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THE PSYCHOLOGY OF INVENTION.[1]

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In compliance with the kind request of our President, I have consented to open this discussion; but I do so feeling that the subject is not one which I myself should have chosen to discuss. Its importance I recognize, as we all do; but its difficulty is notorious. In the present state of our knowledge of the processes involved I do not think that it is possible to attempt much more than a statement of problems, and some indication of those methods of work by which in future we may obtain more light. With this understanding—that I am here not to state results, but to assist, however little, in opening, or at least in suggesting, some lines of inquiry—I accept the proposed task, while I am fully aware of the very modest character of the little contribution that I can make. This contribution will consist: (1) of a definition of the problem, (2) of a thesis as to certain pretty vague general conditions which favor inventiveness, and (3) of some merely illustrative experimental reports, intended not to prove but to make more comprehensible my thesis.

It is difficult of course to give any psychological definition of what is meant by invention. Ordinarily, if we take the word 'invention' in a decidedly wide sense, we mean by invention an important new idea, or system of ideas, or an important device or system of devices, by means of which such new ideas are expressed. The first way in which this general

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definition has to be called vague, is due to the fact that the word 'important' is not a term of description but of estimate. When is a new idea or a new device important enough to be called an invention? There is no scientific answer to this question. And the value of a given mental product is something with which the psychologist, who considers how that product came to pass, has only an indirect concern. The second respect in which this definition just suggested is necessarily vague has to do with the meaning of the word 'new.' In a strict sense, one may say that, while we may have new experiences to any extent you please, we cannot have absolutely new ideas, since an entirely new idea is a contradiction in terms. In the same way, every device, such as a word, a sentence, a poem, a mechanism, is inevitably based upon former devices, is composed of elements previously existing and well known, and is so far never entirely new. On the other hand, it is also true that in all mental life there is an element of novelty. Every moment of our mental existence differs in some respects from any previous moment of our lives. And about our actions and expressions of our ideas there are similar elements of relative novelty, however slight this novelty may be. When, then, shall an idea or an invention be called new? Still a third element of vagueness enters into the foregoing definition, in so far as, whenever we speak of a new idea or device, the question necessarily arises: *For whom* is this device or idea new? If I myself think a given thought for the first time, if I myself produce a contrivance that I never produced before, the act involves for me what is relatively an invention. On the other hand, with reference to the race at large, or to the thoughts and habits of the community in which I live, the idea or the contrivance may be very old. Inventions are, therefore, inventions either for the individual, or for the society of which he is a member. Ideas and devices are new in the life of this person only, or in the life of mankind in general; and one has to bear this distinction in mind in estimating novelty. So far then the importance and the novelty of any invention are matters only vaguely definable; and one has also to define for whom the invention is in any case to be a novelty.

If, in view of the difficulty of defining invention in all these respects, we try to consider afresh the situation in which our questions arise, a glance at well-known psychological considerations will enable us to characterize our problem more exactly. We cannot exactly define what is worthy to be called a valuable invention, but we can define some of the processes that condition inventiveness. The acts of any intelligent human being who has received training are, on the one side, expressions of the law of habit. That is to say, they are repetitions, more or less exact, of acts and systems of acts that have been performed before. Habits themselves are the results of adjustment to environment. The sense impressions to which an organism has been subjected, working upon the basis of its inherited tendencies, have led to the gradual moulding of the original instincts, impulses and reflexes of the organism in question; and the outcome of all this moulding is a system of habits which tends towards an invariable routine, although the routine actually attained by any individual organism is never during its normal life absolutely invariable. Some of these habits, namely the most complex and the most deliberate, are accompanied by consciousness; such habits we call intelligent. On the highest levels, the acts in which these habits get embodied are the expression of ideas or of trains of ideas, of thoughts, of states of mind which involve a knowledge of the environment. Now, in consequence of the general laws of habit, the most of what is done during the mature life of any intelligent being pretty closely resembles what has been done before. The habits expressed when we use language are, for instance, old habits. The words that we use have been used before. But under certain circumstances a change of stimulation may cause already acquired habits to vary in ways which involve new combinations of old but already intelligent activities—and in ways which do not merely repeat current facts of experience. These independent variations of intelligent habits constitute the general region within which are found the activities that we call invention; and the ideas or system of ideas that accompany these variations of intelligent habit are, on the mental side, more or less inventive psychoses. Thus a new combination of words may constitute a poem. This combination is not

wholly due to the present facts of the poet's outer experience. It is in so far an independent variation of his habits of speech. Thus all inventions are relatively independent variations of intelligent habits, and the psychological question as to the origin of inventions is parallel to the biological question as to the origin of variations. Meanwhile it remains true, as before, that not every such variation of intelligent habits, but only the important variations, are usually dignified by the title of invention. But the psychologist is more interested in the appearance of the variation than in its importance for the individual.

Thus one may view inventions in their relations to an individual life. If we turn from inventions, in so far as they are novelties in the individual's life, to the variations of habits that are novel in the life of society, we are met by a further situation which may be briefly summarized as follows: What the individuals in society mostly learn to do is to imitate other individuals. The intelligent adjustment of the social being to his environment involves conforming his ways to the ways of other people. As Professor Baldwin has pointed out, the law of imitation in the social order is a sort of extension of the law of habit in the individual life. In his habits the individual repeats himself. In his imitations, even when, as he learns them, they are for him novel, the individual repeats what society has already accomplished. For this reason most variations of individual habit in the social being, most inventions of an individual life, involve no variation of the habits of society, involve no essentially novel ideas or deeds. On the other hand, it is true that, despite this tendency to uniformity, there do appear in social life from time to time relatively original independent activities—deeds that have never been done before by anybody, combinations of ideas that in some respects are not due to imitation, that are not the results of the past habits of individuals simply repeated, or of the habits of society simply imitated. If these variations of our imitative activities themselves get imitations from others, they constitute, in the social sense, inventions. Viewed from the social point of view they then come to have the same relations to what men in general do, as in the individual life the relatively novel variations of habit have to the past deeds of the individual.

To sum up so far, we have thus two distinct processes worthy to be called inventive. Inventions involve intelligent variations of habits already acquired and present in the individual; and where inventions are socially important, they involve similarly independent variations of imitative activities, or variations of social habits. The question about the psychology of invention is therefore twofold. It is, first, Under what conditions does an individual tend to vary his own already established and intelligent habits? and, second, Under what conditions does the individual tend to be what is called original, namely, not imitative? The two questions are, of course, very closely connected.

The question of the variability of our individual habits, where the variations are of an intelligent grade, and accompany the appearance of relatively novel ideas or combinations of ideas, constitutes a very wide and difficult problem. What we know about it may be indicated by considerations which every psychologist will recognize. In the most limited degree it is true of every act that, because it is done under novel conditions of experience, it tends to involve some variation of former acts. It is because of this plasticity to experience that we originally acquire our habits at all. This primary sort of plasticity remains, to a certain extent, present even long after our habits have reached an intelligent grade. One lives and learns. But mere learning by experience, adjusting our ideas to presented facts, is rightly distinguished from true inventiveness, which involves novel ideas and acts that are not merely determined by outer experience. In the next place, the organs used in our more active life tend in an extremely complex way to acquire one the habits of another, so that unconsciously we all of us are in possession of a great number of habits of movement which have never been purposely acquired, and have never been merely adjusted to outer facts, but which have been imitated, so to speak, by one group of nerve centres in consequence of organic connections with another group. Thus, one can on occasion write with the foot or with the knee. The left hand is frequently able to repeat symmetrically the movements already learned by the right hand. Such unconscious co-education of our various organs is itself a source of considerable independent variability in our actions.

For a habit to which one group of organs has been adjusted becomes *ipso facto* altered when it is imitated in this unconscious way by another group of organs. And everybody has a great deal of skill of this unconscious sort which can be called out on occasion, and which can be adjusted to new tasks. Finally, those laws which psychologically appear as the laws of association of ideas involve, as every one knows, a good deal of relatively independent novelty both of ideas and of activities, whenever our organisms are brought into new situations.

Thus mental processes which Stout has called 'Relative Suggestion' involve a certain independent novelty in the suggested ideas. For instance, my habits may have already determined, on the mental side, the combination of two ideas, A and B, where A and B are contents standing in a given relation to one another. This habit is aroused, for any reason you please, in the presence of some new content, P; and the associative process may so work that I thereupon form a relatively new idea, $\mathcal{Q}$, which stands in the same relation to P as that in which B had stood to A. Thus, in consequence of this sort of relative suggestion, $\mathcal{Q}$ appears in my mind as a novel mental content, not directly derived from experience. The mere form of the combination A B has been repeated, without the repetition of the matter. On the motor side this sort of permanence of form with alteration of content in the expressions of our habits is not unfamiliar, and appears in all our more intelligent actions. In this way we tend not merely to repeat literally our former acts, but to produce acts that have merely the same form or general type as former acts. Most of our intelligent habits are thus what one may call generalized habits. Such, for example, are the habits of the syntax of our mother tongue. These involve not merely the power to repeat old phrases, but the power to make new combinations of an old type. Such habits are essentially, within limits, variable habits. In a measure, they are habits which involve a certain novelty of behavior at every new expression of the habit. There is routine running through all this novelty. But it is the routine of form, not of content, or at least not altogether of content. Our social habits show endless variations of this tendency to permanence of form in conduct

amidst great variety of detail. Consider, for instance, the habit of repartee, the habit of courteously adapting one's behavior to the present social atmosphere, and many similar cases. Athletic habits involve much of the same sort of generalization. The skilful player may at any moment do something which is in content more or less different from anything that he ever did before; but his skill shows itself in the form. Now, in all these cases, where the nature of a habit is such that a given form is preserved through great variations of content, whether in ideas or in actions, the variability that appears is not itself an exception to the law of habit. On the contrary, in such cases the intelligent habits in question are, as I just said, essentially habits of variation, although the variation is in most such cases subordinate to the routine, and the range of variation is very sharply limited. Habits of this sort constitute precisely what we mean by skill. All skill involves, therefore, some more or less obvious, although limited degree of inventiveness.

In one further direction, however, we can understand the way in which our habits may slowly vary, and vary in useful directions. Professor Baldwin has laid great stress upon the influence of the 'try, try, try again' tendency in the early stages of formation of habit. At any stage of our development we are possessed of an imperfect adjustment. We elaborately repeat that adjustment in constantly altering situations, with a steady disposition to eliminate any useless elements. Here the constantly changing situation involves a constant slight alteration of what we do. A steady selection of the slight variations leads to improvement of habit.

To sum up this brief survey of the factors in the individual variation of habit, we see that in all their routine our habits have in normal cases a considerable tendency to independent variation, apart from our direct dependence on the facts of outer experience, although this variation does not in general tend to produce very great or very important alterations of behavior, except during the formative periods in the life of an organism. The defect of all such considerations, if regarded as an explanation of the variations which we call, in the narrower sense, significant or true inventions, lies in the fact that all these tenden-

cies are in general useful in so far as they lead *towards* routine, and tend to make both our life and our knowledge systematized, and in the end simplified. The great inventions of humanity all seem to include processes more complex, and more mysteriously rational than this ordinary routine of variability will explain. Skill is not talent. The artisan is not the artist. The apt scholar is not yet the discoverer.

If we pass to the relations between the individual and society, we must admit that just as all our habits within limits normally tend to vary, so all the imitative social processes normally involve certain individual variations. Every imitator is, in his own little way, an originator. For every organism inevitably colors its imitations with its own individual qualities. Our handwritings are different, even where we have been taught to imitate the same models. Our voices are individually recognizable in their variations, even when we sing the same note, or repeat the same words. The imitative life is in so far also an individual life. And every individual is thus a possible source of socially important variations. Chance may make anybody a socially prominent person, just as Captain Boycott's name but a few years since entered, perhaps forever, the English Dictionary. Moreover, since no two individuals can have precisely the same social environment, since the range of acquaintances, not to speak of closer affections, is inevitably an individual range, no two individuals have the same models to imitate. Where two individuals are trying to imitate the models or fashions of conduct presented in the life of the same social group, every individual has more acts suggested to him than he can possibly succeed in carrying out, and, therefore, each of our two individuals is obliged to select for himself what models he proposes to imitate. The social order is a sort of elective system of social instruction, where every individual to a certain extent chooses his own models. Hence, despite the vast power of social routine, despite the universal prevalence of imitation, there is always, even in the life of a savage tribe, a great deal in the social order that constantly tends to favor social variation. Yet this variation is confined within comparatively narrow limits, except in the case of the most progressive societies, and of the most plastic individuals.

If we now put together, after our brief survey of the known field, the social and the individual factors that tend to favor variation of habit and of idea, we thus find that while there are important factors tending to work against the too literal repetition of habits and of ideas, it is hard to point out precisely the conditions that favor those rapid and significant changes in the routine of action and of intelligence which appear when inventions of greater importance take place. And so, since there is often a wider range of variation favored and explained by decidedly pathological conditions, it becomes natural enough that some psychologists should have looked to pathological explanation as sufficient for all the forms of large variation, whether useful or useless. Hence the general basis in fact for the now so frequently current view that all great inventions and inventors are more or less pathological phenomena. Yet I do not believe that we are limited to such pathological explanations. In any case, by this survey of the known conditions, we reach the statement of our problem itself, which is this: What factors tend to produce such variations of habit, either in the individual life or in the activities of society, as more specially include the significant variations, the valuable novelties, that we call invention? Are such more extreme variations simply special instances of the ordinary processes that, as we have seen, tend to a constant, minute and relatively insignificant variation of our routine? Are such processes, on the other hand, due to wholly chance interferences with the normal laws of habit, to interferences of no definable type whatever? And is the problem of invention simply the problem as to how the useful variations get selected when in this wholly atypical way they happen to occur? Or can we define beforehand the conditions under which valuable variation is likely to take place?

As I said at the outset, it is rather the statement of our problem than its solution that I can hope here to attempt. Yet at this point *one* consideration occurs to me as worthy of notice. It is a consideration suggested by the history of invention. Important inventions do not, in general, occur except under particular social conditions. And the social conditions have their definable type. What is this type? In the individual the

most important independent variations of his habits occur during the growth of his social sense. The mere organic growth of the brain has, of course, a good deal to do with this youthful variability. But there can also be no doubt that it is the social sensitiveness of the young which is one very important factor in the same process. On the other hand, if we pass to mature minds, there cannot be the least doubt that individuals themselves vary more in their own habits, become more productive of novel processes, and contribute more to the variation of social habits, when the conditions are such as to favor the social tendencies often called by the general name individualism. And individualism means a mass of social tendencies having a definable type. In other words, the individual varies more in the long run when the society in which he belongs expects him to vary more, when variation is encouraged, when independence, private enterprise, is favored by the social environment. This is a very simple consideration, and very easily verified in history, as well as in individual psychology. It is a consideration which the psychologist cannot leave out of account. Children in the country, or children brought up in comparative isolation from school routine, often show a much greater inventiveness in their games and romances than do children early submitted to the routine of large schools. Anybody who has watched this process in a relatively isolated child recognizes at once that the child is still dependent upon his social environment for his ideas, and that also the relative independence of his situation favors the variation of his habits. In society the same thing holds. The periods of great individualism have been periods of relatively great inventiveness. This was the case in Athens at the great period. It was the case in the Renaissance. It was the case during the Revolutionary period at the close of the last century and the beginning of this. It is the case wherever, in a highly intelligent people, similar conditions have prevailed. Nor can the processes present at such periods be referred simply to the happy chance that geniuses were then produced. To be sure, I have no idea of explaining the greatest cases of genius, or of reducing them to any one law. I am here referring to the average inventiveness of

the really clever men who, in the civilized races, are constantly produced. In the great age of individualism, the lesser men invent as well as the greatest. On the other hand, the uninventive ages in the history of civilized people are characterized, not by the mere absence of geniuses, but by the helplessness of the men of talent to accomplish anything of importance. Now, what is known of the biological conditions of heredity would make it very improbable that, extraordinary genius apart, the organic basis for the variation of talent, for the appearance of milder forms of originality, should be very different in one age, in a given stock of people, from what it is in another age in the life of the same people. But, in the life of any civilized stock there are periods of invention, and periods of stagnation, and it seems to me that we may say, of society, that if we here deliberately leave out the cases of the greatest geniuses, civilized society, while dependent upon biological processes for the production of its men of talent, still gets out of these men of talent, in any age, very much what it deserves to get—*i. e.*, what in a proper way it asks for. It cannot produce the great genius, and it cannot make stupid men clever, but from its lesser men who are still men of real ability, it gets within limits very much the degree and the type of inventiveness that the social situation suggests. In a poetical age, poetry is invented by the second-rate poets; and some of it is very good poetry. In a scientific age, scientific discovery is the order of the day, and the men of talent are scientific inventors. During a period of war, military ability is encouraged. Of course, no such social encouragement can produce Shakespeare's plays, or Darwin's discoveries, or Napoleon's achievements. And only heredity can account for the very wide differences between clever men and stupid men, or explain why men of talent exist at all. But the minor and still important inventiveness of the men of talent, the men of the second grade, is somehow due to a social stimulation which sets their habits varying in different directions. And this stimulation is of the type which abounds in periods of individualism. So much for a very obvious and general suggestion, which of course once more helps us to state rather than to solve our problem. I expect, of course, the immediate question, How can

one's social situation tend to make one more inventive, more variable in one's significant habits, than one otherwise would be? For, once more, the primary character of the social influences to which we are exposed is that, within limits, they set us to imitating models, they tend to make us creatures of social routine, slaves of the mob, or obedient servants of the world about us. On the other hand, if all that society says to a man at a given time is, Be inventive, be original, it seems indeed a very serious problem how the suggestion can possibly work; for if a man is left to his own devices, and tries to invent something of importance that is novel, he so often finds himself merely repeating old habits, or merely imitating models, that he often concludes that his inventiveness cannot be stimulated by any conscious suggestions whatever.

Inventions thus seem to be the results of the encouragement of individuality. Yet how individuality can be encouraged to go beyond its limits is a very serious problem. Here then is a new statement of our problem. The problem of the psychology of invention in the more important social cases becomes the problem of the psychology of the tendency called individualism. What sort of influence is it that puts the individual on his mettle, that awakens him to valuable and independent variability of habit, that, as they say, makes him let himself go? The problem is familiar in pedagogy. But can we suggest any new way of illustrating it when we approach it from the side of the psychology of invention?

In thinking over this problem, I have of course tried to inquire what form of experiment could be devised for the encouragement, in however slight a form, of something dimly resembling individuality and inventiveness. Inventions, I suppose, can be experimentally produced in the laboratory in some miniature shape. The miniature might indicate the nature of the great fact, and so I cannot forbear to bring before you the results, such as they are, of a few very insignificant efforts to produce a situation where the subject of an experiment should be encouraged to invent something. The small value that such experiments can have lies in the very simplicity of the conditions used, and in the fact that, in a very small miniature, such con-

ditions may be made to simulate the motives that, in societies, seem connected with individualism.

It occurred to me to choose in a number of subjects a certain variable group of habits, and to submit this group to specific experiments. The habits chosen were to be not wholly unintelligent. On the other hand, they were to be habits not already too much subject to social training, or to reflective observation on the subject's own part. Furthermore, they were to be habits that could be exposed, first to the workings of the private inventiveness of the subject himself, and, secondly, to the workings of a distinctly social stimulation—a stimulation of the same sort that exists when in a company of people we are urged to do our best, or are put on our mettle. My object was to get some glimmering of the way in which such a social stimulation becomes effective. In order to get my case simple enough to be of any value whatever, I had to put the subject in the dark as to the purpose of the experiment, and to make the social encouragement introduced of a very mild and minute type so that I could regard it as a factor somewhat isolated from other factors in the conduct of the individual experiment. What I actually did—or rather began to do, for the brief time that has elapsed since I was asked to make this report has been too short to admit of any extended series of experiments—was this : Taking subjects in groups not too large to be controlled, I made each subject perform three, or in some experiments four, series of acts according to directions. In the completer experiments, where four series of acts were tried, the method was that, first, the subject was asked to draw on ten cards, one after another, and as quickly as possible, some figure or combination of curves and straight lines, which should not be an imitation of anything, so far as he could keep himself from such imitation. He was asked to throw aside each card as he drew it, and not to look back. He was asked to make his design each time as independent of former designs as possible. He was not to erase anything that he drew. He was to make each design at one movement. The plan of the first series having been carefully explained and understood, the subject, who was not to design until the experiment began, began at a signal, worked as fast as he could, and

was required to finish the ten designs within two minutes. In the second series of ten, the subject was required to continue drawing new designs that imitated nothing and that were independent each time. "Draw something new each time," I said, "but this time be deliberate. Do what you do as carefully as possible, only throw aside each card as soon as it is done." This second series completed my test of the subject's independent inventiveness; that is, of his inventiveness apart from social stimulation.

Now, for the second half of my experimental test I wanted, as I said, to get a stimulus of the sort to put the man on his mettle, and one that still does not permit him to be satisfied with what he takes to be an imitation. In reading the history of inventions, and in observing in general the inventiveness of children, I have been much struck with the effectiveness in exciting originality of a certain motive which I may call the motive of being in a decidedly sharp contrast with one's social environment. This I should call *one* typical motive of all individualism. The child that desires to show himself off, the successful wit, the adept at repartee, the ambitious young poet, and in general a man of mark in an age of great individualism, all illustrate the psychological effectiveness, within certain limits, of the mere desire to make a contrast. A contrast of this sort is at first a vague ideal. It is, however, an ideal that tends to grow definite as it works. At first an illogical motive, it tends to grow more logical as it is applied. For the dwelling upon a contrast, the mere effort to show one's skill by reducing the contrast to some deeper sort of similarity, the studious effort to invent something that shall at once take account of the existing contrast, emphasize it, and, at the same time, reduce it to some sort of deeper uniformity with its opposites, this has been a motive even in the pursuit of the soberest science. Such a motive led, for instance, to Plato's philosophy, or to the mathematical concepts of zero and of negative quantities. Before I ventured on the experimental suggestion of the second half of the experiment, I accordingly said to the subject: I am now going to show you in succession ten cards drawn at random, just as you have been drawing yours. As your third series, I

want you, on the sight of each card, to draw at once and without the least reflection some object that feels to you at the moment when you draw it like a new design, but that *also feels as unlike as possible to the object that you see.* I added the observation that the subject must find out for himself in each case what 'unlike' meant; that I could not tell him beforehand; and that I simply wanted him to draw as well as he could. It was simply this stimulus of the unlike, this *Geist der stets verneint*, which constitutes the Mephistopheles that I wanted for stirring up my subjects;[1] and I suppose that we shall all agree as to the interest of any attempt to get the devil to assist in a bit of experimental psychology. After ten such cards had been drawn, I then let the subject at his leisure compare these cards one after another with the model, deliberately consider whether he had made them as unlike as possible, and draw a fourth series of cards containing if possible new unlikenesses and unlikenesses as great as possible. In some of the earlier experiments, for fear of wearying the subject, I at first used only three series of experiments, omitting what later became the second set, namely the deliberate efforts at unaided invention. But in most of the experiments four sets were used.[2]

Throughout the experiment great care was taken to give all the subjects concerned the same directions, and to make the inevitable suggestions involved in these directions as uniform as possible. Thus, I had to make clear that the designs were not to be imitative of any object. In making this statement I used always the same names of objects, or rather of classes of objects, to indicate the nature of this exclusion. I said, 'no character of an alphabet, no picture of an object,' and so forth, using as nearly as possible the same formula, although I often had to repeat or slightly to vary my phrase in order to make the matter perfectly

[1] Des Menschen Thätigkeit kann allzu leicht erschlafen
Drum geb' ich gern ihm den Gesellen zu,
Der reizt und wirkt und muss als Teufel, schaffen.

[2] I must explain, to avoid an obvious misunderstanding, that I do *not* suppose any true poets, or other inventors, to be guided by so gross a motive as the one here used, viz., by the motive to be merely *as unlike as possible* to their predecessors. I have wished to isolate the motive explained in the text. Hence the grossly abstract form here given to this motive.

clear to each subject before beginning. In presenting the objects that were to serve as the stimulation of the unlike I used a set of drawings very much resembling in their random type the sorts of drawings that I expected to get from the experiment. I used the same set of presented drawings throughout. In one case the drawings were presented in a very slightly altered order. But as direct suggestion from the particular drawing presented played a decidedly minor part in any single resulting drawing, this one change of order seems to have been of small importance. Yet I should of course avoid it in any final preparation for drawing detailed conclusions from further ex periments. In the fourth column experiments of the charts presented, the subjects commonly had the opportunity to see more than one of the drawings at the time, but as they had by this time seen them all once and were now engaged in a fixed effort of attention comparing their own work with the particular drawing, I did not deem it necessary at this stage to guard against such manifold suggestions. In general, as I just said, direct suggestions from the drawings shown played a minor part in the results. The experiments test, therefore, in a rough way, the results of one interference nearly constant in all cases.

Now I need not say that it was far from my thought to obtain from such experiments any final or exact results whatever. I regarded them, and regard them, merely as giving a first glimpse into the labyrinth of the influence of social suggestion upon individual inventiveness. I should be in such a case well satisfied to find that a stimulus of this sort gave results that made it seem in any sense an encouragement of individuality. I can best deal with the experiments and their suggestiveness by presenting to you the enlarged charts of twelve results.[1]

[1] Of the charts here presented, the first three, and the twelfth, are reproduced in the figures numbered 1, 2, 3 and 4. The figures given are intended to show in brief rather the way in which the cases varied, than the degree of inventiveness actually to be found Of the latter only a statistical estimate could be of service A preliminary, but pretty careful study of 40 cases, the work of people of both sexes, and of widely varying ages and occupations, showed 24 out of the 40 as cases where in the later columns, as compared with the earlier, a decided *increase* of inventiveness could be observed I give this not as a result, but as a mere beginning.

An examination of these charts as to their general appearance will first indicate that they are, to say the least, suggestive of a possible method for the study of individual psychology. The first ten, the independent drawings, have a very decidedly individual range of variation and uniformity. Each person challenged to draw ten designs of this sort, will draw a set of designs that obviously stand for a system of habits, some of them no doubt technical and conscious at some time in the past, or even at present—some of them, however, especially in people not accustomed to drawing, habits more or less subconscious. They vary from individual to individual in a way that is certainly worth observing. I suppose that the particular experiment taps but a very small portion of the world of motor-habits here involved. The second column's work in the four-column cases in our charts would stand of course for the second ten, namely, the results of deliberate individual effort to vary the designs. These efforts, of course, made thus hastily, cannot be regarded as just to the individual's actual range of power to construct such designs. But they do illustrate what habits of the individual belonging to this range were just then at control under the conditions of this experiment. Now comes the stimulus in the form of the requirement: See that, and make the unlike. What will the individual do under such circumstances? Will he helplessly follow the suggestions of the models presented, and make something like them in trying to make the unlike? Will he do what he might well do, namely, simply continue the style of his private inventions of this type, without variation of style? If he did this latter, he would in general make something decidedly unlike the models shown. Will he start upon an entirely new track? Will he be frightened out of his inventiveness altogether and be unable to make any designs? Or will he, finally, be stimulated to become more inventive, whether by combining his own style with the presented styles or by striking off on entirely original lines? Very naturally, I found subjects who did nearly every one of these things. The actual range of variation in some eighty cases[1] where the experiment was tried, is consider-

[1] Out of these eighty cases were chosen, at random, the forty that were submitted to the more careful statistical study mentioned in the previous note.

ably greater than in the charts here displayed. I took, however, some of the most striking results for consideration. And I may ask you at this point to form your own opinion on the cases presented.

The subjects of the experiments vary greatly in training and in age. I begin with the case of a workingman, aged 47, a stitcher by trade, a member of a workingmen's club, and performing the experiments with undoubted good-will. He had no warning of the nature of the work and is of course without psychological training. You see (Fig. 1) that he begins his independent designs with very short curved marks, without apparent ideas of any objects, and with variation merely in the direction of this or that small feature of the curves used. His second column—that of his deliberate but still uninfluenced invention—involves making small objects of an indefinite character. The rather rough method of reproduction here used—namely a pantagraph pencil marking marked over with crayon—is somewhat unjust to the smaller outlines of his drawings. The last one tended in the original to look somewhat like a glove. All are small objects with closed outlines; a rounded form predominates. The type is one that could not very widely vary. The last figure suggests that the subject could not go further without drawing genuine objects. With the third column began the successive display of the cards which were to stimulate the subject to make the 'unlike.' Notice at once the very marked change. At once his entire style altered. The first alteration is, as it chances, a distinct suggestion from the model. This character remains, although not in a very marked way, in later cases. It soon becomes hard to say in what fashion the subject was influenced by the individual object seen; or at all events, where this suggestion can be traced it is usually of a rather general character. But mark, whether you call it individual suggestion or not, there can be no doubt our subject is trying to make his

The value of the estimates made can be, in a measure, tested by comparing the text and the plates in the four cases here reproduced. More careful statistical studies, with a fuller statement of the methods of estimate used, will, I hope, be given hereafter It has not been possible to reproduce here in plates the drawings used as the stimulus for the 'unlike.' They were a set of rude outlines, of the general character here in question

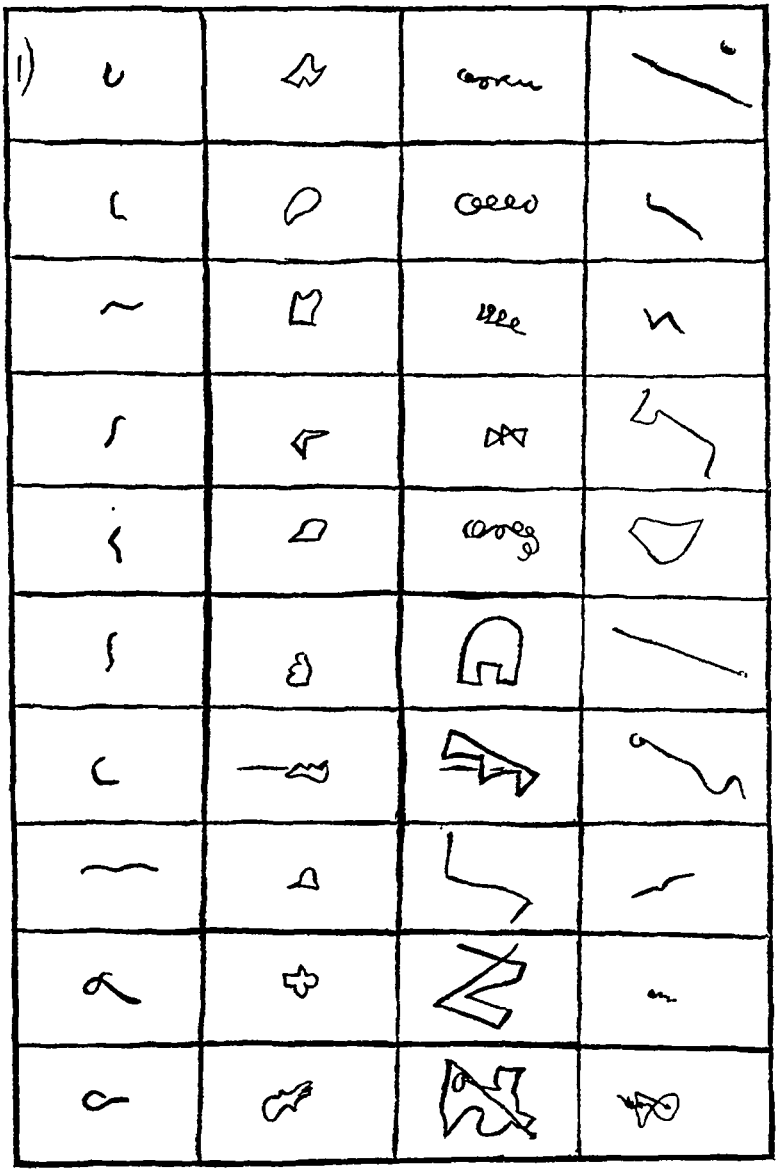

FIG. I.

objects unlike; and there can be no doubt that in so doing his inventiveness is increased. It is noticeable that all these cases were made very rapidly, within a little more than two minutes

for the whole ten. The cards were seen and taken down at once. The fourth column shows still a new character. The subjects return to simplification. He is now deliberate. He is not so inventive in novel forms. In his case the stimulus works best as the cause of variation in his habits and association, or if you like, in his selections from amongst his habits, when the stimulus works quickly. In any case, there can be no doubt of the actual importance of the new stimulus as a cause of variation.

A notable contrast exists between the foregoing case and No. 2. Here the subject is a young lady, an elementary student of psychology, with a reputation as a clever and successful student. Like the foregoing subject, this subject disclaims any skill in drawing. In the first column are independent designs drawn without deliberation. The subject was given in this case no opportunity to develop her independent inventiveness. Doubtless, if left to herself, she could have made her scroll-work considerably more complex. But the habit is a highly developed one. When questioned, the subject declared that it had long existed, and was a subconscious habit—namely, the habit of making symmetrical curved forms for amusement. Technical skill was not reported in this case as being in any way responsible for the forms. In the second column the intruder appeared. Here a rapid and important change occurs. For the moment the subject is, as it were, 'all broken up' by the requirement to make the unlike and to make it quickly. The formless scrolls resulting are of course not genuine novelties, but do represent, apparently, either a reversion to the very early habits or a disintegration of existing ones. Whatever the effect, it is only momentary, although the effect of suggestion from the cards shown is visible and yet productive of no valuable result. With the fourth case the subject begins to return to her own style. Her scroll-work habit rises again to the surface. It is now more elaborate than ever, although no more deliberation is allowed. The slighter influences of suggestion from the models are not invisible. They act to produce more varied forms, which are, perhaps, not less worthy of regard. But when, in the third column, the subject is given a chance to deliberate, she produces in the first, third and fourth cases forms

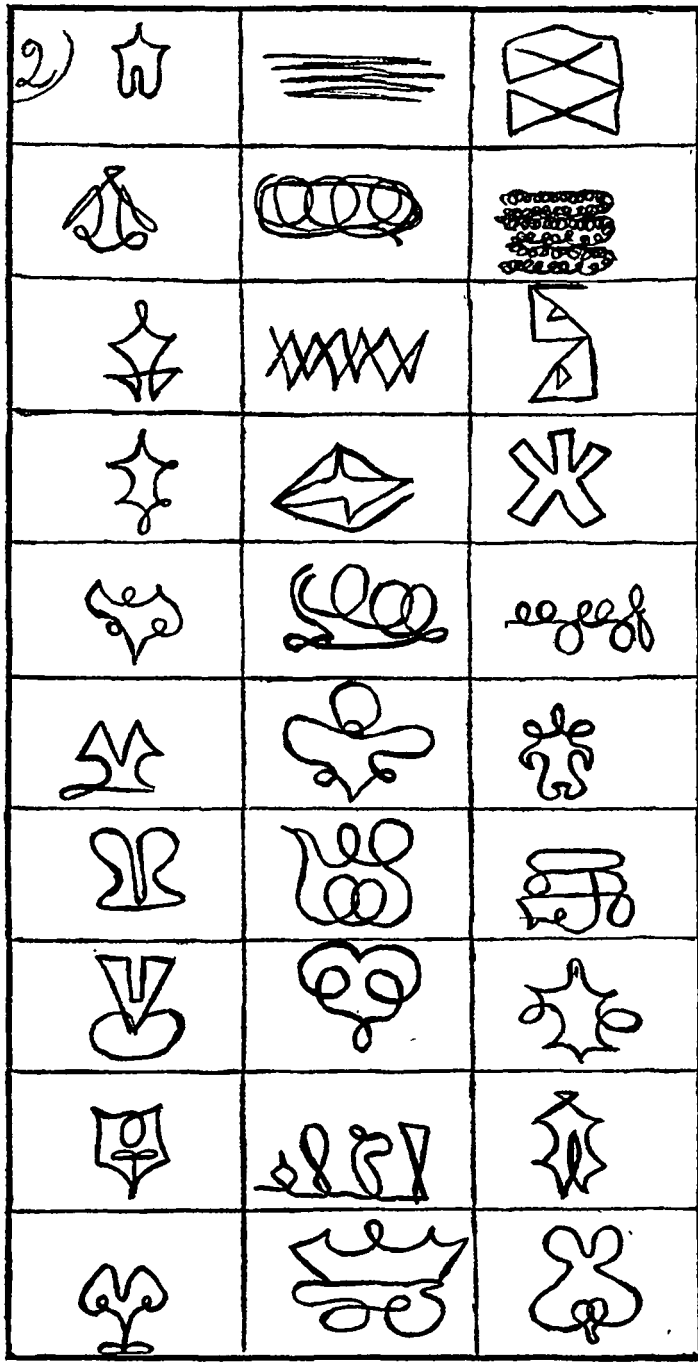

FIG. 2.

which are useful combinations of her own bias for symmetry with suggestions due no doubt to the objects seen. In notes which the subject independently made upon the latter cases of this third column, notes made while she drew the deliberate forms, she explained, with a certain *naiveté*, that, since the figures which she saw were in these cases unsymmetrical, she might as well oppose bi-lateral symmetry to them as her own invention of the unlike. She was plainly unconscious at the moment of the prevalence of such symmetry in her now unseen drawings of the first group. Afterwards she said she recognized the permanence and depth of the subconscious habits involved.

This case introduces us to a type present with the most manifold variations in numerous cases amongst our experiments. I should venture to call this the self-preservative type. It is notable that the forms produced in our first column would in general serve well enough to fulfill the vague requirement of the 'as unlike as possible.' The subject whom we first considered was unable to make use of the forms of the first column when the intruder first appeared. His 'unlike' had to be a new invention. In the present case, after the momentary scattering of the subject's habits by the intruder, the subject returned to the type of the first column. But it is notable that in returning to this type she returns to it in an enriched and more variable form. She preserves her own fashion, but with an addition which leads in two or three cases of the last column to what one might call a genuine novelty, namely, a new type of symmetrical figure.

Our third subject is a salesman, aged 41. He is an interesting modification of the self-preservative type. He begins (Fig. 3) with short lines; habits of writing are evidently involved; letters appear, although he tries to escape from them. The process, left to itself, turns into a making of flourishes. These are combined on two plans, one the plan of a spiral in and in interweaving, the other the plan of overlaying one flourish by another. With the appearance of the intruder a slight change occurs in these habits. The flourishes get a little more of the zigzag effect. They are, at the same time, more open. No great elaboration occurs. But, in general, whether with or without deliberation, the effort to make the unlike results in a pretty constant and subtle mod-

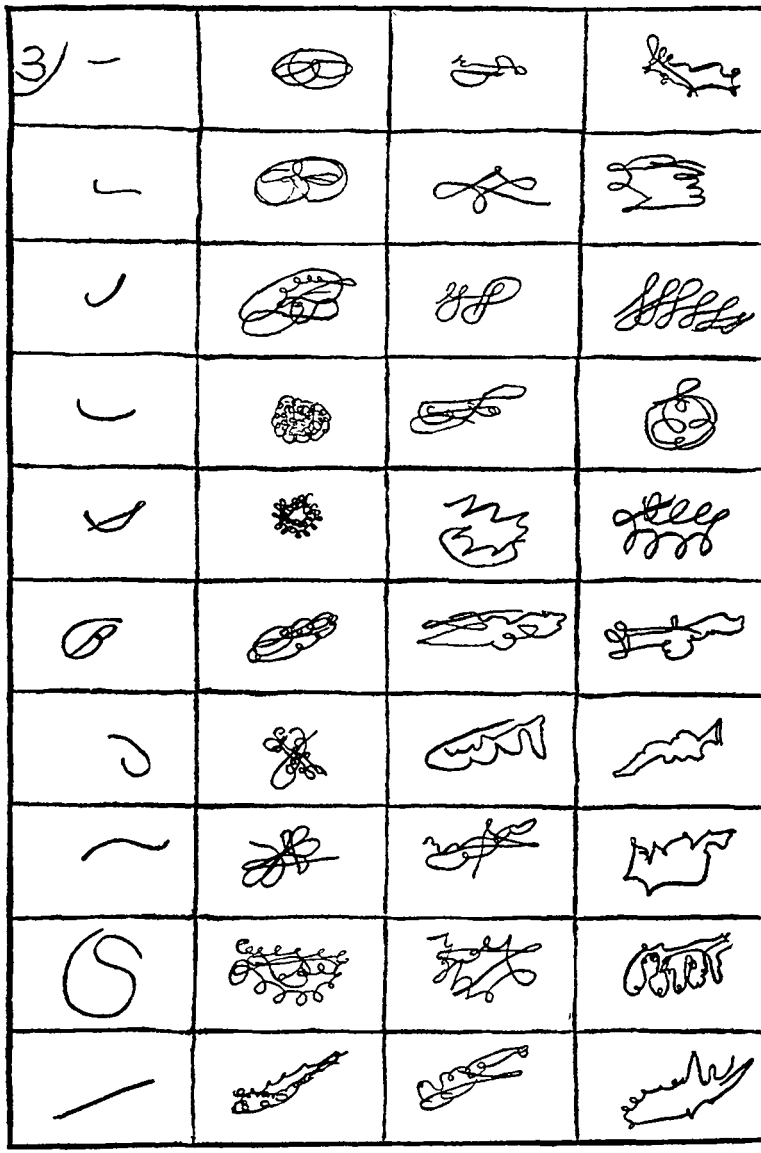

FIG. 3.

ification of the style of the original habits, a modification small, but visible, and due, if you like, to suggestion. Here is a blending of one's own style with the results of outer stimulus.

It is just such blending that, in some arts and even in some sort of scientific work, constitutes valuable inventiveness.

Decidedly different is the fourth case. A young man, in the third year of psychology work, is here in question. The cases of the first column are the quick-drawn ones. They are all small objects, suggestive of natural history studies. They have closed outlines, and strive to be something. The intruder introduces a number of new shapes, makes the figures larger, but does not in general alter their character of closed outlines, or their tendency to resemble natural history objects. The type is self-preservative. Some general suggestions from the objects shown are visible. The result is that the subject improves, if anything, the expressiveness and the character of the habits which he originally employed.

Plain so far is the fact that the requirement as made for the first column is a requirement that does appeal to pretty definite individual habits, that vary in certain persons. Notable also is the fact that the intruder produces a change in these habits which is in part, as you would expect, a reflex, a combination of dim suggestions, with existing tendencies, and which, whether or no it decidedly alters the first habits, at least tends to make the conditions of the work more varying, and possibly more inventive. But what is the nature of the influence of the intruder? If the cards shown were to be imitated, we know perfectly well what the influence would be. The subject would try to imitate, and within his limits and his own style he would do so. And in so far his habits would not tend to vary in any ways except those determined by the models shown. But our subjects are in an inventive position. Without knowing that they are to be specifically judged for their inventions, and without regarding this as any particular test of skill, since they, of course, find this business of making nothing in particular a business that gives little chance for skill, my subjects are still trying to vary their habits. They do so in new ways when the intruding stimulus intervenes. Is this because of the direct combination of the possibly suggested imitations of the models with their own habits? I should answer that the result of the stimulus is somewhat more complex than this. Compare, for instance, the following case:

The subject is here a salesman, aged 37. He is ready with his forms in the first column. These are obviously derived from handwriting; but he keeps fairly clear from complete letters. In the second column he introduces the motive of symmetry, and in so far grows in inventiveness. Now, why does he not continue just this process in the third column? On the contrary, he becomes at once, as it were, monosyllabic in his answer to the intruder's presence, like a person who stiffens or becomes relatively silent in the presence of an embarrassing social situation. Yet the forms chosen actually vary. One may well question whether the selection used is not about as great in the third column as in the first. The effects of direct suggestion from the model are hardly visible. In the fourth column the subject returns, as it were, from his relatively silent condition. Upon deliberation he has something to say to the intruder, but what he has to say is, on the whole, decidedly different in style, both from the style of the first column and from the style of the third. He has progressed to a new kind of invention. The type is not self-preservative, but it is the style of a man who, after all, meets the new requirement with at least some relatively new device.

Our next case is a bookbinder, aged 40. His style in the first column is very individual, and unlike what we have seen before. I suppose that the words that I used in describing the experiments, where I spoke of combining curves and angles, had to do with the choice here, but the style is as individual as a man's handwriting. Notice the entire change at the third column. The intruding stimulus entirely banishes the devices of the second column, although these have been very deliberately elaborated; they vanish not to return. More regular flourishes later take their place. But in the earlier cases of the second column you have a pretty logically varied selection of types differing from one another in definite geometrical fashion. The call 'make the unlike' here tends to arouse a systematic group of logically contrasted habits.

Our seventh case belongs once more to a relatively self-preservative type; and shows how the intruding stimulus, appearing in the midst of a lot of scroll-work patterns, at first scatters these, produces the small figure, monosyllabic type of reply to

the intruder—a reply as unlike as possible by being small when the intruder was big—while when the freedom of construction returns upon deliberation it returns in the forms of the columns 1 and 2, with the inventiveness as it were chastened, unable to run as freely as before.

Our eighth case is a three-column case, the work of a trained psychologist, and student of general science, an extremely critical and cautious man. He is distinctly less inventive in his second column than in his first. He knows why. It was because the intruder made him cool, considerate, critical, unwilling to do anything but precisely what was asked for.

The ninth case is again of the self-preservative type, although the intruding stimulus produces at first a large change. This subject found it almost impossible to avoid drawing objects. He was a man aged 20 who described himself as a private man and messenger. He was unable to avoid drawing what he had seen. The intruding stimulus first seemed to teach him to invent forms that were not objects, and certainly in so far increased the variability of his habits. Yet the tendency to return to objects was unconquerable. The result of the struggle between the new and the old is a decidedly large variation of style.

If, in the foregoing case, we had the relatively self-preservative quality, with the result that the habits involved varied in consequence of the struggle with the intruder, in case ten we have an illustration of the absolutely self-preservative type that can be taught, so to speak, almost nothing by the particular device used in this experiment. I need not say that I draw no conclusion as to the variability of the other habits of this subject. I report the case, partly to give a fair notion of how variable these cases themselves are, when compared with one another, and partly to suggest the use of this sort of experiment for individual psychology. I do not think that the subject knows the origin of these forms. She is a young lady in the first year of psychological study.

Case eleven illustrates in a happier way how self-preservation may be combined with invention. The subject is a woman, an advanced student of both psychology and general philosophy. The type is self-preservative, but the new forms are interwoven

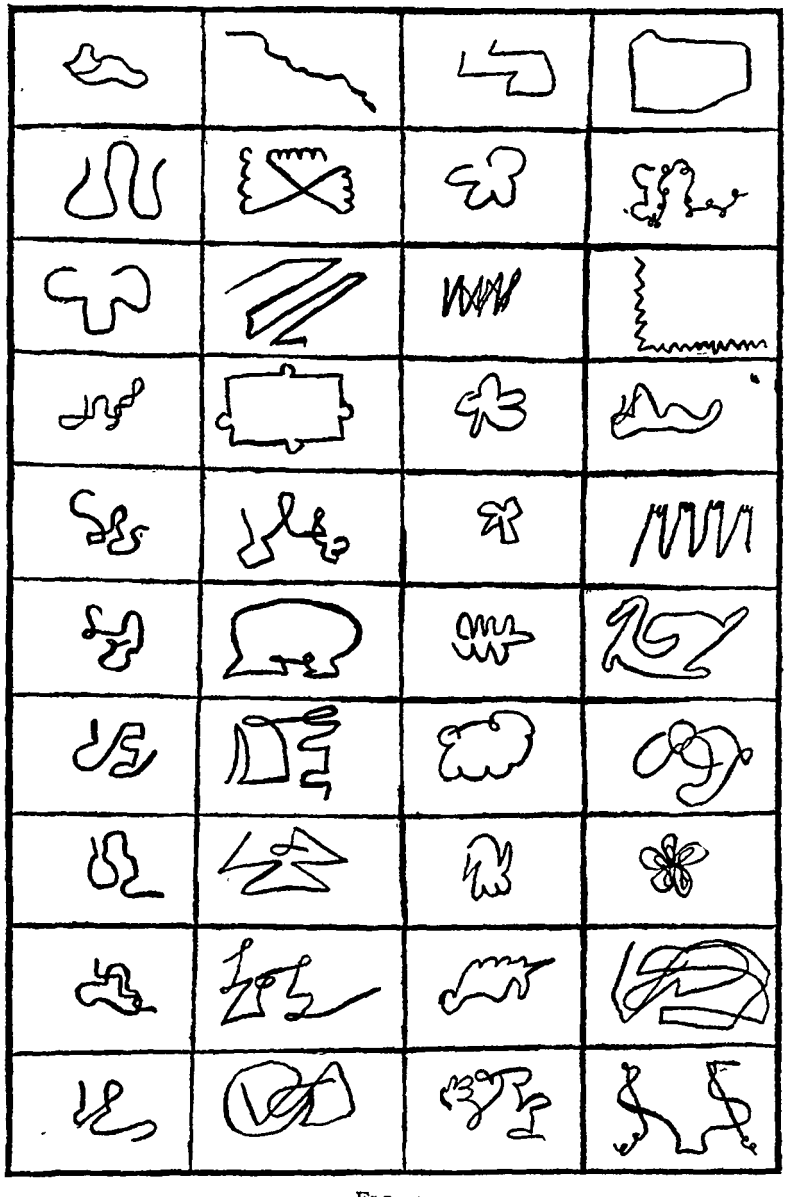

FIG. 4.

with the old in a way that indicates how important results may follow from the appearance of the intruding stimulus.

Very interesting, finally, as involving useful variations of

the habits first present, under the influence of stimulation, is the twelfth case,[1] with which I will close the present exhibits. In this case the stimulus causes entirely new forms to appear in the third column. These forms and a certain combination of them with earlier forms in the fourth column show a decided increase of inventiveness.

So far for the cases themselves, in so far as I can here show them. Meanwhile, a few words as to the significance of these processes. You have in these instances a certain group of more or less subconscious habits—habits rather characteristic of an individual subject, called forth somewhat at random from a mass of motor-habits by the conditions under which the experiments begin. The subject is told to vary these habits; he does so independently. His variation usually involves an elaboration of them, but ere long comes to its limits, or threatens to do so, in consequence of the fact that he is forbidden to draw an object. Then you introduce a new stimulus. This stimulus is the presence of a definite object and the giving of a suggestion, intended to stimulate in its very vagueness a sort of suggestion that social conditions frequently give, and a sort of suggestion, too, that in history appears, when developed in more rational and less abstract forms, as of great importance for the development of inventiveness. This suggestion is: Look at your object, and in the presence of that object preserve your independence and express yourself in an individual way in contrast to that object. Now, this suggestion with many of my subjects has worked to make them merely self-preservative. That is, they have repeated their own former deeds, and thus have accomplished the unlike. But in a certain number of cases they have shown at least at first that the stimulus presented shatters their already formed habits. They must do something different. What this something is, the dim suggestions derived from the object and the general sensitiveness produced by the shock of change, seem to determine in a rather chance way. The notable fact is that a

[1] This case is reproduced in Fig. 4. The cases from the fourth to the eleventh, inclusive, could not here be reproduced; and I regret to have to leave my report of those cases to be accepted, or doubted, by the reader, without any direct control. My purpose in giving the mere reports of these cases here, apart from the plates, is simply to indicate the range of variation of the facts.

considerable alteration is very frequently wrought in attitude and matter by the coming of the intruding stimulus, and this alteration is due unquestionably to the fact that one is to maintain one's self against an intruder and is not permitted to imitate. In the cases more favorable to inventiveness, and these cases are not few amongst the cases studied by me, the result is that the subject combines his old habits with the new impression, in such wise as to become distinctly more inventive.

But what interests me most in the situation thus observable is the fact that three distinct kinds of results are produced by the intruding stimulus. (1) In some of the subjects the intruding stimulus produces *mere variation or tendency to vary*. In so far it is like many another contact with the environment in instances where one is a little puzzled or confused, or is in general put upon one's mettle, but with the result that one is not crushed by the intruding stimulus, but is rendered more active. In such cases, stimuli of the sort that we are considering show themselves as simply tending to increase the variability of the habits at any moment at our control. They tend so far to make us fuller of resources, less creatures of routine, but also in so far the victims of chance. But this is not the only effect that appears in the cases now under discussion. For (2): The call to make the unlike resembles many other social stimuli in making some subjects *more critical*, *more cautious*, and in so far *less disposed* to make new and free variations of their former movements. In extreme cases the result may be to paralyze inventiveness altogether. But now are these two tendencies wholly opposed? This new tendency is a tendency to check the freedom that appears in our second column's work in the four column cases. But it checks this freedom by making the subject more self-critical, more selective of his movements. Well, two such tendencies may well coexist; and in the case where normal individualism is encouraged by social stimuli whose general type my experiments have attempted to imitate in miniature—by stimuli, namely, that lead a man to maintain himself against social intrusion, to contrast himself with the environment, to hold his own against the critics—these tendencies do coexist. In some of my subjects they have done so. In

many of the experiments self-preservation and variation have gone altogether. In several cases the check which the intruders introduced soon gives place to a richer variety. But now (3): In many cases the effect of the shock of difference is to lead to a combination of the old style with something new, and a blending of old and new elements which may involve a true invention.

In short, I submit that these experiments, not by proving any law, but by giving us symptoms of comparatively simple facts that are subject to analysis, do not indeed prove, but do in miniature illustrate a thesis whose proof I should leave to the whole history of invention. This thesis is that a particular type of social stimulation, a type prevalent in communities where individualism is encouraged, is productive of a threefold result. This type, namely (1), makes the habits of the individual more variable, by presenting to him manifold definite objects to think about in the acts of other individuals. In such individualistic communities, the individual, being encouraged to think about the acts of his fellows, and to criticise them, is led to be watchfully observant of a great many details of actions, just as my subjects were observant of the details of the objects shown them. Where such observation leads merely to imitation, the habits of the observing individual vary in only such ways as lead him to conformity with the social order; and in a great part of everybody's life this is the result of social observation. But in the individualistic communities the social stimuli involve the suggestion that one must hold his own, must not do quite as the rest of the people do, must use whatever motive of variation the feeling of time encourages. Criticism, argument, controversy, effort at eccentricity in conduct, on occasion even gossip and scandal, or the love within normal limit of the extraordinary generally, will involve such dispositions. That is, dispositions to produce the unlike, are so far causes of social variation in such organisms as are adapted to independent variability in any sense at all. But so far this variability gives the mere material out of which inventions may come. (2) Notable in the social situations of which our experiments are a miniature illustration, is the presence of tendencies towards a very rigid selective or self-critical

inhibition of variations that otherwise exist. So far the same conditions which favor variations may also favor rigid selection. (3) The combination of these two tendencies may produce the most remarkable results. One may observe that in normal social relations the individual, brought in contact with foreign models, against which he must maintain himself, is required to vary and, at the same time, to bring his varying habits into some sort of combination with the already highly organized habits of his social environment.

It is easy to illustrate all these three tendencies from life. An individualistic community is very keenly selective of the individuals whom it will permit to continue their variations. It encourages variation, but also destroys by stern selection the kinds of variation that do not contribute to the general organization of the current social interests. This is the case even in a fairly successful debating club, where everybody is encouraged to break the routine of debate, while nobody is tolerated who is not a successful speaker. In consequence, the social situation of the sort prevalent in an individualistic community involves altogether three kinds of motive. First, by calling upon an individual to do the unlike under the definite stimulation of closely observed models, the individual habits are set to varying. Our experiments illustrate in a miniature instance how a variation that one could not produce alone is instantly produced by such a definite social stimulus. Of course, such variation is not always produced; but, in view of the rarity of true originality, a very few instances in such experiments as mine would be enough to illustrate very instructively what may happen in consequence of stimulating suggestions. In the second place, the very stimulation that puts one upon one's mettle, and calls out the unlike, renders one more keenly critical, more rigidly selective of one's own variations than one would be if left to one's self. And, finally, the fact that the social stimuli are already those which result from pretty highly organized social conditions assures the possibility of important combinations of the new and the old, such as occasionally appear even in our miniature experiments. And these may involve increased inventiveness.

But I said that I should for the most part only suggest prob-

lems. I point out, at any rate, where the problem lies. Our knowledge of the variability of habits, and of the causes that make the variation of habits, either in the individual or in society, valuable, is a knowledge still in its infancy. I have endeavored to show that there are conditions prevalent in individualistic ages and societies which involve an increased variability and an increased selectiveness in the habits of all concerned. Using a few illustrative and by no means final experiments, I have tried to indicate a way in which, perhaps, some more ingenious student of this subject may be able to organize an experimental investigation of the conditions that render our habits variable, and especially of those social conditions which, as I believe, the study of the history of human originality will show to be of the first importance for the comprehension of the psychology of invention.