pleasant than quietude, any emotional experience being preferred, perhaps, to a purely intellectual activity. Where, as in actual court work, life and happiness might hang on the success of a deception, it is much more doubtful whether the whole situation during deception would be more pleasant than while telling the truth. Probably, in such cases, both would be disagreeable.

Whether the experience of fear can be pleasant per se is a more

difficult question, which need not be decided here. The popularity of such amusements as "scenic railways," the sole attraction of which lies in the fright on the steep inclines, suggests that fear may be pleasant--at least retrospectively.

Of the "I" records, 76 percent show downward b.p. curves, 62 percent showing final return of b.p. toward its initial level. On the whole this unlooked-for result seems too persistent to be entirely disregarded. Certainly no significant emotional element appears in the "I" introspection, and the only common factor there seems to be a very general mental and physical feeling of passivity. Thus the effort necessary to maintain attention on the task in hand is prominent in consciousness, and the subject remains indifferent to mistakes, or failures of memory. A general passive mental attitude of this sort might affect the b.p. in two ways: (1) By general relaxation of all muscles, and consequent lack of cardio-accelerator impulses, with the possibility of actual inhibitions at the accelerator center; (2) by vaso-dilations throughout the body such as occur during sleep,[13] with consequent lowering of diastolic b.p. and indirect reduction in systolic pressure. Such influences would, in short, tend to remove several of the ordinarily acting physiological factors which determine the subject's average b.p.; and would not prevail against any positive influences which might be suddenly introduced. That the uniformity of "I" curves is due to some such general negative influence is indicated by (1) that fact that it does not take effect in 24 percent of the "I" records; (2) the fact that it is clearly overcome in a few records by positive influences such as muscular contractions; (3) the fact that the average drop in b.p. during "I" records was only 8 mm., as contrasted to an average increase of 16 mm. for all "L" records, and (4) the fact that the "I" curves are much more irregular than the "L" curves, and subject to inexplicable variations as large as that record's minimum decrease. Thus it appears fairly certain that the downward "I" curve is a function of one or more general, negative influences, but it is much more difficult (and perhaps less profitable) to discover which of the great possible numbers of such influences determine the result recorded in the "I" records.

E. Judgments of Experimenter and Jurymen

A total of 107 records were taken in this experiment. 10 of these records were "I and L" records, and 3 of the "I" records were influenced by muscular contractions. The experimenter, basing his judgment entirely upon the b.p. behavior, made 103 correct judgments and 4 erroneous ones. Of the latter, 3 mistakes were made on "I and L" records, and 1 mistake on a "I" record influenced by muscular contractions. The b.p. judgments were, then, 96 percent correct.

Benussi reported that he found two distinct classes of liars divided upon the basis of their success in deceiving his "trained observers." He further reported that the breathing of the successful liars was more modified during deception than was that of those unsuccessful at deception. No such result was obtained in this experiment, however, as the following table will show. Only the judgments of those men who sat regularly in the juries and whose judgments were therefore susceptible of comparative study, are recorded in Fig. 15.

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Figure 15
Jurors' Judgments

Subjects...	A		B		C		D		E		F		G		H		I		J		%R.
	R.	W.	R.	W.	R.	W.	R.	W.	R.	W.	R.	W.	R.	W.	R.	W.	R.	W.	R.	W.	
1											1								2	4	.28
2																			4	3	.57
3					5	7				5	3										.41
4					7	3											5	2			.68
5													6	4							.60
6		1										2	7								.20
7							3	7											1	3	.28
8							4	1													.60
9							2	1			5	1							3	1	.76
10	2	1											2		6	4					.66
11			1	1							3	4			1	2	1	2			.40
12											4	4									.50
13	1	3							2	2							2	4			.35
14																	2	5			.28
15		4	1	5																	.10
16			4	1													3	2			.70
17			4	3						2											.44
18	4	1			2																.85
19	2								5	1	1	4									.61
20									2	6		3									.18
% W.	.53		.50		.42		.50		.50		.57		.52		.46		.54		.54		

Note.—"R." = Right and W. = Wrong, judgments. Per cent. R. = Per cent. of juror's correct judgments. Per cent. W = Per cent. of subject's successful deceptions of the jurors.

It is clearly evident, from the above table, that the jurors, not the subjects, are the ones to be divided into successful and unsuccessful classes. 7 of the subjects were from 50 percent to 57 percent successful in deceiving the jury, but these percentages are obviously too low to be significant. Jurors 4, 9 and 10, on the other hand, were clearly successful at "sizing up" the subject, all three being consistently successful in judgments made upon three different subjects. Other jurors, such as 1, 6 and 20, are clearly poor judges of men, and, although the classes of successful and unsuccessful jurors approach within 20 percent of each other, only No. 12 is squarely on that neutral line of 50 percent about which the percentages of the subjects so consistently hover.

F. Series D, Checking Series.

This series followed exactly the method of Series B, an extra story being prepared and used throughout the series. A juror was selected without any warning, and requested to take the subject's place for that day, while the subject took his place in the jury. The chief importance of this series lies in testing the practical value of the b.p. record as an indicator of deception. These subjects could have had no fear or other emotion associated with previous experiences as subjects in that experiment, and were in exactly the position of any naive witnesses who might be called upon anywhere to testify. It will be noted that 5 clearly

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significant "L" records were obtained, that the "T" records were all of a persistent downward tendency and that, when juror 9 lied a little in answer to the last question, he was immediately betrayed by the b.p. All b.p. judgments in this series were correct.

Figure 16
Extra Story, Series D

	T			L					T and L	
	1	2	3	4	5	6	7	8	9	
	116	108	118	126	110	130	118	124	112	
End of preparation	←	←	←	←	←	←	←	←	←	
4	114	6 98	4 110	3 140	10 122	8 142	10 134	10 138	6	108
End of ques. 1-5	←	←	←	←	←	←	←	←	←	
7	112	7 102	6 108	8 144	7 126	6 128	6 126	8 140	7	106
End of ques. 5-10	←	←	←	←	←	←	←	←	←	
12	116	11 106	9 116	8 138	6 118	8 130 2 122	10 116	9 128	9	118 ¹
End of cross-exam. by experimenter	←	←	←	←	←	←	←	←	←	
2	116	1 102	3 120	2 140	3 120	2 132 6 128	15 108	11 110	1	112
End of cross-exam. by jury	←	←	←	←	←	←	←	←	←	
6	114	12 100	12 118	12 124	3 120	6 118			14	102

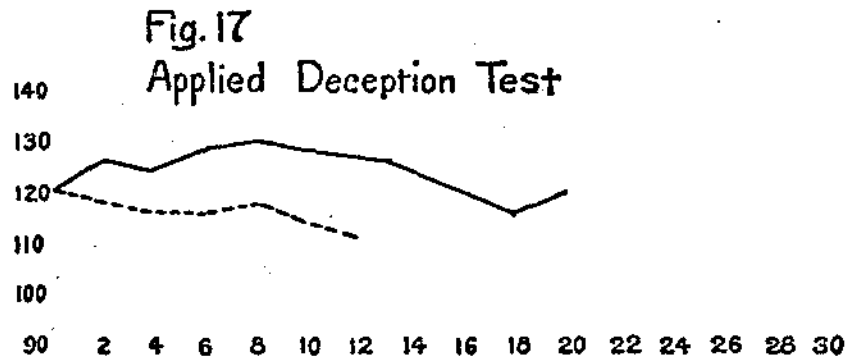
¹ Lied at Ques. 10.

With reference to the practical application of the b.p. test, a final individual experiment is of interest. Mr. Dewey, who had witnessed several of the experiments, proposed to tell two stories of his actions on a certain afternoon, both stories to be objectively true, but one set of actions to be those which he performed during another afternoon than the one selected. The curves in Figure 17 show the result. The "L" curve, while not great in height, is perfect in form as a significant deception curve, and contrasts sharply with the truth curve which, starting at identically the same b.p. level, drops slowly and evenly 8 mm. The experimenter passed over, in writing, the correct judgment at the end of the fourth b.p. reading of the second curve.

5. Conclusions

1) The behavior of the b.p. does not act as the least indicator of the objective validity of the story told by any witness, but it constitutes

Figure 17
Applied Deception Test



a practically infallible test of the consciousness of an attitude of deception. Mere awareness of a mistake, even if the mistake is uncorrected, or the mere addition of trifling details, even if the subject is conscious of such additions, will not constitute that mental situation which is the necessary stimulus to fear, and will not, therefore, cause the b.p. to rise.

2) The significant curve of deception differentiates a story the foundation of which is false from a story mostly true, but containing one or two substantial lies. The sudden sharp, short rises of b.p. betray these substantial lies in an otherwise true story. It seems probable that, if a truthful witness became violently angry at some chance question of the examiner, or if he suddenly saw his worst enemy glaring at him, gun in hand, in the court-room, his b.p. would suffer a short, abrupt rise, but if such extreme outside influences are avoided, all major b.p. modifications would seem to depend upon the deception elements of the story itself.

3) The b.p. record during testimony might be made practical use of as an indicator of deception if the test embodied the following features:

(a) Two records must be taken as in the test on Mr. Dewey, the story told during one record being truth within the knowledge of the examiner.

(b) The examination should be private, with carefully controlled conditions, and means at hand for recording involuntary movements, muscular contractions, and sudden or suppressed laughter.

(c) The record should be interpreted by a psychologist experienced in this particular line, and should be scrutinized with careful reference to the construction and subject matter of the story, the record of the manner and muscular contractions of the witness, and above all it should be compared minutely with the record known to be symptomatic of that individual's consciousness while telling the truth.[14]

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Footnotes:

- [1] Archiv fur die Gesamte Psychologie, 1914, pp. 244-271.
- [2] Abbreviation "b.p." will hereafter be used for "blood pressure."
- [3] See Boston Med. and Surgical Jour., Vol. ClXXII, No. 14, p. 530.
- [4] W.B. Cannon, "Interrelations of Emotions," Am. Jour. Psy., Vol. XXV, pp. 256-282.
- [5] Binet et Vaschide, "Influence du travail intellectuel des Emotions, et du travail physique sur la pression du sang," L'Annee Psy., 3, pp. 129-183.
- [6] In medical diagnoses, of course, the peripheral resistance is often, on the other hand, the very condition to be investigated.
- [7] Here we find the compensatory heart mechanism decreasing the force of the beat with the increase of rate.
- [8] W.B. Cannon, Ibid., p. 270.
- [9] It would be obviously impossible to compare the lying curve of one subject with the truth curve of another, on account of the individual differences of initial and average pressure.
- [10] And also of pain and anger.
- [11] W.B. Cannon, "Interrelations of Emotions," Am. Jour. Psy., XXV, p. 281.
- [12] "Principles of Psychology," II, p. 415.
- [13] See Howell's "Physiology," 5th ed., pp. 255ff.
- [14] The writer expressed his gratitude to Professor Munsterberg and Professor Herbert S. Langfeld, to his assistants, E.H. Marston and T. Ramsdell, and to the Harvard men who served as jurors.

* * * * *

PSYCHOLOGICAL POSSIBILITIES IN THE DECEPTION TESTS

William M. Marston

Introductory Statement

The legal problems involved in the introduction of psychological tests into court or probation office procedure are very complicated and interesting; but before we can consider the legal possibilities of the use of psychological tests we must discover whether or not the psychological development in any particular field justifies the introduction of tests in question. This article concerned with an examination of the state of the psychological authorities in the field of deception tests and the presentation of results of practical application of some tests during the war.

There are four types of psycho-physiological deception tests known. First, there is the galvanometer test. The spring galvanometer measures the electrical body currents, which have been found to vary greatly with the varying emotions of the subject. This test is of very little value in detecting deception, because the instrument registers nearly every emotion experienced during the testimony of the subject, and so renders it nearly impossible to distinguish those emotions caused by deception.

Secondly, we have the association reaction-time test. This consists in presenting to the subject lists of "crucial" and "non-crucial" words, the crucial words combined in groups of three to five or scattered singly through the non-crucial words at the choice of the operator. The crucial words are those which would have, to the guilty defendant, a meaning connected with the principal crime; but would carry no embarrassing significance to an innocent defendant. The subject is instructed to reply to each stimulus word with the first association which comes into his mind and to perform this reaction as quickly as possible. If the defendant is guilty his emotions concerning the crucial words usually delay his reaction times (although the writer during experiments in the Harvard Psychological Laboratory has obtained results which seem to indicate a "negative" type liar whose reactions on crucial words seem to be hastened).^[1] This association reaction time test is of some practical value, but is limited in any practical situation by the difficulty of finding stimulus words which are truly crucial, inasmuch as the defendant or witness has doubtless read all the details of evidence in the papers or has been thoroughly informed with regard to same by his attorney, so that very possibly a perfectly innocent defendant or witness would show the same psychological reaction to the crucial words as would the guilty person.

Thirdly, we have Benussi's breathing test for deception. This test consists in the measurement of the length of the suspect's inspirations and expirations before and after making a statement. A different ratio between inspiration and expiration is found when the subject is lying. This test was used by the writer, assisted by Dr. H. E. Burt, in certain criminal courts in 1918 at the request of the Psychological Committee of

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the National Research Council. Certain results were obtained having psychological interest, but not susceptible of sufficiently definite analysis to prove legally acceptable. The practical limitation upon this test is the difficulty of breaking up the subject's testimony into isolated statements, the truth or falsity of which may be tested. Moreover, it is seriously to be doubted whether the mental content of a witness or defendant with regard to the crime or conduct in issue can actually be analyzed out into real psychological elements. In other words, the subject may be asked "Did you do this?" or "Did you do that?" and the Benussi test may indicate that he is lying. Yet the witness' consciousness of guilt may not relate to the act upon which he is questioned, as the operator understands it, inasmuch as that act may have a large number of secret complications unknown to the operator and irrelevant to the issue in hand which, nevertheless, serve to force the subject into a deceptive reaction. The final criticism of this test seems to be that Benussi's results are as yet uncorroborated by other experiments, and whereas there is no reason to doubt that the deceptive attitude is expressed in modifications of the subject's breathing, it seems probable that the test as reported by Benussi is a little too much of a "patent medicine." In other words, the breathing symptoms are nowhere nearly as clear cut and definite as the casual reader of Benussi's report might suppose.

Fourthly, deception may be tested by means of the measurement of the systolic blood pressure of a suspect while he is testifying. The success of this method was reported by the writer, working under Prof. Munsterberg at the Harvard Laboratory in 1915.[2] In October, 1917, at the request of the Psychological Committee of National Research Council, tests of this type were conducted in the Harvard Laboratory, with a view to determining their value in government service during the war, and were reported upon as having given 100% accuracy of judgment under very difficult conditions.[3] Finally, over 20 tests were given, as above mentioned, at the request of said Psychological Committee, to actual defendants in certain criminal courts. As far as findings could be verified, all judgments based upon the b.p. records were correct; although equal accuracy did not attend either association or breathing tests which were simultaneously given.

It should be noted, however, that this blood test, as hereinafter described, was never alleged to be a simple cure-all or patent medicine automatically detecting every deception on the part of the subject, but rather, in the belief of the writer, the systolic blood pressure test is to be regarded as a psychologically complicated indicator of deception requiring expert knowledge and skill in its application and interpretation. Psychologically, however, it may be said to have the very important advantage over all other deception tests that the psychophysiological mechanism modifying the blood pressure is almost exclusively influenced by the emotions of fear and anger, which probably largely constitute the deceptive complex.

Inasmuch as the results hereinafter reported deal very largely with the systolic blood pressure test, a brief explanation of its method of application may be of interest. The simplicity of the apparatus and method of this test is its first recommendation for practical usefulness. The sphygmomanometer is attached to the subject's left arm above the elbow, the subject being seated 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 of the subject and also 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 fluctuation of the witness' emotions during the telling of his 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 interposed, and the cross-examination could then be built up with great effectiveness upon the elements of the defendant's own voluntary story.

Two practical trials of deception tests are reported below. First, three types of deception tests were tried out upon actual defendants in the criminal courts. These tests were performed, with the consent of each defendant, in connection with the psychiatric and medical examination of various individuals referred for this purpose to the probation office; some before trial, and others at various points in the proceedings, with regard to continuance of probation, dismissal of the case, or recommendation of the probation office to the court. This opportunity for a practical try-out of these tests was made possible by the liberal and patriotic attitude of the court and the energetic efforts of Major Robert M. Yerkes and Dr. Angell of the National Research Council. The resulting records, although not used in court nor taken official cognizance of, yet proved of such considerable value as embodied in the doctor's reports that the probation office was considerably interested in the continuance of the tests; and the doctor, himself a man of large psychological experience and ability, was anxious to co-operate in a future extension of the work. The tests used were the Benussi test, the association reaction time test, and the systolic blood pressure test.

Secondly, the blood pressure tests were tried out at Camp Greenleaf in the Psychological Training School, where the attempt was made to train expert operators and examiners for the installation of these deception tests on a large scale. This work virtually constituted a trial of the practicability of training a corps of experts for the widespread use of the deception tests. Fourteen psychological student officers, all of some legal experience, were chosen and trained, the results reported below serving to point the essential legal character, place, and possibilities of deception tests, and the skill and training necessary for their operation.

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II. Blood Pressure, Breathing, and Association Tests on Criminal Defendants

The apparatus for all three of these tests was set up in a screening-off portion of the office of the examining physician, attached as an assistant probation officer to the criminal court. All the apparatus was hidden from the view of the subject, each defendant thrusting his left arm through a slit in a black curtain so that even the sphygmomanometer could not be seen. By order of the chief justice we were able to choose any out of the many cases sent up to the doctor's office for medical and psychological examination and we chose, as far as possible, those cases where the blood pressure judgment as to truth or falsity could be immediately checked up either by a medical examination or by an immediate hearing in the court below. Twenty individual cases where the b.p. judgment as to deception could be thus verified were selected for report. In a few cases the examiner's assistant was not able to be present so that the examiner was obliged, beside conducting the cross-examination, to record the psycho-physiological measurements. That this did not interfere materially with the results indicates the practicability of the application of the tests. In every one of the twenty cases where immediately determination of the accuracy of the b.p. judgments were possible, the judgments were found correct, and in at least five cases discoveries made by the examiner on the basis of his cross-examination, together with the b.p. behavior at these crucial points were of assistance to the doctor and through him to the court and probation officer in disposing of the cases. It may be said that the association and breathing test data were so complicated and difficult of treatment that as a practical matter all the examiner's judgments were based upon the blood pressure alone.

The examiner made eight b.p. judgments of complete truth (Nos. 1, 2, 6a, 9, 12, 14, 17 and 18); eight b.p. judgments of consistent lying (Nos. 3, 8, 10, 11, 15, 16, 19 and 20), and in five cases the examiner was able to pick out points upon which defendant lied and other points upon which defendant was telling the truth (Nos. 4, 5, 6b, 7 and 13).

The cases in detail follow:

Case No. 1. Woman (White). Age, 42 Years

Record of Case Given to Examiner Previous to Deception Test.

Several previous arrests for drinking; known to be an old drug user, arrested December 1st because hypodermic outfit was found in room where defendant spent the night. Defendant claims she is not now using drugs.

B.P. Judgment.

Innocent. Woman is not now using drugs.

Verification.

Medical examination showed increased weight, better all-around health, etc., which could not have existed were defendant now using drugs.

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Case No. 2. Woman (Colored). Age, 31 Years

Record of Case Given to Examiner Previous to Deception Test.

Colored woman, 31 years of age. Arrested six months ago for larceny of a ring and placed on probation on the strength of the testimony of a colored man from whom a ring was alleged to have been stolen. Defendant during the six months had not made restitution, as she had been ordered to do, and was suspected by the probation officer of having avoided her calls. Examination was to determine whether or not she stole the ring in the first place.

B.P. Judgment.

Innocent. Woman telling the truth as to the ring, having been given to her.

Verification.

The judge dismissed the case, although probation officer advised six months further probation. New evidence had turned up indicating that the colored man who first alleged that defendant stole ring was a disreputable character, etc.

Case No. 3. Woman (White). Age, 29 Years

Record of Case Given to Examiner Previous to Deception Test.

Twenty-nine years of age, white. No court record. Arrested for fornication in a disorderly house in South Boston. Woman denies ever having been to that house before, and claims that this is her first sexual offense. Secretary who examined defendant believed her story absolutely and told examiner there was no material there for him.

B.P. Judgment.

Lying as to never having been to said disorderly house before, and guilty consciousness with regard to past experiences enjoyed with "lady friend," whom she was visiting at time of arrest. Also guilty consciousness with regard to her husband, probably was involved with him in some criminal acts.

Verification.

While discussing B.P. judgement with the doctor ten minutes after examination, another women from the same disorderly house, arrested for having drugs in her possession there, and already placed on probation, was brought in. She stated that she had seen and heard principal defendant at the house repeatedly previous to the evening of defendant's arrest. The doctor then looked up husband's record, and found that he had forged fifteen or more times; that there was evidence she knew of his criminal acts; that she knew the police were after him, and that she knew where he was. When the case came up for trial the judge told defendant that he did not believe a word she said and placed defendant on probation. Still later evidence turned up showing that defendant had lived with her husband at

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said disorderly house for over a month while he was being sought on several more forgery charges, and that, of course, defendant knew said warrant was out for husband.

Case No. 4. Woman (White). Age, 31 Years

Record of Case Given to Examiner Previous to Deception Test.

White woman, 31 years of age. An old drug user cured by hospital treatment three and a half months ago. Now suspected of taking more drugs than she admits.

B.P. Judgment.

Truthful. Defendant's account of the number of drugs she is taking is correct. Lied, however, about not having had sexual relations with other men.

Verification.

Medical examination by the doctor showed defendant had serious glandular trouble in the neck and jaw, causing severe pain, and that defendant was apparently taking small doses of morphine whenever the pain became very severe; as nearly as could be judged she was taking about same amount she had admitted. The doctor's medical judgment, as sent down to the court, was identical with B.P. judgement. Not much evidence on point of promiscuous sexual intercourse, but general circumstantial evidence points to intercourse with at least three men other than her husband.

Case No. 5. Woman (White). Age, 46 Years

Record of Case Given to Examiner Previous to Deception Test.

White woman, 46 years of age. Arrested for sale of liquor. Admits sale of liquor this once, but says that she never did it before. This statement probation officer suspects is untrue. Also says she only drinks whisky and milk three times a day; never drinks any other sort of alcoholic beverage. Probation officer suspects this is untrue.

B.P. Judgment.

Lied as to only drinking milk and whisky three times a day. Probably drinks heavily whenever she can get liquor. As to sale of liquor, has feeling of guilt; probably knew when she sold it that it was against the law. Telling truth as to how she got the liquor and as to never having sold it before.

Verification.

Medical examination by the doctor showed without question that defendant was a confirmed alcoholic who is now drinking heavily and continuously. Evidence by detective who made the arrest tends to show defendant knew her act in selling the liquor was illegal; also his evidence tends to show that she lied as to amount of money she took for the liquor. As to previous sale of liquor by defendant and as to how defendant got liquor in question, there was absolutely no evidence.

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Case No. 6A. Woman (White). Age, 19 Years

Record of Case Given to Examiner Previous to Deception Test.

White woman, 19 years of age. Arrested for larceny of goods to value of \$500 by use of department store coins found in a pocketbook lost by the owner in the South Station. Has been under examination in court and by the probation officer all day long and has now confessed practically to whole affair, including the present location of the stolen goods. Details on which the defendant is still suspected of deception are --

1. When she found department store coins.
2. Immorality with other men and as to whether she supported herself by this means.
3. Relations with husband, where she lived with him, etc.

B.P. Judgment.

B.P. examination interrupted at end of free recital which did not touch on any of above mentioned crucial details. Judgment is truthful as to points covered during recital.

Verification.

Recital as given verified by all the evidence now in the record of the case. Case to be sent back for further B.P. test on crucial details December 8th.

Case No. 6B

Record of Case Given to Examiner Previous to Deception Test.

Girl tells probation officer she never took any of her mother's money; that she never took anything previous to principal offense except a coat, dress, and silk night dress, which she took three months ago. Also tells probation officer that she has never had any sexual relations with other men than her husband. Probation officer suspects all above statements to be false.

B.P. Judgment.

Lies as to only having stolen three articles previous to principal offense, and also probably lies as to lack of sexual relations with other men. Also lies clearly about never having stolen money from her mother.

Verification.

Mother calling at office later the same day says girl has frequently taken money from her pocketbook and that she has often caught her doing this, but was lax with her and had done nothing about it. Defendant has no previous criminal record, but probation officer has evidence from other girls with whom she has been going to the effect that defendant has stolen several articles of clothing and one or two pieces of jewelry previous to principal offense. Also the evidence of these girl companions tends to establish the fact that defendant has had sexual intercourse with men other than her husband. This evidence, though not sufficient to convict

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of any previous larceny or fornication, was sufficient to induce the judge to find the girl guilty in the principal case and to place her on six months' probation, part of which is to be spent at the House of Good Shepherd in view of above mentioned evidence.

Case No. 7. Woman (White). Age, 39 Years

Record of Case Given to Examiner Previous to Deception Test.

White woman, 39 years of age. Arrested for drunkenness. According to probation officer's suspicions, defendant's husband had been arrested and had served three months for beating her. Defendant claimed that she did not remember this at all and defendant took the attitude that probation officer was trying to "put something over on her." She also maintained that her husband did not drink at all and that she never quarreled nor had any harsh words with him.

B.P. Judgment.

Truth as to knowledge of husband's serving time for beating her, etc., but lies as to the amount she knows her husband drinks -- probably drinks pretty steadily. Under the conditions of the B.P. examination, defendant immediately admitted that she had "little chewing matches" with her husband quite often and that on these occasions when he failed to come home promptly from work, she had quarrels when he would grab her by the shoulder and push her about a little.

Verification.

Husband's record was looked up and it was discovered that his arrest for abuse of his wife occurred ten years ago. It also appeared that he did not serve any time, but paid a fine of \$25 to escape a sentence of three months and was released immediately. There is, of course, no absolute verification as to whether or not defendant remembered this incident, but the doctor gave as his informal medical judgment the opinion that defendant's long time memory was so poor that she probably could not remember with any distinctness events that happened more than three or four years ago. On the point of drinking, it was discovered from the records that husband was arrested last Saturday, December 1st, very early in the morning for drinking and disorderly conduct and was released again at 11 o'clock that night at defendant's earnest solicitation.

Case No. 8. Woman (White). Age, 19 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 19 years of age. Two girls arrested together for shoplifting. Several shirt-waists and camisoles were found in the possession of one of the girls. The other girl says she only took the waists for her companion and at her instigation; that she had never stolen before and that she had never had intercourse with any men. Also accuses her companion of having stolen the clothes she is at present wearing. Medico-psychological examination shows defendant to be a very low mental type, almost an f.m., and also shows that her affective re-actions are sluggish almost to the point of non-existence.

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B.P. Judgment.

Lies as to all elements in her story, but particularly as to relations with men, the guilt of her companion, and on the point of defendant never having known others who stole. B.P. test was cut short in the midst of cross-examination by the entrance of an officer to take defendant to House of Good Shepherd. It will be noted that the B.P. follows the typical form of a "L" curve and it was the judgment of the experimenter that the very small actual amount of the B.P. rises was due to the dulled affective re-actions of the subject.

Verification.

Before being taken into court, defendant was examined physically and it was discovered that she had a well-developed case of syphilis with the other usual indications of continual sexual intercourse. For this reason, together with the extremely low level of her mentality, she was sent away for preliminary medical treatment, and her case was indefinitely continued pending results of further medical and psychological examinations. There was, however, evidence in the hands of the police tending to show that this girl belonged to a shoplifting gang in which many feeble-minded and subnormal girls had been taught to steal by older women, who took all the loot and threw all the blame on girls like the defendant.

Case No. 9. Woman (White). Age, About 19 Years

Record of Case Given to Examiner Previous to Deception Test.

White; arrested with stolen shirtwaists, etc., in her possession as noted under last case. Also a rather low mental type and very suggestible. Defendant confesses having taken the shirtwaists, etc., in co-operation with her companion, but denies ever having taken anything before, and denies instigating the present theft. Defendant takes an equal share of blame in the principal offense, but insists she deserves no more than an equal share.

B.P. Judgment.

B.P. interrupted in the midst of cross-examination by entrance of officer. B.P. judgment based on record as far as test had gone was that defendant was absolutely truthful.

Verification.

Case continued because of absolute lack of any evidence tending to show defendant had ever stolen before. This is, of course, only a negative verification, but no further positive evidence has as yet been turned in by the police.

Case No. 10. Man (White). Age, 32 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 32 years of age. Arrested for larceny. (Experimenter was not told what defendant was alleged to have stolen or any further details

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concerning defendant's actions.) Defendant maintains complete innocence of offense charged.

B.P. Judgment.

Has guilty consciousness with regard to the stolen goods and either lies concerning having met his brother at Higgins' saloon at just the time he was supposed to have stolen the goods, or else had some guilty consciousness with regard to some criminal actions in which his brother and probably himself have been involved.

Verification.

Previous record of thirty arrests, mostly for drunkenness, but several for larceny. Case continued until next week, but police claim they have positive evidence that defendant stole the goods in question. Verification on point of brother's possible complicity entirely lacking, but at the suggestion of the doctor the police are investigating further along this line.

Case No. 11. Woman (White). Age, 46 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 46 years old. Defendant arrested for shop-lifting and is strongly suspected of having stolen before. Also is suspected of drinking heavily, although defendant denies this absolutely. Suggested by one of the defendant's neighbors that whole family were thieves.

B.P. Judgment.

Lied as to drinking and also as to never having stolen before. Also lied in testifying that none of her children had ever stolen anything.

Verification.

Medical examination showed that defendant was a confirmed and heavy drinker. On the point of previous thefts, no criminal record was found against defendant, but the police had strong evidence that defendant had been shop-lifting systematically for some time and on this evidence defendant was found guilty and placed on probation. Later defendant admitted that one of her two boys had been arrested for stealing and on being asked which, said the fifteen-year-old boy. Upon being told that there was a court record against her twelve-year-old boy in the Juvenile Court, she thereupon said that it was the twelve-year-old boy she referred to and that the fifteen-year-old boy was innocent. Evidence of neighbors and police tends to show that both boys have been engaged in petty thefts for several years, the twelve-year-old boy being now on probation in the Juvenile Court under conviction for larceny.

Case No. 12. Woman (Colored). Age, 21 Years

Record of Case Given to Examiner Previous to Deception Test.

Colored, 21 years of age. Arrested for fornication. Admitted she

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lived three weeks with a man, but says she never had intercourse with anyone else. Probation officer suspects this statement to be untrue, and also suspects that she takes drink and drugs.

B.P. Judgment.

Under conditions of B.P. examination, defendant admitted that she had lived four weeks with the man she was found with and that she had had intercourse with one other man. B.P. judgment was that defendant's story was wholly truthful.

Verification.

Medical examination showed no traces of alcohol or drugs and the evidence leading the probation officer to suspect defendant had had intercourse with other men turned out to be evidence of intercourse with that man whom defendant confessed in B.P. examination to having had intercourse with.

Case No. 13. Woman (White). Age, 34 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 34 years old. Defendant arrested for sexual offense; has been married twice, first husband died and second divorced. Suspected of earning money by promiscuous sexual intercourse, also suspected of drinking heavily. Defendant denies having given her second husband just grounds for divorce by her relations with other men; she denies drinking during the last month and denies ever having earned any money by sexual intercourse. Also suspected of taking drugs and was arrested in company of two other men and her landlady, one of the men being intoxicated, and it was suspected that defendant had been having intercourse with one of these men.

B.P. Judgment.

Lies as to (1) having given any grounds to husband for divorce, (2) having had anything to drink for one month, and (3) as to never having earned money by sexual intercourse. Tells truth as to (1) taking no drugs, and (2) as to not having had intercourse with the man with whom she was discovered by the probation officer.

Verification.

(1) Record of divorce suit shows husband presented very strong evidence tending to prove that defendant had had sexual intercourse with several other men and the finding of fact was in favor of the husband and divorce granted on grounds of adultery. (2) Medical examination showed that defendant had been drinking very heavily quite recently and later in court defendant admitted having had a little beer recently. (3) Defendant also admitted in court, after very strong evidence had been procured against her, that she had had intercourse six months ago with a certain man and had received \$5 therefor. Medical examination showed no traces of drugs and no further evidence was found by the probation officer as to whether or not defendant had had intercourse just previous to being discovered.

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Case No. 14. Woman (White). Age, 17 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 17 years old. Defendant arrested at request of father as a stubborn child. Had run away from home twice and was reported by someone at the Franklin Square House where defendant worked while away from home, to have been discharged from employment there because of continued deception practiced upon the Franklin Square House authorities. Also defendant is suspected of often going to dances, etc., when she is supposed to be at evening school.

B.P. Judgment.

Under conditions of B.P. test, defendant admitted coming in late several times at the Franklin House and skipping by the watchman and also having committed other infringements of the rules of that institution. She claimed, however, that she had never lied to the authorities there. Defendant also admitted that very frequently she went to the movies or to a dance when she was supposed to be at evening school, and said she did not tell her father because he got very angry. B.P. judgment was that defendant told the truth about everything.

Verification.

Investigation at the Franklin House showed defendant and another girl continually broke the rules there, especially the rule about coming in late at night. A new watchman, apparently, had detected defendant and another girl slipping upstairs late one night and had mistaken them for two innocent girls. The resulting circumstances, accusations and investigation, had been very disagreeable for the two innocent girls, but defendant had voluntarily confessed and had thereupon been asked to leave the house because of her continued disobedience. Probation officer had based her general suspicions of the defendant's veracity very largely on an inaccurate account of the Franklin Square House affair and when this was cleared up, all the evidence in the hands of the probation officer tended to show that defendant had confessed the whole truth.

Case No. 15. Woman (White). Age, 40 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 40 years old. An old drug user; has used morphine, coke and heroin for twenty years, taking at one time as much as a dram in two days. Six months ago defendant underwent a hospital cure and was thought to have been successfully turned against the habit. Defendant's probation was up and she had surrendered herself to the probation officer for disposition of her case. In making this disposition, the judge wished to know whether or not she had used any drugs since her supposed cure six months ago.

B.P. Judgment.

Very marked general weakness in the sympathetic nervous system, undoubtedly produced by drugs during the past. This weakness is judged to account for the continual sharp fluctuations in the B.P. which were

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apparently caused by slight light, nervous excitement of any kind. In view of this very evident condition and the medical drug history of the case, lack of sustained B.P. at a high level in the form of an "L" curve cause experimenter to make a judgment of truthful with regard to witness' entire testimony as to her abstinence from drugs during the last six months.

Verification.

Medical examination shows no trace whatsoever of recent use of drugs and also shows a general improvement in health, weight, etc., which probably could not have occurred were defendant now using drugs. Defendant's physical condition is still decidedly weak, however. On basis of medical judgment, defendant was dismissed.

Case No. 16. Man (White). Age, 17 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 17 years old. Defendant arrested for larceny. (Examiner was given no further details concerning this larceny or any other suspicions concerning defendant's case.)

B.P. Judgment.

Guilty. Defendant also has guilty consciousness with regard to the way of spending his evenings while in New York City.

Verification.

Defendant had no criminal record in either New York or Boston, but on special further inquiry it was found that the New York police had long been watching him as a suspicious character in view of the fact that he entertained many companions of very questionable character in his rooms night after night, and carried on long conversations with these men in an unknown tongue. Both the Boston police and the New York police are convinced from circumstantial evidence that defendant had been pursuing a criminal career for several years. In the light of this evidence, defendant was found guilty and placed on six months' probation.

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 discovered that several other longshoremen, working on the

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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 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 had 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.

Case No. 18. Woman (White). Age, 23 Years

Record of Case Given to Examiner Previous to Deception Test.

White. Defendant arrested for shop-lifting. Has lived with sister for over a year and has apparently done nothing to support herself. Is suspected of previous shop-lifting and of earning money by promiscuous sexual intercourse.

B.P. Judgment.

Defendant truthful in saying she has never had any sexual intercourse and that she has never stolen anything before.

Verification.

Medical examination showed that defendant had never had sexual intercourse and there was a total lack of evidence on the point of previous thefts, defendant's sister testifying that she had supplied her with clothes and board in exchange for defendant's assistance with the housework during the past year and three months. This evidence exactly corroborated defendant's story and the probation officer and police had no evidence whatsoever in rebuttal.

Case. No. 19. Man (White). Age, 22 Years

Record of Case Given to Examiner Previous to Deception Test.

White, 22 years of age. Defendant has criminal record of three convictions for larceny. Arrested this time for larceny of a thousand cigars which were found in his possession. Defendant has already been found guilty and placed on probation under a suspended sentence. Defendant, however, still denies that he stole the cigars from the Adams Express Company, and maintains that a friend of his gave them to him to sell.

B.P. Judgment.

Lies both as to present and past innocence. Man who defendant claimed gave him cigars is pure fiction.

Verification.

It will be noted in this case that the B.P. examination came after the defendant had been found guilty by the court on very strong and

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practically indisputable evidence. There is, therefore, of course, no question of verification. This case was specially requested by the examiner in order to test the effect of a previous disposition of a defendant's case upon his B.P. It will be noted that the B.P. record assumes an almost perfect form of lying curve, but that the total maximum rise from the probably norm plus excitement was very small in comparison with the other lying B.P. records. If this same B.P. curve had been found before the case came up for trial, however, the examiner believes that his judgment would have been the same, especially if subject was a low mental type.

Conclusions

(1) The blood pressure deception test has demonstratable practical value in determining the truth or falsity of various elements in a witness' story as well as of the story in its entirety; and also in determining the general attitude of innocence or guilt in a person accused of criminal acts.

(2) The blood pressure deception test seems to have value as a substitute for the oath now used in court procedure in that confessions seem to occur under the conditions of the psychological test which it had been previously impossible to extract in court or under the examination of the probation officer and police.

(3) By detecting guilty emotions focused upon hitherto unsuspected points of testimony the deception tests appear to open new and fruitful channels for police investigation.

III. Training Tests at Camp Greenleaf

(From report submitted to Surgeon General's Office, Office of the Judge Advocate General, and Bureau of Military Intelligence.)

Problem

The problems contemplated by these tests were two-fold; first, the investigation of the value and the applicability of the systolic blood pressure deception test to military situations arising in connection with courts-martial, where psychological examiners might be called upon to testify as to truth or falsity of testimony, or as to the sincerity of the accused, or in connection with investigations of alleged enemy agents by the Military Intelligence Department, where psychological examiners might be required to test the truth of the story of the person under suspicion; and, secondly, to determine the extent to which these deception tests could be confided to non-expert operatives.

Occasion

The tests herein reported were given to the enlisted men and non-commissioned officers of Psychological Co. 1, School of Psychiatry, Camp Greenleaf, Chickamauga Park, Ga., under the direction of the writer, in 1918, in connection with courses given said Psychological Co. 1 upon Military Problems of Testimony.

Method

A. Crime. About 50 articles, each of some intrinsic value to a soldier, together with ten five-cent pieces, were disposed about a room on the second floor of the Psychology Building. The men were then instructed to enter said room, examine contents, and if they so chose, to steal and conceal upon their person one or more of said articles. If they chose to steal they must hide the stolen articles within the Psychology Building within 5 minutes after taking same; and in 10 minutes thereafter, they must take the stolen article out of the building, convey it to their barracks, and there conceal it among their effects. When examined, they were instructed to do their utmost to convince their examiners of their innocence. If they stole and yet succeeded in deceiving their examiners, they could keep the article stolen; if detected they must return same.

B. Examiners. Fourteen men, all of some legal training, were selected by the writer to act as agents for the procuring of evidence against the accused, and to act as examiners when the suspects were summoned to testify. These agents were allowed to question any suspect, and to watch his movements as closely as possible, after he emerged from the room where the articles were planted. Private Clifton Murphy (a member of the New York Bar) was placed in command of these agents, in order that they might be disposed effectively about the Psychology Building and barracks. All evidence was then sorted and distributed to those agents who were to examine the suspect involved thereby, the entire group of suspects having previously been divided and assigned among the agents for examination. The agents working in seven groups, two agents to a group, then prepared general outlines for the cross-examination of each suspect on the basis of the evidence collected against him. A brief preliminary instruction in use of apparatus and interpretation of b.p. curves was then given the agents by the writer, but none of said agents had ever previously given a single deception test. Agents alternated within group as cross-examiner, the other agent recording the b.p.

C. Apparatus. Three sphygmomanometers, Tycos type, were used. One instrument was very defective, as reported by the medical officer who used it; and one of the others was somewhat inaccurate.

D. Results. Thirty-five men were examined. Nineteen men chose to steal, while 16 men were innocent and told the truth under cross-examination. It will be noted that the choice between guilt and innocence was left wholly with the subjects, no check upon the proportion being retained by the experimenter. Twenty-six correct judgments, based solely upon the b.p. curves interpreted in light of the conditions of examination, were made by the agents and 9 incorrect judgments were recorded. This gave a total percentage correct agents' judgments of 74.3.

The writer, upon inspection of the curves turned over to him by the agents, made 34 correct and 1 incorrect, judgment, giving a percentage correct judgments of 97.1. It is to be noted, however, that one of the records judged correctly by the writer was such that, on a second inspection (after the sealed confessions had been opened), it seemed to him mere chance which had determined the correctness of his judgment, since the curve was not one upon which a judgment of "Guilty" could normally be based. The more accurate percentage of the writer's correct judgments would, then, be 94.2.

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Eighteen judgments, based upon the evidence alone, were recorded by the examiners, although they were not required to record such judgments. Seventeen of these disagreed with the corresponding b.p. judgments; and of these, 15 evidence judgments were wrong, b.p. judgments being correct in each case. In one case evidence judgment was as to isolated inaccuracies of testimony, so that no comparison with b.p. judgment can be made. In one case evidence judgment was correct and b.p. judgment wrong. It may fairly be assumed that where no evidence judgment was recorded, said judgment coincided with the b.p. judgment.

It will be noted from the following detailed tabulation of results, that each group of agents examined 5 suspects, thus furnishing a fair basis for comparison between the groups with regard to expertness in interpreting the b.p. curves; and groups are arranged in the following table in order of their skill:

Operatives and Examiners	No. of Men Examined	No. Correct B.P. Judgments	No. G. Judged I.	No. I. Judged G.	Per Cent of Correct Judgment
1. Murphy Puhak	5	5	0	0	100
Lt. Marston		5	0	0	100
2. Bundlie Myhre	5	4	0	1	80
Lt. Marston		4	0	0	100
3. Rushmore Coleman	5	4	1	0	80
Lt. Marston		5	0	0	100
4. Broehl Allenberg	5	4	1	0	60
Lt. Marston		5	0	0	100
5. Wilson Watkins	5	4	0	1	80
Lt. Marston		4	0	0	100
6. Lewis Hanemann	5	3	1	1	60
Lt. Marston		4	0	1	80
7. Schaeffer Strauss	5	2	2	1	40
Lt. Marston		4	0	0	100
<u>Total</u>					
Operatives	35	26	5	4	74.3
Lt. Marston		34	0	1	97.1

One correct judgment based on record insufficient, on later inspection, to substantiate judgment. It might, therefore, properly be recorded as an error, bringing total percentage Lt. Marston's correct judgments down to 94.2.

Psychological Possibilities in the Deception Tests

It is, therefore, a most significant feature of our results that one group of examiners stand out pre-eminently without a single error, while out of 9 mistakes, 3 were made by a single group. To test this point more fully, a second series of tests were given by the expert group, Murphy and Puhak. Ten subjects were selected from among the agents, instruction to do anything they wished for ten minutes, and were then examined by Murphy and Puhak to determine the truth, or falsity of their accounts of their action during the said 10 minutes. The examiners recorded 10 correct judgments, thus substantiating the thesis that their former perfect record was due to expertness in interpreting the b.p. curve.

Conclusions

(1) The total average percentage correct judgments attained by 14 examiners without any previous experience whatever in these tests, and especially the very high degree of accuracy of their b.p. judgments as compared to their spontaneous evidence judgments, would seem sufficiently high to indicate that this b.p. deception test has considerable practical value, even when applied by non-experts; but above results would not seem to justify the conclusion that courts-martial or military intelligence officers should rely solely upon the results obtained from these tests when operated by non-experts.

(2) The percentage of correct judgments, however, obtained by Privates Murphy and Puhak, and by Lieutenant Marston, would seem clearly indicative of the practically absolute reliability of this deception test when administered by examiners who, by virtue of previous extended experience with the tests or by virtue of natural aptitude for this type of work, may be termed experts.

(3) The fact that, in the single case where Lieutenant Marston made a wrong judgment, the examiner made a correct judgment, and that in the case where he made a correct judgment upon an insufficient curve he was present at the examination and noted errors in the recording of the b.p., would lead directly to the conclusion that the expert should himself give the examination, in order to be personally cognizant of all the conditions in the light of which the curve must be interpreted.

The general conclusion of the writer from the above reported results and also from various other applications of the tests in question which are being published elsewhere, is that, at the present writing, a sufficient psychological background probably exists to qualify an expert upon deception in court, and that the use of deception tests in connection with probation office procedure and examination is, beyond question, justified. The writer is conducting at the present time researches in the Harvard Laboratory upon the numerous psychophysiological problems relative to blood pressure behavior under varying psychological conditions, and it is to be hoped that long before the legal problem of such tests is solved the fundamental psychophysiological elements will be rather clearly analyzed out. Meanwhile, the legal application of these tests presents a very interesting problem which, as the forerunner of an endless series of problems concerning the introduction of psychological tests into legal procedure, seems worthy of immediate consideration.

Psychological Possibilities in the Deception Tests

Notes

[1] See "Reaction Time Symptoms of Deception," Journal of Experimental Psychology, February, 1920.

[2] See Journal of Experimental Psychology, April, 1917.

[3] See Report in Psychological Committee files, under date November 13, 1917.

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STUDIES IN TESTIMONY
(1924)

William M. Marston,[1] Washington, D.C.

1. Problems

It seems to be a regrettable fact that little systematic psychological experimentation is being carried on in the field of normal adult testimony. Much valuable material is being produced by psychiatrists, sociologists, and criminologists from time to time; but the subjects of such studies are, for the most part, either psychopathic or criminal variants from the mental or social norms. On the other hand, much constructive work is being done by statistical and educational psychologists toward the development of intelligence and fitness tests; but the direct application of such psycho-statistical procedures to everyday legal problems of testimony seems a long way off.

Such work as has been reported in the legal field proper lies almost wholly in the line of the "Aussage," or "fidelity of report" tests.[2] An incident is performed, or an object presented, before experimental subjects whose immediate, written report is scored as to accuracy and completeness by the experimenter. "The question has been asked," says Wigmore,[3] "whether the alleged percentages of testimonial error, as found in the laboratory experiments, do really, in trials, produce misleading results in the verdicts. The way to answer this is to include a jury (or judge of fact) in the experiment, and observe whether the findings of fact follow the testimonial errors or whether they succeed in avoiding them and in reaching the actual facts." The problem, thus stated, is, from a psychological point of view, such a broad one that preliminary studies are indicated for the purpose of roughly determining, first, where lie the possible psycho-legal causes of testimonial error; and, secondly, as suggested by Wigmore, what possible psychological realtions may exist between the findings of judge and jury and the original testimony upon which such findings were based. Such were the purposes, then, of the preliminary studies herein reported.

2. Comparison of Methods of Eliciting Testimony

The most obvious analytical modification of the older method, which consisted of testimony written without questioning, and of written responses to questions, would seem to be a closer approximation of the typical conditions obtaining in actual cases. Three different methods of eliciting testimony for use in the courtroom exist. First, under certain conditions, the witness may refresh his memory from notes made by himself. Such notes are written, according to usual rule, immediately following the occurrence. Psychologically, it is safe to assume, as a working premise, that perusal of such notes, on the stand, substitutes the notes for present memory. Therefore, an account of the incident witnessed, written by the observer himself without questioning, immediately after the occurrence in issue, almost exactly reproduces the actual condition of notes of this sort used on the witness stand. I have called this "Free Narration."

Secondly, the witness is subjected to direct examination. No leading questions may be asked, and the witness does not fear legal trickery, or

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attempts to entangle his testimony by "catch" questions, since he is examined by an attorney whose purpose is to co-operate in every way possible with his own witness. To be sure, in actual court procedure, the testimony is orally given, and is recorded verbatim by the court stenographer-- a condition not practicable in experiments where a number of witnesses must be examined simultaneously. Moreover, no trial is ever held immediately after the occurrence of the incidents in issue; whereas, for the sake of experimental uniformity between witnesses in Aussage tests, it is advisable to take all testimony immediately upon conclusion of the incident, before the witnesses leave the room. In the present experiment, I was able to frame questions conforming, with sufficient accuracy, to a comprehensive direct examination of witnesses in actual practice; but it should be borne in mind that the answers were written by each witness, instead of being given orally; and that the writing was done immediately, instead of after the usual interval between incident and trial. This series of immediate, written responses to non-leading questions I have called "Direct Examination."

Thirdly, witnesses actually on the stand are subjected to cross-examination. The witness knows that the examining counsel is antagonistic, and that every device will be used to entangle and obscure his testimony. Leading questions may be asked freely, and queries of a leading nature based upon deliberate erroneous suggestions are commonly introduced for the purpose of influencing the jury, and of suggesting a doubt, or a contradictory answer to the witness. These conditions may readily be reproduced in experimental procedure, subject to the qualifications of answers being written immediately, by the witnesses, instead of being given orally, after an interval, as in actual trials. I introduced several deliberately suggestive leading questions of the nature above mentioned into this portion of the test, and 40 questions were propounded, as against 10 in the Direct Examination. This longer series, as described, I have called "Cross-Examination."

Method

The incident to be observed and reported was performed before a group of 18 students who were attending a lecture in Legal Psychology at American University, Washington, D.C. All 18 subjects were lawyers, either practising in the District of Columbia or employed by the Government. None of the subjects received any intimation that an experiment was to be performed, nor were they aware that any test was in progress until the incident had been concluded and the experimenter began to issue instructions for recording of testimony.

In constructing an incident to be reported, three modifications of the usual Aussage types of action were attempted, with a view to eliminating psychological sources of error obviously occurring in the older methods. First, many incidents performed before students, or other subjects, have been of a nature deliberately deprived of logical meaning, but designed to suggest a false or sham meaning. Thus an actor might be armed with a shining wrench, intended to suggest a revolver. When the glimmering steel did suggest a gun, and was so described by the witness, a serious error was recorded. But murderers or holdup men do not, as a rule, deliberately assume stage properties in order to lay a heavier weight of evidence against themselves; nor do most innocent persons voluntarily go through the motion of a holdup, in the presence of the real

criminal, in order to divert suspicion from guilty to innocent persons. Although I have never seen this criticism in the literature, it seemed to me a most potent one from the standpoint of psychological method. I therefore took pains to prepare an incident with a logical meaning of its own and devoid of a false or hidden one likely to trick the witnesses into error.

Secondly, most of the Aussage tests previously reported have used an incident or observational material wholly foreign to the conscious content of the subjects at the moment the incident occurs. A sensational intrusion of blood (or paint) smeared actors, shouting and gesticulating causes an abrupt shift in the whole motor attitude of the subjects and often evokes more or less violent emotion. This shifting of motor setting, and the accompaniment of the incident by unusual emotional experiences, inevitably tends to disturb normal memory. Often emotion may virtually hold connected perception in abeyance, with the result that the subject has only isolated sensations to remember, instead of a logically connected unit perception. It is a well-known psychological fact that memory is greatly assisted by the logical connection of the remembered sensations. Therefore, it would seem that emotional and motor factors tending to break up such connection must be eliminated if experimental results are to be regarded as significant of the amount and types of error occurring under most natural conditions. Occasionally we find in the courtroom eye witnesses of murders or other violent crimes; but the great mass of actual testimony relates to matters observed in connection with ordinary, routine actions, and the Aussage experiments should test the rule rather than the exception. The incident used, therefore, in these studies was of such a character that no one of the 18 witnesses suspected anything unusual had occurred until so informed by the experimenter.

Thirdly, the incident selected should contain the usual sort of legal meaning. No individual witness, as a rule, is called upon to testify as to the interpretation or significance of the incident he saw. He is put on the stand to narrate certain details, and these details are most often used as individual pieces in the mosaic counsel is attempting to lay in the minds of the jury. While the witness' mind is usually aided, in its remembering of details, by an obvious logical unity of incident, it is not the unity, or meaning, which has legal significance, but rather the details which are thus strung together. An occurrence should be planned, therefore, containing as great a proportion as possible of details legally significant, for some predetermined trial purpose. Most of the incidents used in previous experiments have contained a large proportion of incidental significance, and a very small proportion of legally relevant meaning. If such is the case, the chances are all in favor of a minimum of possible legal meaning in the result. I tried to construct an incident, therefore, nearly all details of which might have a predetermined and proper legal significance.

The incident used was that of an unknown youth rapping on the door of the lecture room, soon after the beginning of the lecture; entering on the lecturer's request, and delivering an envelope to the lecturer. The latter removed a yellow paper from the envelope, pretended to read a message, and exchanged remarks with the stranger, who thereafter left the room. There were no deliberately false suggestions in the affair to lead witnesses astray, and the actions were of such a usual nature that no emotion

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beyond mild surprise or curiosity could be evoked from the witnesses.

There were a large number of details, however, of possible and connected legal significance. The predetermined plot was trial of the strange youth for the knifing of a person of his acquaintance. In strict adherence to realism, the youth chosen was a Texan, very quick of hand and temper. He possessed a long, green-handled pocket-knife, the blade of which might well be used for stabbing purposes. With one hand the young Texan could draw and open this knife, all in the same motion. Under his left arm he carried three books, one red, one green, and one blue (colors to furnish psychological primaries), and the predetermined plot included the finding of these books at the scene of the crime. Beside the envelope handed the lecturer, the young man carried a second envelope in the same hand, which might have contained a taunting letter, just received from the murdered acquaintance. While the lecturer read his supposed message, the Texan faced the audience, drew and opened his knife, and scraped at his gloved thumb with it, in supposed embarrassment. The points of usual legal significance, therefore, would be all those details serving to identify the Texan, his books, his envelope, and his knife--a not unusual type of legal meaning for any testimony offered. I may anticipate the results by stating that not a single witness noticed the knife at all!

Results

Each observable detail in the above outlined incident was allotted a score of one point, summing into a total of 147. Similarly, the number of possible points scorable in answering direct and cross-examinations were separately compiled, giving a total of 120 points for direct, and 107 points for cross-examination. Most of these points, of course, were included in the original 147 which might have been obtained, as a perfect score, in the free narration; but for the purpose of comparison of the three methods of eliciting testimony, it was necessary to score each part of the test separately. Table 1, following, gives the results.

TABLE 1

Scores of Witnesses Reporting An Unexpected Incident

	Free Narration	Direct Exam.	Cross Exam.
Average of All Witnesses --			
Completeness	23.2	31.2	28.7
Accuracy	94.05	83.2	75.7
Caution	...	40.1	51.8
Highest Witness --			
Completeness	31.9	48.7	43.9
Accuracy	100.	94.5	97.2
Caution	...	77.7	88.8
Lowest Witness --			
Completeness	6.4	7.5	19.6
Accuracy	83.7	64.2	61.9
Caution	...	15.3	10.

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The figures in Table 1, above, represent percentages. The per cent "Completeness" means the completeness of the correct points given by the witness. Thus the first figure given in Table 1, which is 23.2 per cent completeness as the average for all witnesses in free narration, means that the 18 witnesses testified, correctly, to an average of a little over 34 points during this portion of their testimony. Since the total they might have given correctly was 147, $34+/147$, or 23.2%, represents the completeness of their correct findings.

The figure for these witnesses' average "accuracy" in free narration, which is 94.05%, signifies the percentage which their correct points are of their total points given. That means that, whereas these subjects, on an average, gave 34+ points correctly, they actually gave a total average of 36+ points 2 of which were erroneous. The handling of errors in figuring Aussage results seems to me another fertile source of possible confusion. If a witness gives 34 points correctly and 2 points erroneously, how can it have any meaning to figure his total, 36, as the number representing his completeness? Surely the 2 erroneous points are not, in any sense, a portion or fraction of the possible number of 147 points to be given. Rather, it seems to me, he has gotten $34/147$ of his job done; and, in addition, he has volunteered 2 extra, wrong facts. These 2 mistakes will not tend to impair the completeness of what he has found correctly; but they will tend to mislead the jury into possible additional erroneous findings. The two errors should, therefore, be used as a basis for figuring the percentage of said witness' reliability, or the accuracy of all his testimony taken as a unit, and should be given a negative rather than a positive value in the estimation of the worth of each witness' testimony.

The percentage of "caution," as used in Table 1 and succeeding tables, signifies that percentage of the total times the witness really didn't know a point, in answer to a question, when that witness declined to answer, or said, "I don't know." The figure is arrived at by totaling the number of errors, "don't knows," and no-answer responses, which total clearly represents the actual total of points unknown to the witness, and then figuring what fraction or percentage of this total is represented by the number of "don't know's" and no-answers, which clearly constitutes the actual total of points the witness knew he didn't know. To take an hypothetical case, suppose a given witness made 6 erroneous answers and replied "I don't know" to 4 queries. Then 4 plus 6 shows that the witness actually did not know the answers to 10 inquiries. But he took a chance on 6 answers and got them wrong, while on 4 he exercised caution and declined to respond. His index of caution, then, would be $4/10$, or 40%. Of course, there is always the possibility that the witness also took chances in answering some of the questions to which he responded correctly; but on this we can obtain no objective check. The value of the index, or percentage of caution, is largely interpretive, as may be seen by a glance at the results in Table 1.

Summary

Careful inspection of these results reveals data which may be summarized as follows:

A--Free narration is uniformly less complete and more accurate than either direct or cross examination.

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B--Direct examination is both more complete and more accurate than cross examination. The "low" witness, put into the table to show the range of variation in results, does not conform to the average or to the "high" witness in this particular, and the explanation would seem to lie in an individual eccentricity which leads this man not to respond to any inquiry unless pressed or irritated. The "high" witness, on the other hand, proved even more accurate on cross examination than on direct, this increase in accuracy evidently being at the expense of completeness.

C--Cross examination shows greater caution than direct examination, though without any corresponding gain in either completeness or accuracy on the average. From study of individual records, however, I would suggest that the added caution in cross examination has a vital influence in holding the accuracy percentage up to a figure at all comparable with that obtaining in direct examination. Added caution does an important, though hidden, work, in short, in redeeming cross examination from a degree of inaccuracy which would render it almost wholly worthless.

D--The percentage of caution, in individual results, shows a close correlation with both completeness and accuracy. It seems rough but certain indicator of the probable value of any witness' testimony.

3. Comparison of Unexpected and Expected Incidents

The lawyer-witnesses in my first experiment were very much dissatisfied with their scores. It seemed to them incredible that not one subject had observed the large, green-handled knife which had been the crux or point of maximum legal meaning in the incident presented. They advanced the theory that the very usualness of the actions involved had cut their perceptions in half; and I countered with the judgment that if they were to see the same incident over again, fully cognizant that it was to occur, their scores would not be improved more than fifteen or twenty per cent. The point was worth investigating, however, since if knowledge that something to be especially observed is about to occur should noticeably increase completeness and accuracy of report, it would mean that the state of witnesses' attention at the time their observations were made is the controlling factor in the resulting value of their testimony. This was the problem, therefore, which I next sought to investigate.

Method

The same incident, with different actor, costume, knife, envelopes, and conversation, was performed before another class in legal psychology at American University, all members of which had been fully informed as to the details and results of the first experiment. This second class, moreover, which was composed of 12 lawyers, contained two of the same witnesses who had reported on the first incident. No special announcement was made when this second incident was performed that a test was in progress; but, according to later report, every member of the class knew from the moment knocks were heard upon the door of the lecture room that an Aussage experiment was contemplated. In this way a general study of the importance of witnesses' initial state of attention could be made without interposing that artificial setting which must always arise when subjects are told: "Here is a picture, look at it." As nearly as the actual conditions usually obtaining in observations of actions especially attracting

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witnesses' attention, and on which they knew while making the observation that they would be called upon to report later, could be reproduced experimentally, this second experiment reproduced them. The two men who had seen the same incident, with differing details, previously performed, enjoyed, of course, a considerable advantage over witnesses in actual cases under otherwise corresponding conditions. A separate study of the results obtained by these two witnesses, therefore, was made, as well as a study of the average scores of the whole group, including the two men in questions.

Results

Since the plot of the second incident remained identical with that of the first, including all the actions of knocking, entering the room, giving an envelope to the lecturer, removing a yellow page, reading a supposed message, stranger's putting second envelope in pocket, taking out knife and scraping at gloved thumb, exchange of almost identical remarks, and stranger's leaving the room, it might certainly be expected that the scores of the two witnesses who had seen the first incident, at least, would show a remarkable improvement. No tricks were introduced, even in the details changed, the new actor being an obviously different individual, with obviously different clothes; his second envelope being very large, and his knife a very large, white-handled affair. The colors of the books were kept the same as in the first experiment. Despite all these favorable conditions for an improved score, Table II, following, shows that the two witnesses reporting on both incidents, one of whom was next to the high man in the second group, failed to exhibit any significant improvement whatever, except in completeness of free narration.

A glance at Table II shows that the only notable improvement in score was obtained, by both students, in the completeness of their free narration, their average gain being 22%. This is slightly more of an increase in score than I had predicted, basing my guess upon the general psychological factors involved. When we continue our inspection, however, we soon discover that only one other gain was made, and that was an average improvement of only 7.2% in cross examination completeness. On the other hand, the most consistent difference between the scores of the first and second experiments seems to be a diminution in accuracy in all types of report, varying from .2% in Mr. H's cross examination to 15.9% in the same subject's free narration. This loss in accuracy is uniform except for a gain of 1.1% during the direct examination of Mr. H. The explanation clearly lies in the tremendous diminution of caution which both subjects showed, this loss running as high as 44.5% during the cross examination of Mr. W. In short, the gain which might have been expected to result from repetition of identical perceptions and report of identical observations in the second experiment was largely counteracted, and, during a considerable part of the testimony was completely reversed by the overconfidence or self-assurance of subjects witnessing the same incident for the second time. This result once more emphasizes the apparent close relationship between the caution of the witness and the general reliability of his testimony; and I venture the suggestion that caution plays its part during the observation of an incident as well as during the reporting thereof.

Table III, following, gives the comparative scores of the eighteen witnesses to the first incident under unexpected conditions, and the

TABLE II
SCORES OF WITNESSES TWICE REPORTING SAME INCIDENT

U=Unexpected Incident.
 E=Expected Incident.

		MR. W.				MR. H.				Average Superiority	
		Score		Superiority		Score		Superiority		U	E
		U	E	U	E	U	E	U	E		
Free Narration.....	Completeness.....	25.5	52.5		27.	22.4	39.4		17.		22.
	Accuracy.....	92.5	85.9	6.6		100.	84.1	15.9		11.2	
	Completeness.....	48.7	34.5	14.2		37.5	46.4		7.9	3.1	
Direct Exam.....	Accuracy.....	92.1	79.	13.1		83.3	84.4		1.1	16.	
	Caution.....	54.5	13.3	41.2		25.	20.	5.		23.1	
	Completeness.....	24.2	40.2		16.	31.7	30.2	1.5			7.2
Cross Exam.....	Accuracy.....	81.2	75.9	5.3		73.9	73.7	2		27.	
	Caution.....	71.4	26.9	44.5		45.4	23.8	21.6		33.	

TABLE III
SCORES OF WITNESSES REPORTING UNEXPECTED AND EXPECTED INCIDENTS

		Free Narration		Direct Exam.		Cross Exam.		Total Average		Superiority of Higher Average	
		U	E	U	E	U	E	U	E	U	E
Average of all Witnesses.....	Completeness.....	23.2	35.2	31.2	33.7	28.7	32.3	27.6	33.7		6.1
	Accuracy.....	94.	81.2	83.2	73.9	75.7	74.3	84.3	76.4	7.9	
	Caution.....			40.1	8.3	51.8	18.6	45.9	13.4	32.5	
Highest Witness.....	Completeness.....	31.9	52.5	48.7	45.4	43.9	40.2	41.5	46.		4.5
	Accuracy.....	100.	91.1	94.5	92.2	97.2	86.6	97.2	89.9	7.3	
	Caution.....			77.7	25.	88.8	35.7	83.2	30.3	52.9	
Lowest Witness.....	Completeness.....	6.4	18.2	7.5	23.	19.6	18.7	11.1	19.9		8.8
	Accuracy.....	83.7	68.4	64.2	57.3	61.9	57.1	69.9	60.9	9.	
	Caution.....			15.3	0.	10.	0.	12.6	0.	12.6	

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scores of the 12 witnesses in the second incident, who did expect it, from the initial knocks on the lecture room door, and who knew it was a test incident throughout. The two witnesses who had also seen the first incident are averaged into the second, or "Expected" group, in order to emphasize any possible differences between the scores resulting from the difference in the state of witnesses' expectations.

Summary

Analysis of Tables II and III, above, shows:

A--Messrs. W. and H., repeating witnesses, manifest great improvement in the completeness of their free narration when the incident is expected; they show slight, but consistent, loss of accuracy under these same conditions; and they show great loss of caution throughout all reports of the expected incident.

B--The entire group of witnesses under expected conditions, as contrasted with the whole group under unexpected conditions, shows slight gain in completeness during all types of report (ranging from 4.5% to 8.8%); they show slight loss in accuracy in all types of testimony (averaging 7.9%); and they show considerable loss of caution in all three types of report (ranging from 12.6% to 52.9%). It is to be noted that most of the gain in completeness in the total group scores, just as in the repeating witnesses' scores, was achieved during free narration, only average gains of 2.5% and 3.6% being registered in direct and cross examination, respectively.

4. Comparison of Findings of Fact By Judge, Male Jury, and Female Jury

The second part of the original problem, it will be remembered, consisted of opening up the psychological analysis of relations existing between the findings of judge or jury, and the testimony upon which such findings were based. A preliminary complication immediately made itself manifest. Which finder of fact can produce most accurate results for purposes of comparison with witnesses' testimony, judge or jury? And, since we have both male and female jurors in most jurisdictions since the adoption of the Nineteenth Amendment, which sex shall we assume to be most reliable in the exercise of this function? It would seem, in light of these complications, that a preliminary comparison of judge, male jury, and female jury, as finders of fact, was indicated before any attempt could be made to compare the respective values of findings of fact and testimony.

Method

The testimony of each witness in both experiments was, it will be remembered, written out by the witness himself. It was only necessary, therefore, to have this testimony typed, with individual copies for each judge and juror. Diagrams of the lecture room were also prepared for the judge in the first experiment, and for two of the juries in the second experiment, who were unable to make a personal inspection of the scene where the incident occurred.

Dean Wigmore, of Northwestern University Law School, very obligingly

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consented to serve in capacity of court for the first experiment, and I wish to take this opportunity of acknowledging my obligation to Dr. Wigmore for his courtesy. It seemed eminently advisable to select as judge a lawyer especially experienced in dealing with evidence, and it will be generally agreed that no American member of the bar more exactly satisfying this experimental requirement could have been chosen. Both the male and female juries who rendered findings upon the first incident were students at George Washington University, Washington, D.C.; and I am greatly indebted to Dean W. C. Ruediger for his careful selection and supervision of these juries. Views of the lecture room where the incident occurred were arranged for both juries, and each individual juror was furnished with a copy of all the evidence several days in advance of the meeting at which they made their final findings. Notes on the methods and general procedure in the jury-room were kept by the foreman and forewoman of male and female juries, respectively. I wish to thank all the students who thus participated in this work.

In the second experiment I decided to select as judges persons of each sex experienced in some practical method of finding facts, but not possessed of legal training. In this way it seemed feasible to open up the possibilities, if any, in problems of the most efficient type of training for individual finders of fact. Miss Emily Davis, newspaper woman and correspondent, consented to review the testimony of the second experiment and to report her findings exactly as she would do in the actual pursuit of her profession; and Dr. Charles C. Tansill, Assistant Chief of the Legislative Reference Service, Library of Congress, whose field of specialization is American history, agreed to make similar findings in accordance with the methods customarily employed by historical research workers. Expression of warm appreciation is due both Miss Davis and Dr. Tansill for their painstaking efforts. Director of Rehabilitation Edward F. New, of the University of Maryland, selected and instructed male and female juries from the college students under his charge; and I wish also to thank Mr. New, who is himself an attorney, for the care and trouble taken both by himself and by his students. Exactly the same procedure was followed by judges and juries in studying testimony and making final findings of fact as in the first experiment.

Results

In the first experiment, both judge and juries, in rendering their findings, followed the three forms in which the testimony was elicited; that is, they made one finding in the form of free narration, another in form of answers to direct examination, and a third in form of answers to cross examination questions. It is impossible to state, with complete accuracy, to what extent the direct and cross examination testimony influenced the free narration findings; but it may be judged, from careful inspection of all results, that the finders of fact adhered rather strictly to the actual content of testimony in each part to which their report corresponded. In Table IV, following, the completeness, accuracy, and caution of the judge, of the male jury, and of the female jury are compared separately for free narration, direct examination, and cross examination.

The interesting, and to many jurists unexpected, result of superiority of female jury findings over those of the male jury is manifest in

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Table IV

Scores of Judge, Female Jury, and Male Jury

	Completeness	Accuracy	Caution
Free narration--			
Judge	31.2	88.4	...
Female jury	16.3	92.3	...
Male jury	20.4	75.	...
Direction examination--			
Judge	40.8	72.	17.3
Female jury	33.3	71.4	23.8
Male jury	21.6	59.	14.2
Cross examination--			
Judge	38.3	82.	30.7
Female jury	30.8	71.7	23.5
Male jury	27.1	68.1	36.3
Total averages--			
Judge	36.7	80.8	24.
Female jury	26.8	78.4	23.6
Male jury	23.4	67.3	25.2

Table IV. The judge, as might, perhaps, be predicted, scored approximately 10% higher, on the average, than the highest jury in the completeness of his findings, while the judge's average accuracy was also slightly higher than that of the juries. For the first time, however, in these experiments, we find that the index of caution seems to have little or no correlation with successful results. The differences between the percentages of caution manifest in the reports of these three finders of fact was negligible, and the very slight difference which existed, on the average, was shown to be in favor of the least successful judge. The explanation of the judge's superiority over both juries, therefore, and of the superiority of the women's jury over that composed of men, is not to be sought in native conservatism, or in added suspiciousness of attitude on the part of those finders of fact who turned in the best results. It is frequently assumed by trial judges and lawyers that the "hardboiled" attitude so quickly acquired in the courtroom is conducive to increased success in evaluating witnesses' testimony; but such a conclusion is not indicated by the results of this preliminary experiment.

Since the percentage of caution seemed to have little bearing upon results, and since, in actual cases, judge, jury, or master in chancery would make findings of fact in the form of unified statements based almost altogether upon direct and cross examination of witnesses, I adopted this form of finding for the judges and juries in my second experiment. Instead of scoring the reports of finders of fact under the separate headings of free narration, direct examination, and cross examination, the maximum number of different points which it was possible to score in the entire report was used as the basis from which percentages were reckoned, and a

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single score, therefore, resulted for each entire set of findings. In such a method of scoring, of course, the index of caution could not be figured, since this index depended upon specific answering of questions. In Table V, below, percentages of completeness and accuracy are presented, in order of merit, as obtained by the findings of male and female judges, not lawyers, and by male and female juries, as in the preceding experiment.

Table V

Scores of Female Judge and Jury, and Male Judge and Jury

	Female Judge	Male Judge	Female Jury	Male Jury
Completeness	61.7	45.9	48.9	44.8
Accuracy	88.9	85.7	77.4	92.6

The first notable result shown by comparison of Tables IV and V is the marked increase in the absolute values of the scores of finders of fact in the second experiment. The absolute average for the completeness of findings in the first experiment was only 28.8%, while in the second it rose to 50.3%, an increase of 21.5%. Similarly, the first total average accuracy of report was 75.5%, as against an average of 86.1% in the second experiment, or a gain for the latter of 10.6%. There was, as we noted above, a slight gain in completeness of testimony by the witnesses in the second experiment; but since there was also manifest a slight loss in accuracy, we cannot look to this source for an explanation of the marked increase in absolute scores of finders of fact for the second incident. Rather, it seems, the main cause for this difference is to be sought in the different methods of computing the scores in question. Although the second method, which results in a single general score for each set of findings as a unit, would seem, at first thought, nearer to actual conditions obtaining in court than would the first method; as a matter of fact, its sharp increase in absolute score values is largely artificial. For instance, had the second method been applied in figuring witnesses' scores in the second experiment, a witness might have testified in direct examination that one book carried by the stranger was red, another green, and the third blue, receiving three points in his score for these correct answers. But in cross examination he might have been asked if one of those books wasn't, as a matter of fact, yellow. If he answered, "No," he must, on the second method of scoring, receive an additional point, since he at no time had previous opportunity to reject this erroneous suggestion. But he has not added any real value whatever to his testimony. He has merely repulsed an attack upon his credibility as a witness. If he hesitated in repulsing this attack, a jury in actual practice might well lessen their estimates of the value of his testimony; but if he replied firmly and consistently, they would not have any really new matter to add to what he had already given. Similarly, the finders of fact in the second experiment were enabled to gain many points in their absolute scores by making correct findings upon matters placed in issue by leading cross examination inquiries which, by the second method of scoring, must be reckoned in as new points. If the first method were employed, on the other hand, each type of testimony would be scored separately, testimonial reduplications like that cited above would be merely averaged together in the final result, and each successful finding would, therefore, receive its

logically proper weight. We may conclude, then, that the second method of scoring, though more legally realistic, did not prove logically or psychologically sound.

In light of this analysis, then, the absolute increase in fact-finding scores of the second experiment should not be given appreciable weight, although the comparative relations between scores of different finders of fact retain the same value as in the previous scoring method. In considering this comparison of scores, as shown in Table V, it becomes evidence that women again succeeded in carrying off the laurels. Not only did the second female jury excel the male jury, by a slight margin, in the completeness of their correct findings, but the woman judge, who was, it will be remembered, a newspaper correspondent, bettered the completeness scores of both juries and that of the male historian judge by very considerable margins. The male judge, on the other hand, obtained a better score than the male jury in completeness of findings, but not quite as high a score in this particular as that of the female jury. Accuracy scores do not appear to follow completeness scores, the male jury being highest in accuracy, though lowest in completeness. It may be said, in explanation of this rather odd reversal, that members of this particular male jury were well acquainted with one of the witnesses, who happened to be most accurate in his testimony of all those who participated in the second experiment. It would seem, from careful review of the findings and testimony, that the male jury in question followed closely the testimony of the witness they knew personally, as an accuracy criterion for all the rest, whom they did not know. This is not a condition likely to occur in court procedure, and might, in fact, if proved, furnish grounds for the granting of a new trial. Unfortunately, it was impossible for me, after discovering this peculiarity of result, to repeat the experiment under comparable conditions with a new male jury. The artificially high accuracy score of the first male jury may be disregarded, however, without impairing the general comparative values of the results. The low accuracy score of the female jury should receive, as I suggested above, a negative value in comparative rankings of finders of fact.

The woman judge, then, takes first place by a significant margin. The man judge follows, excelling by a small and rather dubious percentage the female jury. The woman jury excels the male jury by a slight margin also if relative accuracy results under uniform experimental conditions may be regarded as following the indications of the first experiment, and the results of the supplementary experiment, reported below.

Table VI, following, shows a comparison of the amounts by which each of the three judges excelled the most successful jury reporting in the same experiment. Because of the difference of method in scoring the findings of fact in the second experiment, no comparison of absolute scores could be made as between the eminent lawyer judge, who made findings for the first incident, and the reporter and historian judges, who made findings of fact for the second incident. It seemed equable, however, to make such comparison upon the basis of comparative excellence in the separate experiments, since difference in scoring methods did not, as above pointed out, affect comparative relations between scores in the least degree. The purpose of this comparison is to open up the problem of whether or not legal training and experience in dealing with evidence is more or less effective,

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psychologically, than other types of fact-finding experience. No suggestion of a final solution of this problem or of the problem of possible sex differences in fact-finding ability of judges is intended to result from this preliminary analysis, but merely a tentative presentation of promising avenues for psycho-legal investigation.

Table VI

Comparative Superiorities of Lawyer Judge, Reporter Judge, and Historian Judge Over Their Respective, Highest Juries

	Reporter Judge	Lawyer Judge	Historian Judge
Completeness	+12.8	+ 9.9	-3.
Accuracy	+ 3.7	+ 2.4	+8.3
Net, or key score	+16.5	+12.3	+5.3

Table VI, above, clearly indicates that considerable differences in fact-finding proficiency may exist as between different professions, and as between different methods used. A general guess might be hazarded, as an hypothesis for further investigation, that those callings which depend for their factual bases upon direct eliciting of data from human sources might be found to secure greatest success in completeness and accuracy of result, while it would not be psychologically surprising if legal training and experience were found to rank comparatively low in the scale of efficient disciplines for successful finding of facts.

The net or key score, as given in Table VI, is merely the algebraic sum of the completeness and accuracy differences between each judge and the highest jury in that experiment; and this key score may be used as a rough indicator of the net comparative proficiency of each judge as a finder of fact. In a more extended series of experiments which might seek actually to establish statistical ratings for fact-finding ability in different professions, a more elaborate and exact method of arriving at the final key score should be devised.

Summary

Review of Tables IV, V, and VI shows the following uniform results:

A--A single trained individual, sitting as judge, is more successful as finder of fact than is a male jury or a female jury, the judge excelling the jury more significantly, on the average, in the completeness of correcting findings than in the accuracy of total report.

B--Female juries excel male juries, on the average, both in completeness of findings and accuracy of report.

C--Professional training and experience, and possibly also sex, appear to have some psychological bearing upon success in individual findings of facts.

5. Comparison of Findings of Fact By Juries, Based Upon

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Written and Oral Testimony

It is frequently asserted by presiding justices at actual trials that much fact-finding value is to be derived from the opportunity given a jury, in the court-room, of observing each witness, fact to fact, as he gives his testimony on the witness stand. This value, if any, must have been totally lacking in the findings of fact made by judges and juries in the experiments reported above, since all testimony was presented to them in typewritten form, and the witnesses were not even known by sight to the finders of fact, except in the accidental instance above mentioned. Such, indeed, is the usual condition obtaining in Aussage tests, since it is difficult and often impracticable to arrange for a dozen or more witnesses to give their testimony, orally, before an experimental court. However, this problem should not be overlooked in outlining the field for further psycho-legal investigation, since if a material loss of testimonial value were indicated as a result of failure on the part of the finders of fact to observe the witnesses while they testified, routine Aussage procedure must be radically revised to permit such observation during testimony orally given. This was the final problem, therefore, which I undertook to investigate before attempting a comparison of the values of findings of judges and juries with the value of the original testimony upon which such findings were based.

Methods

Two juries, male and female, were assembled simultaneously, with the aid of Mrs. Ann Severance Hartman, Mrs. E. H. Marston, and Captain F. M. Van Natter, whose assistance I gratefully acknowledge. The jurors were all of mature age, advanced education, and unimpaired perceptual abilities. The 12 witnesses to the second experimental incident were brought before the juries, one at a time, in the same lecture room where the incident had originally occurred. Each witness was asked, first, to tell what happened in his own way, without questioning. He was thereafter examined in both direct and leading form, just as he had been questioned when he wrote out his report, immediately after the occurrence in issue. All witnesses remained in a separate witness-room, across the hall from the lecture room, until called to the stand, in accordance with strictest trial procedure. Jurors were allowed to take such notes as they wished during testimony, and the testimony was taken down verbatim by stenographers who were present. The transcript of testimony was not furnished the juries during their deliberations, since this would have necessitated impracticable delay, and since juries in actual trials usually make little, if any, use of the testimonial record.

Necessarily, as in actual cases, court did not sit, as above described, until three months after the incident in issue occurred. It is to be noted, however, that every witness had written out his complete testimony immediately after the incident. This might well tend, psychologically, to fix the memory in his mind, since kinaesthetic and visual imagery of the testimony thus set down would be added to perceptual imagery of the original incident. Moreover, the real incident was reviewed at the lecture following its occurrence, and witnesses spent much time discussing together their individual errors. In view of these memory reinforcements and corrections, and in light of the fact that actual trials often take place several years after the occurrences which are testified to thereat, a higher percentage of oral

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testimonial value might well be expected than that obtained in actual cases. E. H. Marston[4] sat, as an observer, with the female jury after it had retired to the jury-room to make its findings; and I say, similarly, with the male jury while its report was decided upon. Results of these observations proved valuable in suggesting a possible explanation of sex differences in fact-finding success.

Results

One of the most interesting details of the results of this experiment was the extraordinary testimony given by one of the witnesses, based, as was afterward revealed, upon deliberate suggestions made to him in the witness room by the other witnesses awaiting their turn to testify. The men were evidently comparing their memories of the incident, to start with, and began to exaggerate and make fun of each other's alleged mistakes. Finding Mr. A. hypersuggestible, they combined to put into his mind the most absurd and improbable details. When called before the juries, in fact, Mr. A. actually testified that the actor in the incident in issue wore one high, black shoe, and one low, tan shoe; that he had some sort of gold medal in the buttonhole of a bright scarlet coat, and that he wore a flaming red tie, knotted in spread-eagle fashion, outside coat and vest! More significant than the mere fact of this witness' unusual suggestibility to mischievously motivated "coaching," however, was the resulting effect upon certain jurors. One woman juror was so impressed by the extreme self-confidence shown by Mr. A. on the stand that she came to the conclusion that he was the only reliable witness out of the 12 men called. As a result of her insistence upon this point, at least two erroneous findings were introduced into the female jury's report. A member of the male jury argued, also, that such extraordinary statements would never have been made by any witness unless he had actually seen details which the other witnesses were not in position to observe. After extended discussion, several of Mr. A.'s statements were adopted as correct by the male jury, thus materially reducing both their completeness and accuracy ratings. Such disproportionate and erroneous importance given by jurors to prejudiced witnesses' self-assertiveness on the stand may well play an important role in many a jury's final findings.

Table VII, following, compares the scores of male and female jury findings of fact based upon oral testimony, as above described, with similar scores of findings of fact reported by the University of Maryland juries, and based solely upon the written testimony of the same witnesses to the same incident. In order to make test jury scores fairly comparable, both were figured by the second method described above.

It is to be noted, in Table VII, that the accuracy percentage of the male jury, which was discussed at length above, is actually based upon the written testimony of a single witness, instead of upon the written testimony of all 12 witnesses. While this accidental variation must invalidate direct comparison of male jury accuracy with the accuracy scores of corresponding finders of fact, as noted in the foregoing discussion, it has no serious bearing upon comparison of average accuracy of written testimony method with average accuracy of oral testimony method. Since all the testimony furnished both Maryland Universities juries was written, all their findings must have been based solely upon material received in written form. It may

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well be, however, that accidental outside knowledge of a single witness' reliability might also have raised the total average accuracy percentage of findings based upon oral testimony. I suggest, nevertheless, that such previous confidence in a witness would probably be found to have less effect, in the oral procedure, since fresh perceptions of each witness as he testifies might be expected, psychologically, to supplant or materially modify previous estimates of the particular witness' accuracy.

Table VII

Comparative Scores of Jury Findings Based Upon Oral and Written Testimony

	Oral	Written	Superiority when based on written testimony
Completeness--			
Female jury	38.6	48.9	10.3
Male jury	33.6	44.8	11.2
Average	36.1	46.8	10.7
Accuracy			
Female jury	80.6	77.4	- 3.2
Male jury	68.8	92.6	23.8
Average	74.7	85.	10.3

Summary

The results and observations in this experiment may be summarized as follows:

A--Jury findings based upon testimony written out by witnesses immediately following the occurrence are superior in both completeness and accuracy to jury findings based upon oral testimony of the same witnesses heard by a jury some time after the event in issue. What proportion of this superiority, if any, is due to the mere lapse of time between incident and oral testimony is not indicated by this experimental procedure, and should be made the subject of subsequent investigation.

B--The self-confidence, or self-assertiveness, of a witness on the stand, even though that witness be the most obviously unreliable and improbably of all those heard, may have a greater influence upon jurors of both sexes than does the logical or psychological probability of other testimony.

C--Careful comparison of the observations of E. H. Marston and myself upon the jury-room deliberations of female and male juries, respectively, gave the following results:

(1) The female jury exercised much greater care in considering detailed testimony than did the male jury. The women jurors were more painstaking, and manifested a thoroughness and a willingness to put themselves to

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more trouble and to do more work in considering all the testimony submitted, no matter how trivial or obviously erroneous it seemed, than the men jurors.

(2) Both juries pursued, without previous discussion or consultation, the same method of compiling their final findings; that is, separate consideration, discussion, and vote upon each moot point, with subsequent revision of previously agreed on findings, where this became necessary.

(3) Individual jurors of both sexes appeared equally prejudiced and illogical in discussion of certain points; and both juries, taken as units, seemed equally unable to "size up" or psychologically analyze the behavior and responses of witnesses on the stand which had been especially noted.

6. Comparison of Findings of Fact With Testimony on Which Findings Were Based

Having examined the preliminary psycho-legal problems of the relationships existing between the findings of judge and jury, and between the findings of juries of different sexes, we may finally compare the scores of all these findings of fact with the average score of the testimony upon which each finding was based. Table VIII, below, contains such a comparison. Necessarily, each experiment, or experimental incident, had to be treated separately, since all finders of fact in the second experiment were scored by the second or "lump-score" method, and all the witnesses in that experiment had, therefore, to be re-scored by the same method for the purpose of this final comparison with the scores of the finders of fact who passed upon their testimony.

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Table VIII

Comparative Scores of Judges, Juries, and Witnesses

	Score	Completeness Superiority over Witnesses	Score	Accuracy Superiority over Witnesses
Unexpected incident (first scoring method)--				
Witnesses	27.6		84.3	
Judge	36.7	9.1	80.8	-3.5
Female jury	26.8	- .8	78.4	-5.9
Male jury	23.	-4.6	67.3	-17.
Average of judge and juries	28.8	1.2	75.5	-8.8
Expected incident (second scoring method)--				
Witnesses	40.7		73.4	
Female judge	61.7	21.	88.9	15.5
Male judge	45.9	5.2	85.7	12.3
Female jury (written testimony)	48.9	8.2	77.4	4.
Male jury (written testimony)	44.8	4.1		
Female jury (oral testimony)	38.6	-2.1	80.6	7.2
Male jury (oral testimony)	33.6	-7.1	68.8	-4.6
Average of judges and juries	45.5	4.8	80.2	6.8

The preliminary point of interest to be noted from the results in Table VIII, above, is the artificial rise in the average completeness score of the witnesses in the second experiment when the "lump score" method of scoring is adopted. In Table VIII the average completeness of witnesses' testimony is 40.7%, as against the 33.7% average in Table III, figured by the original method of scoring. The average accuracy of these witnesses, on the other hand, appears to be 3% less when figured by the second method, a result which calls attention to the suggestibility element in any accuracy score over-emphasizing errors in cross examination.

The average accuracy superiority of finders of fact over the average witness was very much greater in the second, or expected incident, than in the first, or unexpected incident test. This is difficult to explain in view of the fact that the second group witnesses were more than 10% less accurate, on the average, than were the witnesses of the first group. That is, the witnesses who expected the occurrence suffered from overconfidence in reporting it, and they included 10% more erroneous testimonial statements, the second group finders of fact were, on the average, 80.2% accurate in their findings instead of 75.5%, the average accuracy of the finders of fact in the first experiment. When this absolute increase of fact-finders' accuracy is taken in numerical conjunction with the decrease in average

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witnesses' accuracy in the second experiment, we find that the comparative average difference between accuracy scores of findings and testimony has passed from a minus quantity to a plus quantity, showing a total improvement in the second experiment average over the first of 15.6%. One might guess, in explanation of this rather odd result, that the finders of fact in the second experiment were able to detect very gross inaccuracies in the testimony before them, while those in the first experiment were not able to detect ordinary, trifling errors; and that, as a consequence of detection of some gross errors, the second group of fact-finders were led to examine all the testimony more carefully. The data at hand, however, is insufficient to point, significantly, toward any definite solution, though it is wholly adequate to indicate the advisability of further investigation of the relation between accuracy of findings of fact and accuracy of the testimony on which such findings were based.

Table IX, following, presents a unified comparison of the findings of fact and the testimony on which the findings were based. No absolute value is to be attached to these averages, since they represent a mean made up of diverse elements in two dissimilar groups, but the comparative value of the averages is not in the least impaired by such dissimilarity, since each unit in each average is individually comparable with a corresponding unit in the contrasted average. The total average, on "indicator," score for judges, juries, and witnesses, made up as it is of a simple sum of accuracy and completeness averages, represents no fixed value, or attempt to create a compound measuring stick giving equal place to completeness and accuracy. It rather constitutes a simple means for showing, at a glance, the final, rough relationship between the success of judges and juries and the success of the average witness in reconstructing a given occurrence of an ordinary sort.

Table IX

Comparative Average Scores of Judges, Juries, and Witnesses

	Average of 3 judges	Average of 6 judges	Average of 30 witnesses
Completeness	48.1	35.9	32.5
Accuracy	85.1	77.5	80.1
Indicator scores	133.2	113.4	112.6
Total superiority over average witness	20.6	.8	

Summary

Consideration of the comparisons of results contained in Tables VIII and IX may be summarized as follows:

A--All finders of fact, averaged together, slightly excel the average witness in completeness of report, and, less clearly, in accuracy of report.

B--Accuracy of findings of fact does not seem to depend upon the accuracy of that testimony on which the findings were based.

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C--Completeness of findings of fact does seem to parallel, roughly, the completeness of the basic testimony.

D--Findings of fact, by juries, based upon oral testimony, are consistently less complete than is the testimony of the average witness. Such jury findings do not differ significantly in accuracy from the average witness' testimony.

E--The total averages of six juries of both sexes show these juries to be slightly more complete, and slightly less accurate, in their results, on the average, than were the 30 witnesses on whose testimony the juries' findings were based. Indicator scores of juries and witnesses, made up of the sums of completeness and accuracy averages, differ by less than 1%.

F--The total average scores of three judges (two of whom had no legal training) significantly excel the average scores of the 30 witnesses, both in completeness and in accuracy. The judges' indicator score excels the witnesses' indicator score by more than 20%.

7. Conclusion

Experimentation upon the completeness and accuracy of testimony, and of the findings of fact which might be based upon that testimony, probably had its origin in an unconscious, scientific wish to prove that our present juristic system is incapable of achieving a decent degree of justice. Controversial discussion of Aussage results has always centered, therefore, upon the issue of whether or not witnesses are capable of perceiving and reporting accurately any considerable proportion of what takes place in their presence. But, if we admit that psychological experiments have proved that human testimony has a necessarily low value, what of it? That is, what can we do about it? Science of the future may, conceivably, substitute itself as a finder of fact to a large degree for judge and jury; but, after all, science can never artificially reproduce a perfect witness always at hand to observe and report everything that goes on in the world at all times. For such observations and reports, therefore, we must continue to depend upon human testimony. In light of this undeniable conclusion, it seems to me that the most profitable subjects of psycho-legal discussion and experiment are to be found in the various possibilities of practical improvement in the elicitation and use of normal, average testimony, rather than in over-emphasizing its futility. Moreover, our present trial system cannot be supplanted overnight, no matter how radically wrong its results may be proved by science. Psycho-legal investigation, therefore, should seek, primarily, to discover sources of error in the handling of human testimony in our courts which can be corrected, and gradually eliminated, without recourse to legal procedure too greatly at variance with the evidential system now in vogue. The present series of experiments sought not conclusively to determine such sources of error, but to indicate avenues of investigation which, when followed through, might scientifically establish fields for psycho-legal evolution.

In conclusion, I would point out various concrete examples of results herein reported which, if verified, might be utilized to bring about practical improvements in courtroom procedure without any prerequisite change in

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basic law. Judges, for instance, have wide discretion in limitation of cross examination, and granting of broad latitude in direct examination. If psycho-legal research should finally establish the fact that testimonial results in response to direct questioning have preponderantly greater completeness and accuracy, the bench would already possess sufficient power to put this conclusion into practice to a considerable extent.

Again, it is possible, under our present procedure, to take immediate, written statements from witnesses who have been present during accidents and other occurrences of ultimate trial importance. Such statements may be used in various ways during actual trial and are so used very frequently. If it were established as a definite, scientific fact that such immediate, written testimony has several times the value of oral testimony given later, at the trial, the court and counsel, knowing this fact, might add much emphasis and weight to the immediately written statements, in many ways, without departure materially from our present trial system. Indeed, it would not necessitate a very radical departure in legal procedure to provide official machinery for the eliciting and recording of crucial testimony, in important cases, as soon after the occurrence as the witnesses could be summoned; and the establishment of subsequent admissibility of such testimony, as a check upon the witnesses' later testimony, at the trial, would merely require an extension of the rule under which previous sworn testimony may be used at the present time to discredit a witness in cross examination. The official, immediate eliciting of testimony might, moreover, be conducted according to that form which psycho-legal research had proved productive of most complete and accurate results.

In the matter of women jurors, in jurisdictions where sex is no longer a bar to jury service, both counsel and court possess the power to influence the proportion of female representation on any panel. Excusing of jurors, disqualification for cause, and the arbitrary right of challenge may all be used, legitimately, to effect the result of securing women on every jury, if this results turns out to be desirable in the interests of justice. Only continued psycho-legal investigation can establish the desirability of such procedure; but the preliminary experiments reported above certainly indicate a possible value of women as jurors which is wholly contrary to the older practice of deliberate exclusion of women from the jury, whenever possible.

If properly guarded scientific researches should establish the fact, which already seems obvious to many psychologists, that an ordinary jury has lamentable absence of ability and skill in analyzing, psychologically, the reliability of the witnesses appearing before it, and of analyzing, both logically and psychologically the testimony of those witnesses, upon which the case must be decided, much may be done in the way of producing expert analysis of testimony for the jury's assistance. Counsel may procure properly qualified experts in various aspects of testimonial analysis; the court has a wide discretion in admitting such expert testimony; and the jury may be required, by the court's charge, to give due consideration to all the testimony before it, with the possibility of a new trial should expert analysis of crucial evidence be patently disregarded. Nor is the plan of a testimonial expert officially retained in capacity of "friend of the court" so foreign to a modern practice which thus utilizes the sociological advice of probation officers and the psychiatric services of medical examiners.

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Finally, if it can be conclusively demonstrated that a single, trained individual greatly excels any jury in fact-finding ability, parties to any cause, civil or criminal, who honestly desire efficient findings of fact may, in most instances, waive the right to jury trial and thus secure that result most in accordance with justice. Also, in the appointment of masters, commissioners, and other non-judicial fact-finding agents, the court or other appointing official may be directly guided by the results of adequate psycho-legal investigations indicating what types of training and experience are most conducive to completeness and accuracy of report upon the testimony submitted.

All these possibilities for practical improvement in the handling of human testimony as a result of psycho-legal experimentation are cited, not because of their supreme intrinsic importance, but merely to illustrate the possibilities of immediate co-operation between the psychological laboratory and the courtroom. Juristic theory and practice have profited enormously from scientific treatment of abnormalities; why should not a similar profit be derived from psycho-legal solution of normal problems?

Notes:

[1] Member of the Boston bar, and of the American Psychological Association.

[2] For summary, see Wigmore: "Principles of Judicial Proof," p. 575 ff.

[3] Wigmore, Ill. Law Review, 1909, p. 426. Cited in summary, reference (2), above.

[4] Member of the Boston bar.

* * * * *

CAN YOU BEAT THE LIE DETECTOR?

A man can't even lie to himself,
love can't lie, and a good liar
is caught easier than a bad one

By

William Moulton Marston

Catching liars is like no other game in the world. It has its own rules, its own peculiar hazards and handicaps. I have been playing this game, as amateur and professional, ever since high-school days. Some boys in the same fraternity whom I considered my most loyal friends, double-crossed me. Pledged to support a joint undertaking, all but one resigned and left me holding the bag. I was hurt--and amazed. They were all such good fellows, so apparently honest and sincere. I would have staked all I possessed--I did stake all I possessed and some more--that these schoolmates of mine were straight. Yet they were all liars. I perceived suddenly that deception was a game which the person deceived didn't begin to play until it was all over. But playing any game, including that of deception, I reasoned, must require added effort, increased energy. If the extra brain energy required for lying could be detected, the fact that a liar was playing the deception game would stand revealed.

When I began research on lie detection in 1913 under Prof. Hugo Munsterberg in the Harvard Psychological Laboratory, I found that psychologists who had hitherto attacked this problem had proceeded on the opposite principle. They had reasons that because a liar's mind must be full of conflicts his efforts would be weakened and his performance showed up. Investigating this idea, I found that it applied only to very poor liars, and that it applied to them only when you were able to put them in an exceedingly tight corner. Any deception test which is based upon breaking a liar down and compelling him to show weakness is very easy to beat. There are too many good liars in the world. In fact, I soon discovered a psychological type of liar who could lie consistently faster than he could tell the truth. Such a person--whom I called a negative type liar--could beat the Wertheimer-Jung word association test every time--his reactions speeded up significantly under the pressure of necessity. He put more mental effort into his lying, and did a faster, better job than when he merely related honestly remembered facts.

So I returned to my original idea. I sought some method of measuring the effort which a story-teller was putting into his story. When he began to lie his effort would necessarily increase. It is impossible to increase one's effort--mental or otherwise--without increasing the strength of the heart-beat. Pulse-rate may quicken also, or it may remain the same. But increased strength of heart-beat may be detected very conveniently by measuring the systolic blood-pressure--that is, the pressure of blood in the arteries when the heart muscles squeeze together, forcing the blood out of the heart into the arteries. Thus systolic blood pressure becomes a reliable indicator of strength of heart-beat which, in turn, varies with the amount of nervous effort being put forth by a subject.

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This reasoning proved sound. Every time a subject lied, his systolic blood-pressure went up. This blood-pressure increase takes place very quickly, within a few seconds at most. The rise in blood-pressure caused by an important lie is very great, showing that great mental effort is needed to lie successfully. This blood-pressure test--the basic principle of the Lie Detector--is hard to beat. No normal person can lie without effort, and therefore no normal person can lie without increasing his blood-pressure.

I published the systolic blood-pressure test for deception in the Journal of Experimental Psychology in 1917. Immediately the newspapers took it up. They dubbed it the "Lie Detector" and referred to it as an invention of some mysterious sort of apparatus which, when a witness was exposed to it, would render automatically a verdict of "lie" or "truth." This delusion about the Lie Detector still persists. The type of apparatus used, however, is of minor importance. Several different types of sphygmomanometer--that little gadget which doctors wrap around your arm just above the elbow to take you blood-pressure--may be used with equal success in detecting lies. I prefer the kind of instrument where the air pressure on your brachial artery is pumped up and released again by hand, because this causes no pain to the subject. But Dr. John Larson, Chicago criminologist who has used the Lie Detector in thousands of criminal cases, prefers the continuous-pressure sphygmomanometer which records on a smoked drum, described by Larson in the Journal of Criminal Law and Criminology under the title "Modification of the Marston Test for Deception."

But the point is that both types of apparatus for taking blood-pressure had been in use for many years before Dr. Larson or I came on the scene. The Lie Detector is not the "invention of a machine"--it is the discovery of a physiological test which uses standard apparatus to reveal objectively the added mental effort used in lying.

Innumerable objections to the Lie Detector came in from all parts of the world. Most of them were silly, springing from ignorance. But one criticism impressed itself upon me as possibly important. A psychiatrist maintained that anybody could beat the blood-pressure test if he believed his own lie--believed it, that is, with his conscious mind. The good doctor cited many cases where people had repeated a lie so often that they had come to believe it. Especially criminals, he said, came after a while to believe their own stories manufactured in self-defense. I had to admit that perhaps such a person could beat the Lie Detector.

About this time I met Mr. L. in Washington, D.C. L. had suffered what he sincerely believed to be a grave injustice, at the hands of the law. Respected member of a well-known family in a southern state, L. had been convicted of second-degree murder and had been sent to the penitentiary where he had served his term suffering bitterly from social disgrace. Since his release from prison L. had devoted his life to helping ex-convicts, many of whom he believed to have been wronged by the courts as he had been. His one overwhelming hope was to prove to the world that the story he had told to the jury at his murder trial was true. He begged me to test his story with the Lie Detector and permit him to publish his confidently anticipated vindication far and wide.

Here was a man who certainly believed his own story. If he had lied

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in the first place before the jury which convicted him, he had since come to believe implicating that his lie was true. Here was a case, perhaps, which would test the psychiatrist's theory that a man who consciously believed his own story could beat the Lie Detector. So I agreed to make the experiment. L. rounded up an army of newspaper reporters and special writers. He produced news-camera men from four different companies. There could be only one outcome to the test in L.'s opinion. I was extremely sympathetic with the man, but warned him that if the Lie Detector proved he was lying I should have to announce the result honestly. "Absolutely, Doctor!" beamed L. And we went ahead with the test.

L. had shot his uncle. This he admitted. But he claimed that he shot in self-defense. His story had two angles to it. First, he told his alleged motive for quarreling with his uncle, which had to do with a financial transaction in which his uncle had cheated him. This angle the jury evidently had believed, since they recommended mercy. The other part of his story had to do with the physical action on the occasion of the shooting. L. said his uncle had threatened him with a heavy cane, L. had drawn his revolver to cover his uncle while L. backed out of the room, and the uncle had rushed him swinging the cane at his head. If true, this would constitute self-defense, L. being a frail person and his uncle a husky brute. But this part of the story the jury had not believed. But the jury had been wrong. This part of the story was true according to blood-pressure results. Then--came the eclipse! The Lie Detector faithfully revealed that the first and major portion of L.'s convincing tale was a lie. With cameras clicking and reporters rushing out to send the story back to L.'s home state, I had to announce that L. was a liar.

He broke down, wept like a child. Then he told the truth--and I managed to stop the newspaper men until they got it. The whole affair had happened over "the honor of a Southern lady." The lady, whom the uncle had seduced, it turned out was a relative of L.'s wife. This was later verified. The true story, revealed as truth by the Lie Detector, would have acquitted L. in any court. He knew he was innocent. And his honest belief in his own innocence had spread emotionally, during his solitary years behind prison walls, to an equally strong belief in the wholly fictitious tale of a shady financial transaction. Here was a singularly satisfactory proof that subconscious knowledge of the falsity of a story would reveal itself in heightened blood-pressure, even though the witness had come consciously to believe his own lie. In other words, kidding yourself about the truth of your story won't beat the Lie Detector. It takes more effort to lie just the same.

The case of L. also illustrates another peculiar rule in the liar-catching game. Good liars are more easily caught than poor ones with the Lie Detector. The reason is that good liars put more effort into their lying, and therefore raise their blood-pressure to a higher level. Poor liars permit their efforts to weaken sometimes at the crucial moment, with indecisive blood-pressure readings as a result. L. was an excellent liar. He had deceived a jury, and had convinced hundreds of people--including himself--that his wholly fictitious tale was pure truth.

This is the situation with a great majority of criminals. As my psychiatric critic maintained, they make up stories in self-defense

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which after a time they come to believe. In the Texas penitentiary system there were 4200 good liars when I interviewed all prisoners as psychologist in a state survey. In addition, there were three or four truthful prisoners who had confessed their crimes in verifiable detail. But none of these excellent liars, many self-deceived, could beat the Lie Detector.

When the United States entered the World War it was proposed to use deception tests as part of our spy-catching system. The National Research Council, to which such matters were referred, appointed a committee of three psychologists to test the various procedures for detecting lies and rate them in order of their infallibility. This committee consisted of Dr. Leonard T. Troland, of Harvard; Dr. Harold E. Burtt, now professor of psychology at Ohio State University; and I. We conducted very severe tests of all methods proposed for lie detection, under crucial conditions in the psychological laboratory. Then we arranged with the Chief Justice of the Municipal Criminal Court of Boston, Massachusetts, to try out the five most promising deception tests on prisoners under jurisdiction of the Court. As a result of our very exhaustive and critical examination of the various proposed tests in actual practice, we reported to Washington a rating of the reliability of deception tests in the following order.

1. Blood-pressure (systolic)--97% infallible when used by a lawyer-psychologist, expert in detecting deception.
2. Breathing (inspiration-expiration ratio)--73% efficient when adaptable to case.
3. Psycho-galvanometer--practical only as supplementary tests; it detects too many irrelevant emotions.
4. Hand-grip test--supplementary value less than galvanometer.
5. Word-association test--impractical in a majority of criminal cases; some supplementary value.

Major R.M. Yerkes, of the Surgeon General's Staff, recommended the blood-pressure test for practical use, with breathing and galvanometer records to be made and synchronized with the blood-pressure record for the sakes of supplementary check on the lie-catching expert's judgments. One of the best ways of putting these three records of changes in blood-pressure, breathing, and electrical resistance of the skin together is to attach all three sets of recording apparatus to tambour-markers on the same smoked drum. In this way you get three wandering lines, or graphs on the same record sheet. This is call the "polygraph" method of recording. Later a neat assemblage of apparatus was made for this purpose by Larson, and still later by Keeler. Again the popular accounts of lie-detection mistakenly identified the polygraphic recording device with the Lie Detector, or systolic blood-pressure test itself. Keeler's polygraphic recorder is confused with the Lie Detector. As a matter of fact polygraph records of different instruments used in lie-detection were made at Major Yerkes' suggestion during the War. But they had been made long before that in Germany, France, and in our experiments at Harvard. The manner of recording is a matter of convenience only, not an essential of the Lie

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Detector, as supposed. Extreme scepticism met Major Yerkes' endorsement of the Lie Detector in Army circles. Then it chanced that the code book was stolen from the Surgeon General's office in Washington. Circumstances made it evident that one of the seventy negro messengers in the Mills Building had probably taken the all-important code key, probably at the instigation of a German spy. I was called upon to examine all seventy negroes with the Lie Detector. Some of those colored boys had to be herded into the examining office at the point of a gun! They were terribly afraid of the test, every one of them. They thought it was black magic, or some voodoo procedure. As the test proceeded it became apparent that a good many of them had practical reasons for being afraid--we uncovered an amazing list of articles which had been stolen from various offices. Here was an excellent opportunity to test out another criticism of the Lie Detector--namely, its alleged failure when suspects or witnesses were afraid or emotionally upset from causes having nothing to do with the problem under investigation.

The Lie Detector stood the test. None of the negroes, terrified as they were, beat the lie-catching expert. The messenger who had stolen the code book was found, and the book traced and recovered. More important from a long-run point of view was the fact that another alleged method of beating the test had been disposed of. You cannot beat the Lie Detector by letting fear run riot in your brain.

William J. Burns, the famous practical detective, was at that time in charge of the Bureau of Criminal Investigation in the Department of Justice. Mr. Hoover, the present Bureau Chief, was one of Burns' assistants in the office. Burns said to me:

"Will this gadget of yours tell me whether a girl is lying when she says she isn't in love with somebody?"

I said it would--provided the girl was really lying.

"Say, boy," said Burns, "you can't kid me--I know this kid is lying, all right. I want you to put Miss X. through the Lie Detector test, and tell me if she's in love with Edgar Hoover!"

So I gave Miss X. the test. She maintained, with many blushes--("love excitement" was one of the emotions which some psychologists claimed would swamp the blood-pressure rise due to lying)--that she didn't give a hoot about Mr. Edgar Hoover. I showed Burns the blood-pressure record. I can still hear his whoop of delight.

"I knew it!" he chortled. "She's nuts about him. You got some test there, Doc. We'll use it."

Still another possible method of beating the Lie Detector had been eliminated. You can't beat the blood-pressure test by being violently in love with somebody you're lying--or telling the truth--about.

As a result of our Washington try-outs of the Lie Detectors, I was commissioned and sent to Camp Greenleaf to organize a staff of army psychologists who might serve as experts in lie-detection for various

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branches of the Government service. The Armistice interrupted this plan. Since the War, application of the blood-pressure test has been made by many criminologists and criminal investigators, with uniform success. Larson has demonstrated in more than 2000 cases that the Lie Detector cannot be beaten by the ordinary criminal. The test is now being used in more than 25 leading American cities by police or criminal authorities.

In 1922 the Lie Detector test was proposed for the first time in court-room procedure. James A. Frye, a young negro, was accused of murder. Dr. Brown, a wealthy colored physician of Washington, D.C., had been killed. His relatives offered a reward of \$1500 for the arrest and conviction of the doctor's murderer. Frye came forward and confessed. His trial and conviction would be a mere matter of form--there was no evidence in his defense. Then suddenly Frye recanted his confession and claimed he had nothing whatever to do with the killing. Asked why he had confessed, he told a fantastic tale. Frye said he confessed because he had been promised half the reward for his own conviction!

Frye's lawyers, completely baffled, begged me to test both their client's confession and his later story of innocence with the Lie Detector. I agreed. We made the test in the District jail. Frye's confession was false according to the Lie Detector; his later story was true. Working with the Detector we gradually unraveled a story of plot and counter-plot. Frye had been approached by a negro who was supposed to be head of a drug ring. This man would have profited by Dr. Brown's death. He had, as a matter of fact, officially turned Frye in as the murderer, and had claimed the reward. According to Frye's story this was the man who had promised to share the reward money with Frye and to get him out of jail just as soon as the reward had been paid. But there was a hitch in the plan because the other negro could not collect the reward. So Frye had retracted his confession.

The case went to trial before Chief Justice McCoy in the District Supreme Court. I was qualified as an expert in detecting deception, and an offer was made--before the jury--to put in evidence the blood-pressure test record showing Frye's present story truthful. Undoubtedly this offer of evidence--which amounted to a statement that the Lie Detector had proved Frye innocent--made a great impression upon the jury. The test itself was excluded by Judge McCoy on the legal ground that it had not been made in Court, and therefore the result of the test bore only upon the truth or falsity of a statement made by the Defendant while in jail, this statement not being itself admissible and so not before the jury. This was a judicial quirk which none of us had foreseen. Nevertheless, with no other evidence in Frye's favor save his own testimony and the offer of Lie Detector results, the jury acquitted him of first degree murder. He was sentenced on another charge, giving time for investigation which verified the Lie Detector findings. Frye and his attorneys gave the Lie Detector full credit for saving him from otherwise certain hanging.

Judge McCoy's ruling in the legally famous Frye case left only one way open to put the Lie Detector test in evidence. Psychologically inadvisable as it was, the test must be given in open Court. This was done successfully by a student assistant of mine, Edward J. New; in Indianapolis, Ind., in 1924. It was an assault and battery case. Both defendant

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and witnesses submitted voluntarily to taking the Lie Detector test while on the witness stand. New then went on the stand as an expert, showing the charts of blood-pressure variations made while witnesses were testifying, and pointed out lies in the defendant's testimony. One defendant was convicted in accordance with blood-pressure findings, the truth of the witnesses' testimony being apparently accepted by the Court as indicated by the Lie Detector. Since that time, Lie Detector results have been used in cases before the courts in California, Washington, and other states.

The difficulty of getting the Lie Detector--consisting of blood-pressure test, supplemented by other test records--accepted by legal authorities has been greatly enhanced by the failure of other types of deception tests previously proposed. For example, the word-association reaction-time test, simultaneously put forward by Wertheimer and Jung more than forty years ago, is nearly useless in practical procedure. This test consists of a long list of words, to which the subject is supposed to respond by speaking the first word that comes into his mind. Mixed among harmless words in the list are "crucial" words which refer to facts about the crime which only a guilty person, or a lying witness, could know. The theory of the test is that a liar will take longer to give his response word during these crucial reactions because he will be hampered and slowed up mentally by his feeling of guilt. But this test, as previously explained, can be beaten every time by people who lie faster than they tell the truth. Moreover, in an actual criminal case, it is next to impossible to find facts or objects which only a guilty or lying person would know about. Defendants and witnesses will have read every detail of a crime in the newspapers long before you examine them. They will also have been coached by their attorneys. Therefore, innocent witnesses will experience the same embarrassment as guilty ones when the "crucial" words are reached in the list.

The psycho-galvanometer is too delicate a test, responding to every tiniest wave of emotion. This test is based upon the well known fact that emotion causes people to sweat. Microscopic quantities of sweat are detected by the extremely sensitive galvanometer string. But the string will fluctuate just the same whether you are sweating over a lie or a love affair. This test, like the word-association test, reveals for the most part fear--these two are tests of a liar's weakness, an emotional breakdown which cannot be relied upon to occur.

The hand-grip test would be an excellent indicator of deception except for the fact that hand-grip can be voluntarily controlled. If a liar wants to beat the test all he has to do is grip his hand together hard throughout the test.

The breathing test, rated by psychologists as next most reliable to blood-pressure, is handicapped by the need of very complex apparatus. This test for deception was discovered by Vittorio Benussi at Graz. He found that people put more effort into their breathing when they are about to lie. This "catching of the breath" is involuntary, it cannot be controlled, and therefore makes a good test. But there is one out about it. A trained psychologist, or a subject who understands the principle of the test, can beat it by catching his breath continuously, whether he is lying or not. He cannot help doing it when he is about to lie; but he can do

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the same thing voluntarily when he is telling the truth.

The fact that psychologists themselves point out the weaknesses in all these tests for deception naturally makes jurists and lawyers over-sceptical concerning the systolic blood-pressure test. Yet this detector of deception is approximately 97% infallible in the hands of an expert. This is a far higher rating of reliability than tests upon which handwriting experts and psychiatrists based the opinions which are accepted in evidence by the Court. And the two or three failures of the Lie Detector out of every hundred cases are due to extraordinary conditions which can be discovered and taken account of. Certain rare diseases of the heart or circulatory system should disqualify subjects from taking the blood-pressure test. The only type of individual who can really beat the Lie Detector is one who has mastered the rare art of controlling his pulse, heart-beat, stomach and intestinal movements, and other involuntary or automatic functions of the body. The Hindus call such a person an "adept." If you want to become an adept, you'll have to spend twenty years or more alone in the mountains of India. It seems unlikely that many Americans will try this just to beat the deception test.

Besides the tests already mentioned there is another procedure for making witnesses talk which is wrongly included among the deception tests by some writers. This is the so-called "truth sleep" proposed by Dr. R.E. House of Texas. The idea is to administer a drug called scopolomin which removes inhibitions in the speech centers of the brain, just as alcohol, light doses of ether and many other drugs do. In effect this is the old detective trick of getting a suspect drunk to loosen his tongue. It works all right. The fellow talks--but he doesn't necessarily tell the truth. Whatever is in his mind comes out, lies, truth and all. If you want to separate truth from lies in a drunken, or drug-induced story, you still must test your suspect's loose talk with a deception test. I remember a case on the West Coast where a man picked up by the police was made to talk in this way. He immediately confessed three murders, describing the places where he had buried the bodies in minute detail. For weeks the authorities dashed about looking for dead men. They found nothing. Later the supposedly murdered people were found alive. The suspect, like most criminals, had been boastful about his ambitions.

In the merry game of catching liars the Hauptmann case represents a sort of modern field-meet. The question has frequently been asked--Why not use the Lie Detector in this case? Aside from the not-so-humorous answer that the Lie Detector, if used at all, should be applied to a great many other individuals connected with the case besides Hauptmann, I may say that use of the Lie Detector was proposed by the press to Hauptmann's attorney, my consent to give the test having been previously obtained. The suggestion, however, was promptly rejected, counsel maintaining that the test was not sufficiently reliable. While not taking this answer very seriously, I am entirely in sympathy with the attitude behind it. Has a lawyer the right to jeopardize his client's interests, in a case of this kind, by placing an absolute knowledge of the defendant's guilt or innocence in stranger hands? Even if counsel honestly believes his client innocent, he knows there is still a good chance that he is guilty. Were a psychologist to determine this fact by test the prosecution might get wind of it, thus greatly strengthening their hand. That is why defense counsel refuses--for his client's sake.

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The prosecution in the Hauptmann case would have been delighted to give the defendant a Lie Detector test. But the U.S. Constitution says that no criminal defendant can be compelled to give testimony against himself. Legal authorities generally believe that this prohibition applies to the Lie Detector, unless a defendant voluntarily takes the test. If compelled to take a deception test against his will he might have to give evidence against himself.

Summing up the Lie Detector's court possibilities, it can certainly be introduced by the defendant in many courts, following the Indianapolis case. Dean Wigmore of Northwestern University Law School, America's greatest authority on the law of evidence, suggested to me that an enlarged blood-pressure indicator like a thermometer might be devised and set up in the court-room, thus enabling the jury to observe directly the fluctuations of a witness' blood-pressure while he tells his story on the stand. Mr. Wigmore's idea was that there could be no more legal objection to permitting a jury to watch the behavior of a witness' blood-pressure than there is to their observing his facial expression, or the flushing and paling of his cheeks when under examination on the stand. This suggestion has never been put into practice. Sooner or later it probably will be. When judge and jury are able to determine with scientific certainty the guilt or innocence of accused persons, the greatest step toward justice in the world's history will have been achieved.

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