

SYSTOLIC BLOOD PRESSURE SYMPTOMS OF DECEPTION

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I. 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

¹ *Archiv für die Gesamte Psychologie*, 1914, pp. 244-271.

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.¹ 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 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)

¹ Abbreviation "b. p." will hereafter be used for "blood pressure."

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.¹ 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

¹ See *Boston Med. and Surgical Jour.*, Vol. CLXXII., No. 14, p. 530.

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,¹ 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 vaso-motor 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

¹ W. B. Cannon, "Interrelations of Emotions," *Am. Jour. Psy.*, Vol. XXV., pp. 256-282.

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-beat and contract the blood-vessels in large visceral areas. There is no reason to doubt that such vaso-contractions occur, yet Binet early reported,¹ 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.² 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.³

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

¹ Binet et Vaschide, "Influence du travail intellectuel des Emotions, et du travail physique sur la pression du sang," *L'Année Psy.*, 3, pp. 129-183.

² In medical diagnoses, of course, the peripheral resistance is often, on the other hand, the very condition to be investigated.

³ Here we find the compensatory heart mechanism decreasing the force of the beat with the increase of rate.

work; thirdly, it is less susceptible to modification by physical pain than is the diastolic; and fourthly, it tends 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,¹ 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

¹ W. B. Cannon, *Ibid.*, p. 270.

rage. Although it is impossible to fix definite boundaries for this field, I shall hope to point out its general demarkations 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 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 supposed 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 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 psycho-

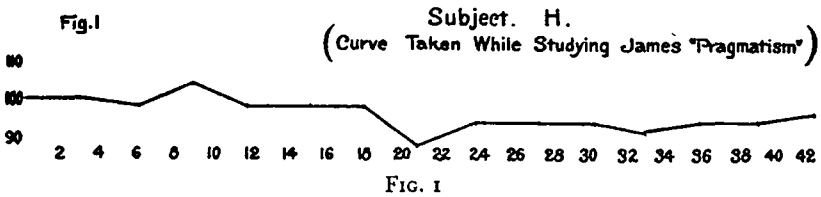
logical laboratory, during the academic year 1914-15. Six subjects were graduate students of psychology, and four were undergraduates of considerable psychological training. The jury varied in number from 2 to 10, and was made up of men from Professor Münsterberg's elementary course. Beside this regular 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 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 the 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 truth curve of the same subject, and at the lowest lying curve obtained contrasted with the highest truth curve of that subject.¹

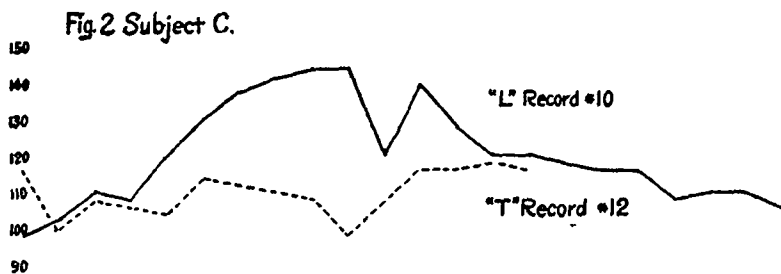


FIG. 2

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

¹ 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.

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,

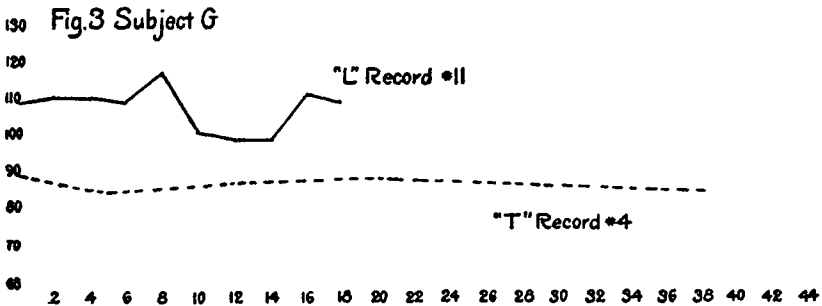


FIG. 3

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.

But what constitutes the "significance" of a pressure curve symptomatic of deception? What differentiates such a curve from any chance rise 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 curves 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. 4¹

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	10.8	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

The table in Fig. 4 will present a rough summary of the

¹ Since closer fractional determination would be meaningless, the averages are given as of the nearest millimeter.

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.

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,"

FIG. 5¹
Subject A

T				
2		4		11
	120		116	2 2 118 118 118
	End of preparation		←	←
	118	6	114	2 2 2 118 124 108
	End of ques. 1-5		←	End of recital
	120	11	118	2 2 2 2 2 2 118 116 114 116 108 108
	End of ques. 6-10		←	End of cross-exam.
	118	9	116	2 112
	End of introspection		←	Verdict given
10	120	10	116	2 2 114 118

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.

FIG. 5 (Continued)

Subject A

L										Conscious of Detection		T and L	
1	3	6	7	9		10	5		8				
120	118	120	118	3 2 2	116 120 124 122	2 2	118 120 124	118	128				
←	←	←	←		←	←	←	←	←				
124	128	6 124	4 130	2 2 2	128 128 126	2 2 2 2 2	130 134 136 130 130 126 126	6 112	5 128				
End of ques. 1-5	←	←	←	End of recital		←	End of ques. 1-5		←				
128	124	10 132	7 128	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		←				
100	132	8 116	11 126	2 2	118 116	2	120	8 118	10 4 122 124 ¹				
End of introspection	←	←	←	Verdict given		←	End of questions by jury		←				
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				

¹Lied

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 of *B*'s "T" records show consistent downward tendency, with a return toward the initial level.

Notable Individual Records. No. 8.—It will be noted that a severe pain raised the whole level of the day's blood pressure much above the subject's average level, and that this influence

evidently counteracted the usual downward tendency of *B*'s "T" curves.

No. 9.—The pressure was probably sent up, during the recital, by odd facial expressions involving considerable

FIG. 6
Subject B

T										L			
4		6		8 ¹		9		11		5		7	
	96		90		106	3 2 2 2 2	84 86 86 88 88 86	2 2	102 106 94		88		120
End of preparation		←		←			←		←		←		←
21	84	10	84	3	106	2 2 2 2	86 90 84 92	2 2	88 88	9	96	4	138
End of ques. 1-5		←		←		End of recital			←		End of ques. 1-5		←
6	88	6	92	9	108	2	86	2 2	92 94	9	98	7	128
End of ques. 6-10		←		←		End of cross-exam.			←		End of ques. 6-10		←
8	88	6	92	8	104	2	86	2	96	7	92	14	112
End of introspection		←		←		Verdict given			←		End of introspection		←
8	92	10	96	10	108	2 2 2 2	88 100 ² 88 90	2 2 2	98 94 98	11	90	10	110
						End of introspection							
						2 2 2 2	90 90 88 88						

¹ *B* has severe toothache.

² Muscular contractions.

muscular contractions. A contraction of the left bicep, just as the pressure was taken, accounts for the abrupt rise to 100 mm. after the verdict was given.

No. 11.—A little physical exercise probably raised the initial pressure 2 to 4 mm.

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 probable 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.

FIG. 7
Subject C

T							
2		4		7		12	
	100		110		94		118
End of preparation			←		←	C returns	
	118	10	99	7	102	10 2 2	102 110 108
End of ques. 1-5			←		←	End of preparation	
	118	11	112 ¹	10	104	2	106
End of ques. 6-10			←		←	End of recital	
	118	7	110	17	104	2 2 2 2 2 2	116 114 112 110 100 110
End of introspection			←		←	End of cross-exam.	
	96	18	106	15	104	2 2	118 118
						Verdict given	
						2 2	120 118

¹ Suppressed laughter.

FIG. 7—Continued
Subject C

L															
1		3		5		6		8		9		10		11	
	112		104		118		116		112	2	118	2	100		
										2	120	2	104	2	130
										2	122	2	112	2	126
										2	124	2	110	2	102
										2	126	2	122		
End of preparation			←		←		←		←		←		←		←
	120		126	9	122	8	126	8	130	2	130				
										2	140	2	132		
										2	146	2	140	2	130
										2	136	2	144	2	138
										2	142	2	146	2	142
										2	146	2	146		
										2	146	2	146		
										2	146	2	146		
										2	146	2	146		
										2	140		122		
										2	136				
										2	136				
End of ques. 1-5			←		←		←		←	End of recital			←		←
	128		128	10	130	16	118 ¹	9	130	2	120	2	142	2	146
										2	134	2	130	2	140
														2	144
End of ques. 6-10			←		←		←		←	End of cross-exam.			←		←
	128		134	7	124	6	122	12	126	2	138	2	122	2	130
														2	126
														2	122
End of introspection			←		←		←		←	Verdict given			←		←
	118		102	19	108	14	108	5	118	2	122	2	122	2	130
										2	120	2	118	2	
										2	118	2	118	2	
										2	110	2	110	2	
										2	112	2	112	2	
										2	112	2	112	2	
										2	108	2	108		
										Period of quiet.			←		←
								16	108	End of introspection.			←		←
										2	122	2	104	2	120
										2	116				

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.

FIG. 8
Subject D

T					
8		9		12	
	102	2 2 2	92 92 96 94		102
End of preparation			←	D returns!	
5	100	2 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	110 108 100	112		
End of prep- aration	←	←	←	←	←		←		←	←		
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 intro- spection	←	←	←	←	←		Verdict given.		←	End of intro- spection.		
100	98	82	18 88	8 82	13 104	2 2	100 96	2 2	100 100	10 98		
									End of intro- spection			
								2 2	96 96			

¹ Lied in answering Ques. 8, 9.

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 “*T*” 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.

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 “*T*” 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 “*T*” records.

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

FIG. 9 (Continued)
Subject E

L												
2		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 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.

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

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	2	106
				2	100							2	114		
End of preparation			←		←	End of preparation			←		←		←		←
				2	102							2	118		
				2	102							2	126	2	108
				2	104							2	116	2	118
3	110	4	108	2	102	7	104	4	102	4	138	2	118	2	110
				2	102							2	112	2	116
				2	102							2	112	2	110
				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
				2	102										
		10	114	2	96									6	100
				2	90										

relied upon as a conclusive test of cerebral factors. During deception he felt "sneaky," cold, "carefree," pleasant, excited and "frightened." During "T" 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.

FIG. 11
Subject G

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

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.

FIG. 11 (continued)

Subject G

T ₁ and L ₁			
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 introspection		Ques. s. by jury	
20	102	11	112 ¹
			←
		9	92

¹Lied to jury.

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.

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 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.

FIG. 12

Subject *H*

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

¹ Record incomplete.

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.

FIG. 13

Subject I

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

Subject I.—*I's* stories were very bare of detail, and told in a prim, 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.

Notable Individual Records. No. II.—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. II.—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

FIG. 14
Subject J

T		L								T and L			
8		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	134 122 112
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	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

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 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 "T" records. It is significant that in these "T" records the b. p. did not fall, but remained on an almost exactly even level throughout. Thus we must recognize a certain tonic 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 tonic 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 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,¹ "the natural response is a pattern reaction, like inborn reflexes of low order, such as sneezing, in which impulses flash through peculiarly coöperating neurone groups of the central system, suddenly, unexpectedly, and in a manner not exactly reproducible by volition."² 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 elimi-

¹ And also of pain and anger.

² W. B. Cannon, "Interrelations of Emotions," *Am. Jour. Psy.*, XXV., p. 281.

nation 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 task of deception¹ 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 "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. 11, subject J).

¹ See page 18 above.

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."¹

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

¹ "Principles of Psychology," II, p. 415.

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 "T" records, 76 per cent. show downward b. p. curves, 62 per cent. 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 "T" 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,¹ 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

¹ See Howell's "Physiology," 5th ed., pp. 255ff.

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 "T" curves is due to some such general negative influence is indicated by (1) the fact that it does not take effect in 24 per cent. of the "T" 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 "T" records was only 8 mm., as contrasted to an average increase of 16 mm. for all "L" records, and (4) the fact that the "T" 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 "T" 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 "T" records.

E. Judgments of Experimenter and Jurymen

A total of 107 records were taken in this experiment. 10 of these records were "T and L" records, and 3 of the "T" 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 "T and L" records, and 1 mistake on a "T" record influenced by muscular contractions. The b. p. judgments were, then, 96 per cent. 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.

FIG. 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															.41
4					7	3			5	3							5	2			.68
5													6	4							.60
6		I											2	7							.20
7							3	7											I	3	.28
8							4	I													.80
9							2	I			5	I							3	I	.76
10	2	I											2		6	4					.66
11			I	I							3	4		I	2		I	2			.40
12											4	4									.50
13	I	3							2	2							2	4			.35
14																	2	5			.28
15		4	I	5																	.10
16			4	I															3	2	.70
17			4	3					2												.44
18	4	I			2																.85
19	2								5	I	I	4									.61
20									2	6		3									.18
% W.	.53		.50		.42		.50		.50		.57		.52		.46		.54		.52		

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 per cent. to 57 per cent. 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 per cent. of each other, only No. 12 is squarely on that neutral line of 50 per cent. 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 naïve witnesses who might be called upon anywhere to testify. It will be noted that 5 clearly *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.

FIG. 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	←	←	←	←	←	End of cross-exam.	←	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 Fig. 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,

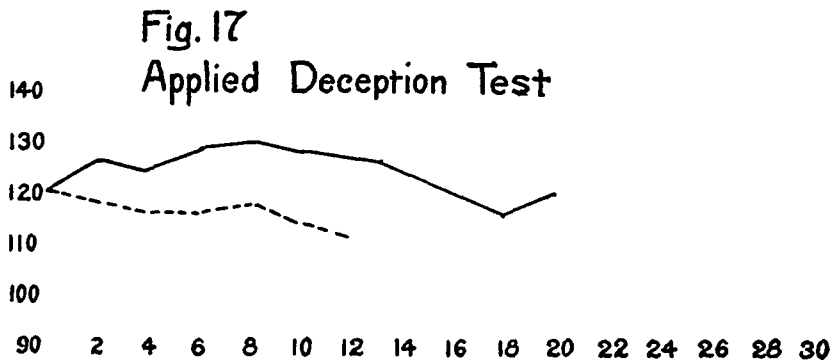


FIG. 17.

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 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.¹

¹ The writer expresses his gratitude to Professor Münsterberg and Professor Herbert S. Langfeld, to his assistants, E. H. Marston and T. Ramsdell, and to the Harvard men who served as jurors.