

### III

#### HOW TO THINK

**T**HERE are two kinds of thinking, the conscious and the unconscious. We begin of course with conscious thinking. We chemists spend a great deal of time practising our students in manipulative skill; but very few of us ever do anything in the way of teaching them to think. Many people do not realize it; but it is not easy to think efficiently. Two very difficult things which I have to do are to teach graduate students to ask why and how to think. I suggest to a graduate student that he try a certain experiment and I tell him why I expect it to go a certain way. After a while he comes back and says that the experiment does not go. I ask him why and he looks grieved. That is not his job. It takes at least a year to get him to asking why. Since all small boys ask why, the result of intensive training is to put a boy further back in some respects than when he started.

In about a year one can cure a good man of not asking why; but it takes a great deal longer than that to teach him to think properly. Most people do research by making a guess, testing it, making another, testing that, and so on. The results obtained are valid only for those conditions and usually are not corrected for the misleading experiment. When one gets through, one knows nothing more than that the particular guesses were not right. It is like four people hunting as they usually do for a golf ball. After five minutes of that, all one knows is that the golf ball has not been

found; but one does not even know where the ball is not, because the ball may have been within an inch of where one was looking. If the four people plus caddies line up and walk down a stretch, one at least knows that the ball is not there at all, which is something.

During the war I happened to be connected with a group which was asked to report on a difficulty in regard to the chemical manufacture of ammonium picrate. Instead of being all one color, the salt crystallized at times with both red and yellow on the same crystal. Nobody knew whether the bicolored salt was any less satisfactory than a uniformly colored product; but it did not meet the specifications. From the point of view of the War Department the work of the group was eminently successful, because rules were laid down which prevented the formation of parti-colored crystals. From a scientific view-point the work of the group was inconceivably bad. When we finished, we knew less about the theory of the subject than when we started because we had apparently eliminated all possible explanations. That merely meant bad planning and faulty experimental work. I have always looked upon the particular investigation as a model of what scientific research should not be, although there are people who point with pride to it.

This sort of thing is not uncommon. There has been a lot of work done on the action of radium and of ultraviolet light on gems, and the net theoretical outcome is practically zero.<sup>1</sup> "When we come to the color of gems, we get into an absolutely unknown country. In many cases a reversible change is possible. Heat makes the gem colorless, ultraviolet gives it one color, and radium (usually beta and gamma rays) give it another color.<sup>2</sup> Colorless topaz is

<sup>1</sup> Bancroft: "Applied Colloid Chemistry," 254 (1926).

<sup>2</sup> Cf. Meyer and Przibram: *Z. physik. Chem.*, 100, 344 (1922).

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made yellow to orange by radium and heating makes it colorless again. Ultraviolet light tends to change the radium orange to lilac. Kunzite changes from lilac to green, under the action of radium, while ultraviolet light reverses this change.<sup>1</sup> Heating makes it colorless and radium restores the green color. This cycle<sup>2</sup> can be repeated indefinitely. Blue sapphires are changed to yellow by radium and yellow sapphires to blue by ultraviolet light. Sapphires become colorless when heated and white sapphires are turned yellow by radium. Newbery and Lupton<sup>3</sup> report that all the colored fluorspars are decolorized when heated. Radium restored the green to a decolorized green crystal but changed a decolorized yellow one first to blue and then to purple. Garnett<sup>4</sup> quotes Soddy to the effect that colorless gold glass is turned ruby color by radium emanation, and Ramsay to the effect that colorless silver glass is turned yellow under these conditions; but Lind was not able to duplicate these results, perhaps because he used a different glass. Lind found that a yellow diamond was turned green by alpha rays and went back to yellow when heated. The green may have been due to a production of blue which disappeared on heating, the yellow being permanent. The ruby becomes green when heated and red again on cooling; this is not a case of selective emission at higher temperatures.

“We do not know to what extent the color changes are due to a change in the size of the particles or to a chemical change. Cathode rays set free metallic sodium from sodium chloride crystals. The wise thing would be to start with the oxides of copper, manganese, chromium, and iron in a borax

<sup>1</sup> This change is undoubtedly due to chromic oxide.

<sup>2</sup> Lind and Bardwell: *J. Franklin Inst.*, 196, 375, 521 (1923).

<sup>3</sup> *Memoirs Manchester Phil. Soc.*, 62, No. 10 (1918).

<sup>4</sup> *Phil. Trans.*, 203 A, 400 (1904).

bead and study the color changes there before trying to straighten out the behavior of gems."

Since this was written, we have shown that the color of the ruby is due to a red modification of chromium oxide, that the amethyst color produced by manganese is due to manganic oxide,  $Mn_2O_3$ , and that the green color obtained with copper oxide in lead glazes is due to the unsuspected presence of cuprous oxide. When we shall have cleared up the colors due to the oxides of titanium and iron, we shall be in a position to study the effect of radium and of ultra-violet light on beads containing these oxides, after which it will undoubtedly be a simple matter to account for the behavior of gems. This will illustrate the advantage of a flank attack. Hitherto, people have merely collected data and have not planned their work at all.

Plotnikow<sup>1</sup> says that "the amounts of substance changed in the whole region of photochemical absorption is proportional to the absorbed quantity of light, independent of the wave-length." So far as one can judge, this relation cannot be true if the nature of the reaction changes with the wave-length of the photochemically active light. If so, this is tantamount to saying that the nature of the reaction is independent of the wave-length of the photochemically active light. H. S. Taylor also believes that light can produce no localized increment of energy and that the molecules will break at the weakest points regardless of where the light enters. One would have supposed that a question like this, which is fundamental, would have been tested carefully; but the ordinary thinking is so inefficient that there is very little evidence either way and what little evidence there is about balances.

H. S. Taylor thinks that one of the mercury lines

<sup>1</sup>"Lehrbuch der Photochemie," 55 (1920).

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decomposes formic acid in two ways, into carbon monoxide and water and into carbon dioxide and hydrogen. As far as it goes, that is pretty conclusive that monochromatic light may act in two ways, though one does not quite see why there should be two weakest points. As against this we have the experiments of Berthelot and Gaudechon<sup>1</sup> that light with a wave-length longer than  $300\mu\mu$  decomposes acetaldehyde according to the equation  $\text{CH}_3\text{CHO}=\text{CH}_4+\text{CO}$ , while light of wave-length about  $250\mu\mu$  polymerizes acetaldehyde to para-aldehyde and metaldehyde. These experiments have not been confirmed independently; but we are starting on this at Cornell.

Destructive criticism is often necessary; but it is not the last word. One must eventually present something constructive. The answer is to be found in the game of twenty questions. When I was a small boy, it was a very popular game to try to find, by asking a series of questions, what the others had selected. The first question was always: animal, vegetable or mineral? After that the questions must be ones that could be answered by yes or no. It is astonishing what things one can find out in this way, if one is not limited to twenty questions. The trick was to frame the questions so as to eliminate a large portion of the possible field each time and to reach the goal by successive eliminations. Direct guesses were usually a waste of time and were not made by the experts. The method might be called the either-or method, or the Socratic method. The latter sounds more impressive. That simple little game exemplifies the principles of scientific research and it would be a good thing if our graduate students would play it regularly as part of their research training.

We make use of the principle involved whenever we weigh

<sup>1</sup> *Compt. rend.*, 156, 68, 233 (1913).

anything on a balance in the laboratory. The student is taught to get a weight that is too low and one that is too high and then to reach the true weight by bringing those two limits closer and closer together. If he guesses at the true weight and then keeps adding weights, he can waste a great deal of time.

Modern naval gunnery is based on the Socratic method or on the game of twenty questions as one prefers. As I understand it, nobody tries to hit the target on the first two shots. One shot is put over the target and the other under. Once a bracket is established, it is a relatively simple matter to hit a target on the third shot.

The advantages of the Socratic method are that one eliminates a great many possibilities definitely, that there is no error due to changing two variables simultaneously, and that one knows exactly where one has failed if that has happened. That means that the problem can be taken up again at some later time whenever one sees what the next step is. The sources of error are: inadequate exclusiveness; experimental error; inability to devise an experiment to enable one to distinguish between the mutually exclusive alternatives; inability to formulate an either-or.

It is not easy to illustrate the application of the Socratic method from the literature because the people who have employed it usually do not give the mental processes through which they have gone and one forgets them in one's own case. One very striking instance has been mentioned in the second lecture to illustrate another point. Sir Humphry Davy believed that the electrolysis of pure water should not give acid and alkali at the poles. When he actually obtained acid and alkali from what he had hoped was pure water, he proceeded to run down the sources of error in a way which is a model to all research men. Davy electro-

lyzed distilled water between gold wires in glass vessels connected by animal bladder or by moist strings. When the result was unsatisfactory Davy reasoned that the disturbing factors either came from the connecting fibers or did not, so he replaced them by well-washed asbestos. He next concluded that glass was either a disturbing factor or not, and he replaced the glass by agate vessels. Part of the disturbance was either due to the agate or it was not, so he replaced the agate vessels advantageously by gold cones. He had now apparently eliminated everything except the water, so he gave that a special distillation and eliminated all acid. His final conclusion was that the disturbance was either due to the air or it was not. Working with his specially distilled water in gold cones with asbestos connecting fibers in an atmosphere of hydrogen, he succeeded in electrolyzing water without the production either of acid or of alkali.

After looking up all the literature on solarization—the reversal of the photographic image—and before making any experiments, I wrote down three hypotheses which seemed to me to cover the field. The first and most plausible one, so far as the available data were concerned, was that the phenomenon was due to an oxidizing action of the light. This was easily proved wrong because the solarization phenomena could be duplicated by the action of suitable reducing agents on the photographic film. I do not remember now what the third tentative explanation was, because the second one proved to be right, that the effect is due to different rates of development.

The evidence in regard to the nature of the latent image in photography can be presented in a similar manner.<sup>1</sup> “Owing to the very slight change in silver bromide on short

<sup>1</sup>Bancroft: *Trans. Faraday Soc.*, 19, 249 (1923).

exposure, it has always been popular to assume that the latent image is a physical or allotropic modification. Namias<sup>1</sup> assumed polymerization, Hurter and Driffeld<sup>2</sup> depolymerization, Bredig<sup>3</sup> mechanical disintegration, Chapman Jones<sup>4</sup> labile form, and Bose<sup>5</sup> a mechanical strain. All these assumptions, and the further one of von Tugolesow<sup>6</sup> that the latent image is an oxidation product, were overthrown by the simple fact that all the phenomena of the latent image can be duplicated by immersing the plate in a solution of a weak reducing agent,<sup>7</sup> such as sodium arsenite. This proves that the latent image is some reduction product of silver bromide. It cannot be a single, definite subhalide because no such compound has been prepared, because no satisfactory chemical reactions can be assigned to it, because the prolonged action of light does not yield the pure compound, and because this hypothesis cannot be reconciled with the facts of solarization.

“The latent image cannot consist of a number of definite subhalides because we cannot isolate these in any way or give any proof of their existence or properties, and because it is absurd to assume a number of definite subhalides between pure silver bromide and silver bromide containing an excess of 0.5 per cent silver, when one can account for all the facts much better on the assumption of a phase of continuously varying composition.

“The latent image cannot be free metallic silver (nucleus

<sup>1</sup>“Chimie photographique,” 102, 110 (1902).

<sup>2</sup>Phot. J., 22, 149 (1898).

<sup>3</sup>Eder: Jahrbuch der Photographie, 13, 365 (1899).

<sup>4</sup>“Science and Practice of Photography,” 383 (1904).

<sup>5</sup>Phot. J., 26, 146 (1902).

<sup>6</sup>Phot. Correspondenz, 40, 594 (1903).

<sup>7</sup>Bancroft: J. Phys. Chem., 14, 294; Perley: 689 (1910); Clark: British J. Photography, 69, 462 (1922).



theory) because it does not show the chemical reactions of free metallic silver, because it does not show the electrical potential of free metallic silver, and because the hypothesis cannot be reconciled with the facts of solarization.

"The latent image is due to silver adsorbed by silver bromide because it behaves like a phase of continuously varying composition, because this hypothesis enables us to account for all the chemical reactions, and because this hypothesis enables us to account for the facts of solarization. The first suggestion that the latent image is due to adsorption was made by Carey Lea,<sup>1</sup> but this came before people were ready for it, and the idea was really carried through by Lüppo-Cramer.<sup>2</sup> . . . Hartung<sup>3</sup> has shown experimentally that thin films of silver chloride, bromide, and iodide lose weight when exposed in air to the sunlight. This is due to loss of halogen, and the original weight is restored almost completely by rehalogenation. As was to be expected, the decomposition takes place much more rapidly in a vacuum."

The application of the Socratic method has enabled us to make real progress<sup>4</sup> in the study of the action of salt solution on gelatine. Gelatine is peptized by a potassium iodide solution much more readily than by a potassium chloride solution. It is a typical case of the Hofmeister series. Either the peptization is due to strong adsorption of the iodide ion or it is not. Nobody has been able to show any marked adsorption of the iodide ion and the effect cannot be due to this because the order of peptization by iodides and chlorides does not reverse as we change from a slightly acid to a slightly alkaline solution. Excluding adsorption also excludes compound formation.

<sup>1</sup> *Am. J. Sci.*, (3) 33, 349 (1887).

<sup>2</sup> Cf. "Kolloidchemie and Photographie," 70 (1908).

<sup>3</sup> *J. Chem. Soc.*, 121, 682 (1922).

<sup>4</sup> Bancroft: *J. Phys. Chem.*, 30, 1194 (1926).

The effect is either due to the solvent action of potassium iodide or it is not. We cannot be dealing with a solvent action of liquefied potassium iodide because the gelatine is peptized and not dissolved. It cannot be a peptization by liquefied potassium iodide because that would mean a selective adsorption of iodide which we do not have. We may assume that the effect is due to hydration of potassium iodide or is not. So long as people believe that potassium iodide is more hydrated than potassium chloride, this cannot be true because the formation in solution of hydrates of potassium iodide would decrease the amount of free water and would therefore decrease the peptizing action of the solution of gelatine.

Since we have apparently excluded any direct action on the gelatine, the only remaining possibility is that potassium iodide changes the water so as to increase the water's peptizing action on gelatine. This is the more plausible because the Hofmeister series for chloride, bromide, and iodide crops up in one form or another as affecting all sorts of phenomena from the apparent hydrogen ion concentration to the temperature of maximum density of water. The mechanism of the effect is easy to see. Everybody considers liquid as an associated liquid with a reversible equilibrium between hydrol ( $\text{H}_2\text{O}$ ), dihydrol ( $\text{H}_2\text{O}$ )<sub>2</sub>, trihydrol ( $\text{H}_2\text{O}$ )<sub>3</sub>, and perhaps polyhydrol ( $\text{H}_2\text{O}$ )<sub>n</sub>. Sutherland considers that at zero liquid water consists practically of 37 per cent trihydrol and 63 per cent dihydrol.

The addition of a salt will displace the water equilibrium, whatever it may be, in the direction of the form in which the salt is more soluble. Since the two forms will not necessarily have the same peptizing action on gelatine, displacement of the water equilibrium may increase or decrease the peptizing action on gelatine. Since potassium chloride,

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bromide, and iodide increase the lowering of the temperature of maximum density of water, we conclude for the present that these salts increase the percentage of dihydrol, and that dihydrol has a greater peptizing action on gelatine than trihydrol has.

This could not have been predicted in advance and we know one case where the polymerized liquid is the active substance. Pyroxylin is peptized by an ether-alcohol mixture and not by either pure liquid at room temperature. Ethyl alcohol causes pyroxylin to swell appreciably, while ethyl ether does not. It has been shown by Lunge<sup>1</sup> and confirmed by Byron<sup>2</sup> in the Cornell laboratory that the ether apparently plays no direct part in the peptization of pyroxylin. It must therefore activate the alcohol either by increasing or decreasing the relative amount of depolymerized alcohol. One would expect a dilution of the alcohol to increase the relative amount of depolymerized alcohol; but this is apparently not the case. If the depolymerized alcohol is the peptizing agent, it should be possible to peptize pyroxylin by alcohol alone at higher temperatures, as one can do with gelatin and water. If the polymerized alcohol is the peptizing agent, it should be possible to peptize pyroxylin by alcohol alone at lower temperatures. It has been shown by McBain<sup>3</sup> and confirmed by Byron that there is no appreciable peptization of pyroxylin by alcohol at 140°. It has been shown by Kugelmass<sup>4</sup> and by McBain, and confirmed by Byron, that pyroxylin is peptized by alcohol at very low temperatures. If the hypothesis is right, a colloidal solution prepared at low temperatures should become more viscous as the tempera-

<sup>1</sup>Z. angew. Chem., 14, 538 (1901).

<sup>2</sup>J. Phys. Chem., 30, 1116 (1926).

<sup>3</sup>McBain, Harvey and Smith: J. Phys. Chem., 30, 312 (1926).

<sup>4</sup>Rec. Trav. chim., 41, 751 (1922).

ture rises, because the relative amount of the peptizing agent decreases with rising temperature. It has been shown by McBain and confirmed by Byron that a colloidal solution of pyroxylin in alcohol, which is quite mobile at low temperatures, becomes a soft flowing jelly at room temperatures. It has been shown by Byron that this soft flowing mass becomes a stiff jelly when heated well above  $100^{\circ}$ , and that the tube can be turned upside down without the contents flowing out.

While we have no independent confirmation as yet of the assumption that ether increases the polymerization of ethyl alcohol, Centnerzwer and Zoppi<sup>1</sup> have shown that "ether causes great polymerization of methyl alcohol."

One of the Cornell non-resident lecturers in chemistry, Professor Barger of the University of Edinburgh, said in one of his lectures that he could not guess how Steenbock got the happy idea of irradiating food to increase the vitamin D content. I do not know Steenbock; but I know how his mind ought to have worked and, therefore, how it probably did work. It was known that irradiating people was equivalent to increasing the amount of Vitamin D in the food. This might be due either to the action of light on some actual constituent of the food or to the action of light on some decomposition product of the food. The way to distinguish between these two hypotheses was to try the action of light on the food itself. While Steenbock's discovery may have been a happy accident, I prefer to believe, and shall believe until I am proved wrong, that Steenbock's discovery was the result of first-class thinking along proper lines.

It seems to be quite clear that the Socratic method, as defined, is the proper way to do conscious, scientific thinking, and that graduate students should practise themselves

<sup>1</sup>Z. physik. Chem., 54, 700 (1906).

in this as much as possible. When we consider unconscious thinking we come into a field in which most of the psychologists are quite definitely on one side and most of the research men in other sciences equally definitely on the other side.

It seems to be generally recognized that scientific ideas seem often to be an inspiration. Whewell<sup>1</sup> says that "scientific discovery must ever depend upon some happy thought, of which we cannot trace the origin—some fortunate cast of intellect rising above all rules. No maxims can be given which will inevitably lead to discovery. No precepts will elevate a man of ordinary endowments to the level of a man of genius."

Libby<sup>2</sup> says that "it will be found that scientific discovery, while predominantly an intellectual process, varies with the nature of the phenomena of the different sciences and the individual mental differences of the discoverers. As stated at the outset, the psychology of scientific discovery must be the subject of prolonged investigation, but some data are already available. One great mathematician, Poincaré, attributes his discoveries to intuition. The essential idea comes with a sense of illumination. It is characterized by suddenness, conciseness, and immediate certainty. It may come unheralded, as he is crossing the street, walking on the cliffs, or stepping into a carriage. There may have intervened a considerable time free from conscious effort on the special question involved in the discovery. Poincaré is inclined to account for these sudden solutions of theoretical difficulties on the assumption of long periods of previous unconscious work.

"There are many such records from men of genius. At the moment the inventor obtains the solution of his problem

<sup>1</sup>"*Novum Organum Renovatum*," 44 (1858).

<sup>2</sup>"*An Introduction to the History of Science*," 267 (1917).

his mind may seem to be least engaged with it. The long-sought-for idea comes like an inspiration,<sup>1</sup> something freely imparted rather than voluntarily acquired. No mental process is more worthy of common respect; but it may not lie beyond the possibility of explanation. Like ethical insight, or spiritual illumination, the scientific idea comes to those who have striven for it. The door may open after we have ceased to knock, or the response come when we have forgotten that we have sent a call; but the discovery comes only after conscious work. The whole history of science shows that it is to the worker that the inspiration comes, and that new ideas develop from old ideas."

Westaway<sup>2</sup> has an interesting page on the intuitions of great minds. "There are times in men's thinking when great truths seem to dawn upon the mind. On such occasions there is commonly not only simple intuition, but also the gathered wisdom of long and varied and ripened experience, refined analysis and generalization, conscious reasoning, exceptional talent, and systematic methods of working. In nearly every great discovery there has been a combination of native gift, accumulated experience, and connected reasoning; at some particular moment a truth has flashed upon the vision as if light from many sources were suddenly focussed on the same point.

"In science and mathematics, intuition is recognized as a legitimate mode of discovering truth. In the integral calculus, for instance, numerous results have been arrived at intuitively, and the clue to all mathematical problems is obtained by an intuition or insight which is due partly to native capacity and partly to knowledge and previous experience. As to the fruitful hypotheses that have led so often to veri-

<sup>1</sup> [Cf. for instance, Helmholtz in Ostwald: "Grosse Männer," 302 (1909).]

<sup>2</sup> "Science and Theology," 251 (1920).

fiable results in natural science, they seem to be almost of the nature of inspired guessing: truth seems to flash across the mind of the inquirer immersed in his research. He becomes aware of something of which a moment before he was not aware. He is not conscious of having arrived at it by any process of logical thinking, but it has dawned upon him. Great scientific discoverers are men who appear to possess almost a genius for the intuition of hitherto unknown facts. So suddenly does the intuition come, without any conscious process of deductive or inductive reasoning, that it is sometimes regarded as a supra-rational faculty. For the moment it seems to be more akin to imagination than to logic, being creative and spontaneous, apparently independent of the mental processes of analysis and synthesis which constitute the ordinary machinery of thought. But in such cases reasoning and intuition are probably always complementary processes; alone, neither is sufficient. Logic does not discover the data with which it works; the premises of a syllogism must be known before the inference can be drawn. Hence intuition is necessary. But, as we have seen, intuition is very largely the result of garnered experience, and this is brought suddenly into instantaneous action. But inasmuch as the experience is necessarily affected with error, the intuitions should always be scrutinised and put to the test of truth. Reason should always be called in, even though it be but to crystallise the findings of intuition.

“Just as we talk of the mind being suddenly illuminated by a sudden idea, so we talk of the suddenness of a flash of lightning. We are apt to forget that every flash of lightning is the direct result of natural forces gradually but inevitably leading up to it, and could, if knowledge had been sufficient, have been foretold in the remote past. Things are sudden only because we do not foresee them, and their

suddenness is no inherent quality in themselves but the mere result of our ignorance. In reality, nothing is more sudden than anything else. It is from our lack of knowledge, understanding, and preparation that lightning borrows its suddenness.

“All this seems to be equally true in the world of the mind. To the sudden idea long thinking has contributed—thinking which we now seem to be unconscious of. In our unconsciousness seem to lie some of the greater powers we possess. Not a little of man’s capital work is done without his knowing it, and when it is done he is amazed at the apparent suddenness of results that reveal themselves in their maturity.”

Even when we make large allowance for the enthusiasm of biographers and writers of popular science, there can be no doubt about the suddenness with which ideas come. Koch<sup>1</sup> was trying to get the anthrax bacilli pure. “Then one day a perfectly easy, a foolishly simple way to watch his rods grow flashed into Koch’s head.” More striking is what deKruif says about Metchnikoff:<sup>2</sup> “Metchnikoff sat alone in his parlor, tugging at his biblical beard, gazing without seeing them at his bowls of star fish. Then—it was like the blinding light that bowled Paul over on his way to Damascus<sup>3</sup>—in one moment, in the most fantastical you would say impossible, flash of a second, Metchnikoff changed his whole career.” As Metchnikoff wrote in his diary, “I suddenly became a pathologist. . . . Feeling that there was in this idea something of surpassing interest, I became so excited that I began striding up and down the room, and even went to the seashore to collect my thoughts.”

<sup>1</sup> DeKruif: “The Microbe Hunters,” 113 (1926).

<sup>2</sup> p. 212.

<sup>3</sup> [The same phrase is used in regard to Julius Robert Mayer and the laws of conservation of energy. Ostwald: “Grosse Männer,” 65 (1909).]



Although Jastrow<sup>1</sup> does not himself believe in inspiration, he records some instances where this seems to occur. "Among recorded instances of important discoveries emerging into consciousness at such indirect moments of leisurely occupation, 'when the mind is at lullaby,' I have noted the following:—

"Sir William Rowan Hamilton evolved the intricate conception of the invention of quaternions while walking with Lady Hamilton in the streets of Dublin, the flash of discovery coming to him just as he was approaching the Brougham Bridge. Mozart had the aria of the beautiful quartette in the 'Magic Flute' come to him while playing a game of billiards, and seemed prepared for such occasional influxes of musical ideas by carrying a note-book for their instant record. An inventor suddenly conceived the proper way of constructing a prism for a binocular microscope—a problem which he had long thought of and abandoned—while reading an uninteresting novel. Professor Kekulé tells how he saw the atoms dancing about in mid-air in conformity with his theory of atomic grouping, while riding on top of a London bus. In the attempt to recall a name that is on the tip of the tongue many persons deliberately occupy themselves with something irrelevant, finding by experience that this is an aid; and the day-dream through which flashes a happy 'Eureka,' or the dream of deeper sleep that discovers the treasures that our laborious digging has failed to unearth, are equally instances in which the fixed intent of the more watchful consciousness is withdrawn."

In another place<sup>2</sup> Jastrow says: "Without maintaining that the extremely variable, even discordant, descriptions

<sup>1</sup>"The Subconscious," 94 (1906).

<sup>2</sup>Ibid., p. 70.

recorded by inventors, artists, composers, authors, and others in regard to the genius of their several pursuits, at all supply what the psychologist is interested in discovering, it may none the less be profitable to consider one such account—that of Robert Louis Stevenson—for the suggestiveness of the matter which it so attractively presents. It pleases this master of imaginative construction to speak of the moments of inspiration as coming to him in dreams,—waking as well as sleeping dreams, we may assume,—and the subconscious contributors to his inventions are made to appear as Brownies.

“This dreamer (like many other persons) has encountered some trifling vicissitudes of fortune. When the bank begins to send letters and the butcher to linger at the back gate, he sets to belaboring his brains after a story, for that is his readiest money-winner; and behold! at once the little people begin to bestir themselves in the same quest, and labor all night long, and all night long set before him truncheons of tales upon their lighted theatre. No fear of his being frightened now; the flying heart and the frozen scalp are things bygone; applause, growing applause, growing interest, growing exaltation in his own cleverness (for he takes all the credit), and at last a jubilant leap to wakefulness, with the cry ‘I have it, that’ll do!’ upon his lips: with such and similar emotions he sits at these nocturnal dreams, with such outbreaks, like Claudius in the play, he scatters the performance in the midst. Often enough the waking is a disappointment; he has been too deep asleep, as I explain the thing; drowsiness has gained his little people, they have gone stumbling and maundering through their parts; and the play, to the awakened mind, is seen to be a tissue of absurdities. And yet how often have these sleepless Brownies done him

honest service, and given him, as he sat idly taking his pleasure in the boxes, better tales than he could fashion for himself.

“In spite of this poetical transformation, the psychological affinities are recognizable, though fancifully disguised; and when the dreamer comes to hold an accounting for the share of his intent and his prompted self in the joint contract, he apportions the credit quite fairly. The Brownies ‘are near connections of the dreamer’s, beyond doubt; they share in his financial worries and have an eye to the bank book; they share plainly in his training; they have plainly learned like him to build the scheme of a considerable story and to arrange emotion in progressive order; only I think they have more talent; and one thing is beyond doubt, they can tell him a story piece by piece, like a serial, and keep him all the while in ignorance of where they aim.’ They ‘do one half my work while I am asleep, and in all human likelihood do the rest for me as well, when I am wide awake and fondly suppose I do it for myself.’ And though this sensitive writer is tempted to suppose that his conscious ego ‘is no storyteller at all, but a creature as matter of fact as any cheesemonger or any cheese, and a realist bemired up to his ears in actuality,’ the reader cannot share this doubt. Stevenson comes again upon psychological ground when he says: ‘I am an excellent adviser, something like Molière’s servant; I pull back and I cut down; and I dress the whole in the best words and sentences that I can find and make; I hold the pen, too; and I do the sitting at the table, which is about the worst of it; and when all is done, I make up the manuscript and pay for the registration; so that on the whole, I have some claim to share, though not so largely as I do, in the profits of our common enterprise.’

“Dr. Holmes similarly acknowledges the portion of our

subconscious acquisitions in our successes, and tells us that 'we are all more or less improvisators; we all have a double, who is wiser and better than we are, and who puts thoughts into our heads, and words into our mouths,' yet equally does he realize that the inspiring source of these subconscious thoughts is really the conscious 'grinding' self."

There is a very wide-spread recognition among people who are not psychologists of the possible importance of the subconscious mind. Dr. Oliver Wendell Holmes speaks of those subconscious products of our intelligence wrought in the underground workshop of thought. He also says: "We wish to remember something in the course of conversation. No effort of the will can reach it; but we say, 'Wait a minute and it will come to me,' and go on talking. Presently, perhaps some minutes later, the idea we are in search of comes all at once into the mind, delivered like a prepaid bundle, laid at the door of consciousness like a foundling in a basket. How it came there we know not. The mind must have been at work groping and feeling for it in the dark; it cannot have come of itself. Yet all the while, our consciousness, so far as we are conscious of our consciousness, was busy with other thoughts."

In "The Three Hostages" by John Buchan, the doctor says: "I belong to more or less the same totem as you, but I've long been aware that I possessed a most curious kind of subconsciousness. I've a good memory and fair powers of observation, but they're nothing to those of my subconscious self. Take any daily incident, I see and hear, say about a twentieth part of the details and remember about a hundredth part—that is, assuming that there is nothing special to stimulate my interest. But my subconscious self sees and hears practically everything and remembers most of it. Only I can't use the memory, for I don't

know that I've got it, and can't call it into being when I wish. But every now and then something happens to turn on the tap of the subconscious, and a thin trickle comes through. I find myself sometimes remembering names I was never aware of having heard, and little incidents and details I had never consciously noticed. Imagination, you will say, but it isn't, for everything that that inner memory provides is exactly true. I've tested it. If I could find some way of tapping it at will, I should become the first scientist of the age, for the trouble with investigation and experiment is that the ordinary brain does not observe sufficiently keenly or remember the data sufficiently accurately."

Since Mr. Buchan is not primarily a research man, one cannot hold it against him that he believes in the Baconian method of research—collecting data and having the generalizations become self-evident. The important thing is that the existence of what he calls the subconscious self is perfectly obvious to him and is not a speculative hypothesis.

We get exactly the same thing in a slightly different form from John St. Loe Strachey in "The Adventure of Living." "There is another point in regard to Senior's power of recording conversations which is worth considering by modern psychologists. It is quite possible that what Senior did, unconsciously of course, was to trust to his subconsciousness. That amiable and highly impressionable, if dumb, spirit which sits within us all got busy when Thiers or Guizot was talking. The difficulty was to get out of him what he had heard and had at once transferred to the files in the Memory Cupboard. Senior, without knowing it, had, I doubt not, some little trick which enabled him to get easily *en rapport* with his subconsciousness, and so tap the rich and recently stored vintage. His writing was probably half

automatic. It certainly was vivid and dramatic in a high degree."

Emerson's phraseology<sup>1</sup> is quite different of course; but he is also speaking about a thing that is real to him. "Our spontaneous action is always the best. You cannot with your best deliberation and heed come as close to any question as your spontaneous glance shall bring you, while you rise from your bed, or walk around in the morning after meditating the matter before sleep on the previous night. Always our thinking is a pious reception. Our truth of thought is therefore vitiated as much by too violent direction given by our will, as by too great negligence."

"It is a secret which every intellectual man quickly learns, that beyond the energy of his possessed and conscious intellect he is capable of a new energy (as of an intellect doubled on itself), by abandonment to the nature of things; that, besides his privacy of power as an individual man, there is a great public power on which he can draw, by unlocking, at all risks, his human doors, and suffering the ethereal tides to roll and circulate through him: then he is caught up into the life of the Universe, his speech is thunder, his thought is law, and his words are universally intelligible as the plants and animals. The poet knows that he speaks adequately, then, only when he speaks somewhat wildly, or 'with the flower of the mind'; not with the intellect used as organ, but with the intellect released from all service, and suffered to take its direction from its celestial life; or, as the ancients were wont to express themselves, not with intellect alone, but with the intellect inebriated by nectar. As the traveller who has lost his way throws his reins on his horse's neck, and trusts to the instinct of the animal to find his road, so must we do with the divine animal who carried us through this

<sup>1</sup>"Essays," 5, 232, 279 (1906).

world. For if in any manner we can stimulate this instinct, new passages are opened for us into nature, the mind flows into and through things hardest and highest, and the metamorphosis is possible."

There is no doubt as to what Buchan and Strachey are trying to say; but one can read almost anything into Emerson's words. I think that the main difference is that Buchan and Strachey consider that what one calls inspiration comes from within, whereas Emerson implies that one opens the windows of his mind and lets the inspiration blow in from outside. Emerson seems to eliminate the subconscious self thereby; but it is a little obscure whether the "divine horse" is internal or external.

In an address given ten years ago, Graham Lusk<sup>1</sup> discussed the question of research in medicine. "Helmholtz, on the occasion of his seventieth birthday, stated that he had never had a great idea come to him when he was at his desk, nor when he was tired, nor after taking a glass of wine; but usually such had come to him when he was walking in the garden musing of other things. The scientist must have leisure to think over the problems which offer and he must have a certain discrimination in order to distinguish between the things that are worth doing and those which are not. To do this requires a certain delay in action in order that plans may be matured. The individual who can not be happy unless he is at work at full power all the time is much less likely to accomplish successful scientific work than he who will not commence a research until he has satisfied himself that it is worth doing. It is not to be denied that this essential qualification of scientific life is frequently regarded with scorn by the busy practitioner of medicine who gives himself no time either for thought or discovery."

<sup>1</sup> *Science* (2) 48, 634 (1918).

The ordinary man, in trying to describe his experiences, usually speaks of a subconscious self or a subliminal self; but both of these terms are anathema to the psychologists, partly because these latter mean something different by these terms from what other scientific men mean. Jastrow<sup>1</sup> furnishes a striking instance of this.

“While confining the exposition to what is offered as the most convincing interpretation, it is well to appreciate the attitude of a differently derived and maintained survey. An opposite theory has framed its conception upon a fundamental emphasis of the schism of conflicting personalities, and upon the exceptional nature of allied phenomena. To account for these, it supposes the existence in the mental constitution from the outset and in all its phases, of a factor wholly different from any here recognized, a pervasive influence in the psychic organism that only in exceptional circumstances becomes articulate, and is thus hampered in its expression, because until released from the thrall of ordinary consciousness, it cannot throw off its enforced silence. It awaits the rare conjunction of circumstances and temperament, and then shoots forth in spontaneous perfection. It reaches independent expression in the emergence of a new personality, in the exaltations of trance, in the superior susceptibilities of hypnosis, in the inspirations of genius, in the peculiar endowments of gifted souls. The issue may be most tangibly presented when applied to the interpretation of the calculating prodigies, whose performances certainly exhibit a more than ordinary development of some type of subconscious facility. In giving name to the theory in question, let it be the designation in common use among its adherents: that of the subliminal self. It admits that a decided proficiency in rapid calculation may be developed upon the

<sup>1</sup> “The Subconscious,” 532, 537 (1906).



basis of intensive cultivation and natural talent, and that performance so achieved may indeed be notable; but it regards certain of these performances as not thus applicable, but as evidence of a wholly different mode of procedure. It points out that the performers are often boys of no high order of general intelligence, whose own accounts of their training and methods contain no adequate basis for such extreme facility, and who, indeed, regard themselves as the receptive instruments of a faculty that is somehow exercised through the agency of their mind, which passively receives the solutions as a revelation.

“While admitting, as applied to our general proficiencies, that much of our intercourse is replete with short-circuiting processes, that our notes of experience are recorded in a mixture of long-hand and short-hand characters, in the interpretation of which we have acquired a facile talent, the view in question none the less holds that in unusual cases, characters appear that are not stenographic records of ordinary experience at all, but are of an independent alphabet, and bear a message removed from the ken of the mind that is ordinarily directive.

“In development of this conception, the theory discovers in hypnosis the exercise of a power by which is thus subliminally revealed knowledge that has no origin in the experiences open to the self that responds to the ordinary vicissitudes of life. It regards hallucinations as of the same status, and attempts to determine their import not from inner analysis, but from the detailed conformity of their content to objective fact, at times in anticipation of the future, at times in overcoming temporal and special limitations. The exalted sensibilities of hysteria are similarly appraised; and alterations of personality become the most explicit expression of a release of the confined subliminal

self, whose experiences, though seemingly trivial and chaotic, and for the most part admittedly decadent, are akin to the recondite sources from which, by a different use of a common privilege, the exceptional man of genius draws his inspiration. The very latitude of this theory makes it hospitable to a wide range of considerations,—many of them supported by questionable data and strained interpretations,—and renders it liable to affiliation with ‘occult’ conceptions of every shade and grade of extravagance. This ‘tumbling ground for whimsies,’ in Professor James’ phrase, there is no obligation to inspect. It is proper to direct attention to the serious shortcomings of the theory of the subliminal self, when most conservatively framed and when applied in the spirit of psychology, not of a plea for the supernatural.

“To begin with it seems difficult to understand how such an independent, and in its essence transcendent capacity could have found maintenance in the evolutionary conditions of our being. To conceive it as an atavistic function that is in its decadence is clearly unnatural, because such functions can hardly be concerned with the economies of elaborated and highly complex service; atavism is survival from below, not a culling from above. It can only be urged that consciousness is itself a lapsed function, adjusted to the present stages of evolution, and has thus replaced a form of psychic energy that existed previous to consciousness, and achieved a perfection of mental efficiency similar, though superior, to that offered by our present form of that privilege; such issue was attained by service of susceptibilities now lost except in sporadic instances. Those who courageously embrace this view relieve themselves of further obligations to provide for subliminal functioning in normal life, and may be driven to this position by the difficulty of finding a place in the evolutionary field for a function of such occasional

service and yet of such high potency and independent status. The feeble support that the conception finds when gauged by evolutionary standards is further disclosed in relation to the higher products of mental evolution. It seems a very mockery of that process to carry the development of the mind as the issue of tortuous and minute steps, laboriously and uncertainly attaining to its present stage of efficiency, and then to have these endowments and achievements outdone by a confined and untutored 'double,' that this same mind has all the while unwittingly nurtured. A complete parallel to such a supposition is not readily found; not wholly unlike it would be the assumption that the eyes were admittedly developed by virtue of their utility as organs of vision, but that somewhere in the bodily economy—say under a fold of the skin—there exists an organ that by a survived potency from primeval days can now, with suppressed experience or service, occasionally convey to the mind, when the eyes are closed or when a saving blindness releases the imprisoned sense, the same type of visions as come through the retina and yet more exalted ones. Until the conception can be better reconciled to evolutionary principles, it is highly improbable that it will find support by appeal to other logical considerations. The theory exposes its further shortcomings by a necessary admission of a different status for that large range of abnormal experience, presenting phenomena wholly parallel to those that it interprets in its own favor, but which are decidedly free from the features that require the assumption of the traits ascribed to the subliminal self. It is the less urgent to enforce these and related objections, for the reason that the theory, being but slightly restrained by exacting allegiance to the large body of normal data and by the systematic obligations thus incurred, has little difficulty in accommodating itself to the

evasion of such objections by yet further complications of like hypothetical nature. The Copernicans were quite ready, when the observed positions of the planets departed from the predictions based upon the supposition of the circular orbit, to 'build, unbuild, contrive,' with 'cycle and epicycle, orb in orb'; the simplicity of the elliptical hypothesis of Kepler not alone did away with the cycles great and small, but rendered such questionable expedients unnecessary."

Even Dr. Morton Prince,<sup>1</sup> who believes in subconscious reasoning, draws the line at a subconscious or subliminal self outside of pathological cases. "Through the conception of the *subconscious* as resolvable, on the one hand, into the *unconscious*, passive or active physiological dispositions, and, on the other hand, into *coactive* conscious states, the subconscious becomes simplified and intelligible. It offers a basis on which may be constructed comprehensible theories of memory, suggestibility, post-hypnotic phenomena, dreams, automatic writing and similar phenomena, artificial hallucinations, the protean phenomena of hysteria, and the psychoneuroses, as well as the mechanism of thought. It enables, as well to construct a rational concept of personality and self. As we shall see, when we take up the study of multiple personality in later lectures, out of the aggregate of the accumulated and varied experience of the past conserved in the unconscious may be constructed a number of different personalities, each depending upon a synthesis and rearrangement of life's neurograms and innate dispositions and instincts. All dormant ideas with their feelings, tones and conative tendencies belong to our personality, but they may be arranged with varying instincts and innate dispositions into a number of differentiated systems, each synthesized into a corresponding personality. In the unconscious may be

<sup>1</sup>"The Unconscious," 255 (1921).

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conserved a vast number of life's experiences ranging in time almost from the cradle to the grave. The hopes, the wishes, the anxieties of childhood may still be there, lying fallow, but capable of injecting themselves under favoring conditions into our personalities. Properly speaking, from this point of view, aside from certain artificial and pathological conditions, there is, *normally*, no distinct 'subconscious *self*,' or 'subliminal *self*,' or 'secondary *self*,' or 'hidden *self*.' In artificial and pathological conditions there may be, as has been frequently shown, a splitting of consciousness and the aggregation into a secondary coconscious system of large systems of ideas which have all the characteristics of personality. This secondary personality (of which the primary personality is not aware) may have its own memories, feelings, perceptions, and thoughts. It may appropriate to itself various complexes of neurograms deposited by the experiences of life which are not at the disposal of the principal personality. Such a coconscious system may properly be spoken of as a subconscious *self*. But there is no evidence that, *normally*, such systems exist. All that we are entitled to affirm is that every individual's consciousness may include ideas of which he is not aware, and that he has at his disposal, to a greater or less extent, a large unconscious storehouse in which are neurographically conserved a large and varied mass of life's experiences. These experiences may be arranged in systems, as we shall see in the next lecture, but they do not constitute a 'self.' To speak of them as a subconscious, subliminal, secondary, or hidden self is to construct concepts which are allegories, metaphors, symbolisms, personifications of concrete phenomena. Their use tends to fallacious reasoning and to perverted inductions from the facts. Becoming major premises in a syllogism they lead to erroneous interpretations of the simplest facts, just as fixed ideas

or obsessions tend to a perverted interpretation of the environment."

Münsterberg says that "there is no subconscious." Titchener<sup>1</sup> says that "if we refuse to explain mind by body, we must accept the one of the two, equally unsatisfactory, alternatives: we must either rest content with a simple description of mental experience, or must invent an unconscious mind to give coherence and continuity to the conscious. Both courses have been tried. But, if we take the first, we never arrive at a science of psychology; and if we take the second, we voluntarily leave the sphere of fact for the sphere of fiction."

Woodworth<sup>2</sup> considers the question of the apparently unconscious solving of problems. "But now for the real 'subconscious mind.' You try to recall a familiar name, but are stuck; you drop the matter, and 'let your subconscious mind work'; and, sure enough, after a few minutes you have the name. Or, you are all tangled up in a difficult problem; you let the subconscious mind work on it overnight, and next morning it is perfectly clear. Just here it is that psychology begins to take issue with the popular idea. The popular interpretation is that work has been done on the problem during the interval when it was out of consciousness—unconscious mental work of a high order. But is it necessary to suppose that any work has been done on the problem during the interval? The difficulty, when you first attacked the problem, arose from false clues which, once they got you, held you by virtue of their 'recency value.' The matter laid aside, these false clues lost their recency value with lapse of time, so that when you took the matter up again you were free from their interference and had a good chance to go straight towards the goal."

<sup>1</sup> "A Text-Book of Psychology," I, 40 (1909).

<sup>2</sup> "Psychology," 563 (1921).

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This is an ingenious explanation of what might have happened; but, so far as I am concerned, it is in no sense a statement of what does happen.

Gault and Howard<sup>1</sup> object to certain specific uses of terms in regard to unconscious processes. "The psycho-analysts are responsible for having injected several new terms into the vocabulary of the psychologists '*subconscious mind*'; '*subconscious*'; '*subconscious experience*'; '*the unconscious*.' These terms have been repugnant to psychologists of the most conservative sort—and naturally so. For them psychology has to do with consciousness; with conscious processes and nothing more. The unconscious is outside of their realm and '*subconscious mind*' and '*subconscious experience*' are contradictory in themselves. These last terms have all but simmered [?] out of existence over the heat of discussion pro and con; but the unconscious, in spite of philosophy and history, bids fair to prove non-volatile and to hold for itself a respectable place in the language of psychologists.

"The word has broad and varied connotations. Many nerve impulses do not arouse conscious processes for the reason that they do not reach the cortex; and yet they affect our behavior most usefully. . . . Many a student has gone to bed and fallen asleep after having vainly attempted to solve a mathematical problem, and has awakened in the morning with the solution all in order. Something had gone on in the meantime, albeit unconsciously. It was an unconscious process."

Troland<sup>2</sup> is not quite as pessimistic as some of the other psychologists, though he is not really very helpful. "Notwithstanding continued adversity, we need not abandon all

<sup>1</sup>"Outline of General Psychology," 407 (1925).

<sup>2</sup>"The Mystery of Mind," 26, 229 (1926).

hope of finding an intelligible conception of the mind as an agency underlying consciousness. We have still to examine a popular alternative of the *unconscious*, namely the 'subconscious' mind. As the term suggests, the 'subconscious' is conceived as a true form of consciousness, which is nevertheless removed from the ordinary awareness of the individual, lying psychically 'under' the normal consciousness. The subconscious, in this sense, may possess any or all of the properties of the conscious realm, except continuity or unity with the latter. Just as my consciousness is separated from yours without either being *unconscious* or necessarily different in kind, so my subconscious may be cut off from my own consciousness and still be of the same general nature as the latter. Just as your consciousness may influence mine, so in even greater measure can my subconscious control the events in my conscious field.

"Here at last we have discovered a conception of mind which is truly intelligible. Although our idea of the 'subconscious mind' may be somewhat vague, it is nevertheless far from being a blank word like 'soul' or 'will.' However, we are not yet out of the woods. We know what we *mean* by the subconscious, but have we any proof that such a thing actually exists? Some psychologists feel very confident as to the reality of the subconscious, but others deny it without reservation. Nearly all would admit that the subconscious is an hypothesis rather than a fact; its existence cannot as yet be proven, but can only be rendered probable through its capacity to explain the actual facts. Accordingly if we identify the self with the subconscious we leave it as a problem whether the self really exists. That would be a rather unsatisfactory termination for our search."

"In its most significant aspect, consciousness corresponds to the *recording point* in the brain. It represents the 'moving



finger' which writes upon the cortical surface. The central brain activity is a formative process. What it writes is determined to some degree by what has already been written at the place where the record is being made. We thus conceive of the central activity as wandering about over the association area, always leaving its impress behind it. The residual activities which continue on the basis of these impressions correspond with the subconscious mind. The wandering focus of activity corresponds with consciousness. The central activity very frequently retraces its movements or walks in some of its own footprints, thus bringing the material of the subconscious into consciousness, and combining the memory influence with that of the present forces of sensation.

"This view leads us to regard the subconscious on the one hand as the *product of consciousness*, and on the other hand as a vast *storehouse of materials* for the latter. Having once discovered these functions of the subconscious, we can substitute the latter for the brain in our explanations. Thus instead of explaining habit in terms of synaptic resistance, we can account for it in terms of some 'subconscious tendency.' Complexes regarded as nerve mechanisms will give way to emotional ideas, or the like, regarded as facts of the subconscious. The physiology of the cortex is to a large extent eliminated. This does not mean that we deny the existence of the cortical structures and activities, but only that we can get along without referring to them. Freud's account of his famous theory is given primarily in terms of a sentient subconscious rather than in terms of brain mechanisms."

This is one of the many cases in which the all-important thing is to know the special terms in vogue. While it is very bad form to speak of the subconscious or subliminal self, it

is possible to convey the same ideas, without giving offense, by speaking<sup>1</sup> of being outside the margin of consciousness. To speak of the subliminal self is unpardonable. To speak of subconscious thinking is unwise. To speak of supra-marginal consciousness is to put oneself well out ahead of the procession.

“When speaking colloquially of the content of consciousness we have in mind those ideas of components of ideas—elements of thought—which are in the focus of attention, and therefore that of which we are more or less vividly aware. If you were asked to state what was in your mind at a given moment it is the vivid elements, upon which your attention was focused, that you would describe. But, as everyone knows, these do not constitute the whole field of consciousness at any given moment. Besides these there is in the background of the mind, outside of the focus, *a conscious margin or fringe of varying extent (consisting of sensations, perceptions, and even thoughts)* of which you are only dimly aware. It is a sort of twilight zone in which the contents are so slightly illuminated by awareness as to be scarcely recognizable. The contents of this zone are readily forgotten owing to their having been outside the focus of attention; but much can be recalled if an effort to do so (retrospection) is made immediately after any given moment’s experience. Much can only be recalled by the use of the special technical methods of investigation. I believe that the more thoroughly this wonderful region is explored the richer it will be found to be in conscious elements.

“It must not be thought that, because we are only dimly aware of the contents of this twilight zone, therefore the individual elements lack definiteness and positive reality. To do so is to confuse the awareness of a certain something

<sup>1</sup>Morton Prince: “The Unconscious,” 340 (1921).

with that something itself. To so think would be like thinking that, because we do not distinctly recognize objects in the darkness, therefore they are but shadowy forms without substance. When, in states of abstraction or hypnosis, the ideas of this fringe of attention are recalled, as often is easily done, they are remembered as *very definite, real, conscious elements*, and the memory of them is as vivid as that of most thoughts. That these marginal ideas are not 'vivid' at the time of their occurrence means simply that they are not in such dynamic relations with the whole content of consciousness as to be the focus of awareness or attention. What sort of relations are requisite for 'awareness' is an unsolved problem. It seems to be a matter not only of synthesis but of dynamic relations within the synthesis."

"Some of these elements may be so distinctly within the field of awareness that we are conscious of them, but dimly so.<sup>1</sup> Others, in particular cases at least, may be so far outside and hidden in the twilight obscurity that the subject is not even dimly aware of them. In more technical parlance, we may say, they are so far dissociated that they belong to *an ultra-marginal zone and are really subconscious*. Evidence of their having been present can only be obtained through memories recovered in hypnosis, abstraction, and by other methods. These may be properly termed coconscious. Undoubtedly the degree of awareness for marginal elements, i.e., the degree of dissociation between the elements of the content of consciousness, varies at different moments in the same individual according to the degree of concentration of attention and the character of the fixation, e.g., whether upon the environment or upon inner thoughts. It also varies much in different individuals. Therefore some persons lend

<sup>1</sup>It is very doubtful whether vivid awareness is a matter of intensity because, among other reasons, subconscious ideas of which the individual is entirely unaware and elements in the fringe may have decided intensity.

themselves as more favorable subjects for the detection of marginal and ultramarginal states than others. Furthermore, according to certain evidence at hand, there is, in some persons at least, a constant shifting of interchange of elements going on between the field of attention and the marginal and the ultra-marginal zone—what is within the first at one moment is in the second, or is entirely subconscious, the next, and *vice versa*.”

“If all that I have said is true, it follows that the *whole content or field of consciousness at any given moment includes not only considerably more than that which is within the field of attention but more than is within the field of awareness*. The field of conscious states as a whole comprises the focus of attention plus the marginal fringe; and besides this there may be a true subconscious ultramarginal field comprising conscious states of which the personal consciousness is not even dimly aware.”

Platt<sup>1</sup> is another man who delights in the term, margin. “It is that at any time we are using but a small portion of our available brain patterns. Only a small part of our mental store can be before us at any one moment of our existence. It is as with our eye vision, we see clearly only that upon which we focus. From this central point vision fades toward the margin where lie but the vaguest suggestions of sight, and here, at the margin, it finally ends. Beyond the margin, however, there lies, we know, a vast world not now seen at all, but which, piecemeal, can be brought into vision by changing the direction of our gaze. In our mental field, likewise, we see only that upon which we focus, that to which we give our attention. Beyond this appreciated field of our present consciousness lies the vastly greater field of unconsciousness, the field of the uncon-

<sup>1</sup>“The Psychology of Thought and Feeling,” 157 (1921).

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scious mind, where lie all the hundreds of thousands of experiences, brain patterns, and emotional potentialities which constitute our inheritance and our experience in life. 'There are secret and individual parts in the nature of men, and mute conditions without show, sometimes unknown of their very possessors.'<sup>1</sup>

"But let us go a step further—our unseen world is not a dead world awaiting our regard before it awakens. It is with the mentally unseen world of the subconscious mind as it is with the vast world unseen by our eyes. This subconscious, unconscious mind of ours is by no means the quiet storehouse it was once assumed to be—deep down in the unconscious mind things happen. It is a storehouse, it is true, but not one of mere inactive waiting. There is going on in the unconscious mind, though possibly in modified form, the very same processes that are known to our consciousness. An unconscious cerebration is there taking place, a modified activity corresponding in kind to that we have already studied. We store away experiences, but these do not necessarily, nor generally, remain isolated; they may, under certain conditions, form unconscious associations and undergo change, and when again brought to consciousness may be altered beyond recognition. To the old orthodox attitude the above is absurd. In the old conception, with soul-controlled thought, the unconscious is simply something which is not. The poets and philosophers knew better. To them the unconscious has always been very real indeed, and so it is to the psychologist of today. The unconscious, it is believed, differs from the conscious merely in not being in focus, and in being incomparably greater and richer.

"We must add one concept more, namely this: that from the unconscious excursions take place into the conscious and

<sup>1</sup> Montaigne.

have an effect on our conscious lives—that there is, in fact, a two-way connection between the conscious and the unconscious, a connection by no means always under the control of the will. Take a very simple example of this. You are seeking a name; you can not recall it; you finally abandon the quest and turn to something else. Suddenly the name comes to you—bobs up, as it were, from the unconscious into the conscious. While *you* were thinking of something else, the original mental process was contained in the unconscious, and there finally found the pattern sought. Or, more elaborately, we are striving to solve a problem, and can not, and give it up, and go to bed—and then wake in the morning with the answer clearly before us.<sup>1</sup>

“Does not this unconscious cerebration, which, it would seem, must be accepted, endorse the description of thought given earlier? Our picture then was of a nerve force, the neurokyme, which once set in action flowed here and there until it found the brain pattern which would solve the problem presented.

“The fact that the unconscious sometimes succeeds better than our conscious effort is explainable, probably, by the presence in the latter of a wilful control which may be mistaken. Our conscious effort may be in the wrong direction, but we, nevertheless, obstinately hold to the path on which we have started. For example; we are trying to recall the name of a man, and we feel sure that it begins with a *B*; so we keep harping on Brown, and Baker, and Bissel, and Black—hanging on to the *B* idea at all costs. But when we finally give over the search, the *B* idea gets dropped also,

<sup>1</sup>“We sleep, but the loom of life never stops; and the pattern which was weaving when the sun went down is weaving when it comes up tomorrow.” This from Henry Ward Beecher! Though we must acknowledge that what he had in mind was quite other than the psycho-physiological phenomenon we are considering.

and the subconscious, left to work it out by itself, finally finds what we want—the man's name was Adams. We remember now that we met him in Boston, and this is, of course, where the *B* idea came from.

“There are examples of simple unconscious cerebration and of recovery from the unconscious of facts lying, as it were, just beneath the surface. But this subconscious, unconscious region contains many, many other things than these temporarily laid aside items. In the unconscious lie all the memories, impressions, and experiences of life; events of our childhood, things near, and far past; things we have put away until needed; things we have tried to forget, and things we have forgotten. Here, too, are things we do not know and may never know we possess—passing impressions which may never have registered in the conscious mind, but which were, nevertheless, duly registered in the unconscious. Here, too, are our inheritances, our innate dispositions, our tendencies; some of them recognized by us at times; and some of them still but potentialities, their patterns never yet having been used, they never yet having received the stimulus necessary to set them in action. These last, we shall find, are important, for whether chance ever discovers them or not, they are there, and do surely affect, albeit unconsciously, our thoughts and our actions. Furthermore, being unsuspected, their control is neither sought nor obtained.

“We have reached now to a conception of a vast region of unconscious cerebration, from which arise impulses and influences which, whether they actually come to consciousness or not, do, still, profoundly affect our conscious lives. From this seething underworld of thought come many of the inhibitions, or *stops*, which obstruct our conscious acceptances, and from it, too, come many of our calls to action. We are influenced we know not, consciously, how nor why;

and we wonder at ourselves—it is the unconscious that is pulling!

“This conception of the unconscious is not new, it is only the precise statement of it which is new. The poets have known it for ages, it is in this their truth lies; and the philosophers, with poetical minds, the only true philosophers, have endeavoured to express it in words.”

Seashore<sup>1</sup> also falls into line as soon as the word marginal is mentioned. “One of the most debatable issues in psychology pertains to the nature of this receding, marginal consciousness and what lies beyond, usually spoken of as the subconscious or unconscious. The idea of the subconscious has been a term to conjure with on the part of all kinds of mystery mongers in alleged psychology. For this there are several reasons. It is a field which has not yet been organized by systematic experiments in the laboratory, and, therefore, its full significance has not been grasped and it has not been adequately formulated in scientific psychology. It is not readily approached through direct introspection. It manifests itself most conspicuously in abnormal and pathological cases. It is by its very nature mysterious in that it often seems to function as a consciousness outside of the personal consciousness. In legitimate psychology it has furnished a most satisfactory explanation of the strange, the weird, and the apparently supernormal, as in hypnosis, alternating personality, and all forms of automatisms and is, therefore, resorted to by the ignorant and uncritical as a cover for anything which is mysterious to them. This, in turn, has made it an easy victim for identification with all sorts of uncritical, semi-religious, pseudo-philosophical and quasi-scientific theories as to its ultimate nature.”

“There is a great diversity of opinion among psycholo-

<sup>1</sup>“Introduction to Psychology,” 192, 194, 375 (1923).



gists on this subject, but, throughout this book, we are proceeding on the theory that the subconscious represents those processes which are outside of the focus of our attention to processes as related to the waking self. We regard the subconscious as an extension of consciousness, the distinction between conscious and subconscious being merely that we call those mental processes 'conscious' which we are aware of experiencing at the time of the experience in the waking state, and all other mental phenomena subconscious. As in the illustration of the landscape above, there is no sharp line between the focal region in which distinct features or objects are observed in turn and the vast region beyond this in which features are massed.

"The term 'subconscious' seems to involve a contradiction. There is a tendency to identify conscious and mental; the subconscious would, therefore, imply something under the mental, not mental. This difficulty, however, rests mainly upon a poverty in words. According to our view, the subconscious is mental and it is the same kind as the conscious, the mental being divided into the conscious and the subconscious. It is merely remote in a part of the waking system of self-awareness. The subconscious may be clear, discriminating, and organized around a remote personal nucleus, just as the conscious is. In the analogy of the painting, one's observation may center about any feature, however trifling, to such an extent as to result in utter obliviousness to both self and painting as such. Our theory denies the assumption that ideas and impressions are stored, as implied in one group of theories; it disavows any metaphysical assumption in regard to the subliminal as a form of ultimate reality; it takes a broader view than the theory which regards the subconscious as a split-off fragment; it recognizes the adequacy of the physiological account of all neural processes underlying mentality; it recognizes the vastness of the sub-

conscious element associated with our ordinary conscious life; it draws no sharp lines between the conscious and the subconscious; and does not attempt to determine the limit of mentality.

"The dream is a perfect example of the subconscious mental process, in that it is dissociated from the working consciousness of self to the extent that the dreamer is not aware of himself as dreaming and cannot control his dreams."

Jastrow is really campaigning against the subconscious or subliminal self and his book<sup>1</sup> contains many helpful things, though he apparently does not see the bearing of them as I do.

"Unusual activities of the subconscious will, in the main, occur only in unusual mental constitutions; normally, the emergence of a fairly independent piece of subconscious functioning depends upon a moderate variation from the standard illumination of conscious attention,—just the darkening of a passing cloud; abnormally, in favorable cases, the measure of its independence is decidedly emphasized and its more notable and impressive performances made possible. Yet throughout, the phenomena present consistent relations; the several factors that determine the result vary constantly and puzzlingly, and none more so than the individual temperament, the dominant integer<sup>2</sup> in the personal equation."

<sup>1</sup> Jastrow: "The Subconscious," 62, 68, 95, 99, 159, 449 (1906).

<sup>2</sup> In this respect the mental states of children are interesting. Children enter into their occupations with a decided intentness and an emotional vivacity that bury them deep in the reality of their play; and they are likewise free from any considerable range of acknowledged claims to their attention. They accordingly furnish favorable opportunities for subconscious activity. At the same time the relative feebleness of their attention and the weakness of their habits militate against any very promising field for the exhibition of such subconscious traits. In actual observation the effect of both these tendencies may be readily observed. Children, if undisturbed, become absorbed in play and are most oblivious of what is going on about them, giving themselves singly and intensely to their play-fancies, forgetting their troubles, and occasionally falling into amusing lapses that exhibit the subconscious activities in formation. On the other hand, they weary quickly, require constant change of occupation, and welcome distraction if it is offered.

Jastrow quotes with approval the statement by Galton that "there seems to be a presence-chamber in my mind where full consciousness holds court, and where two or three ideas are at the same time in audience, and an antechamber full of more or less allied ideas, which is situated just beyond the full ken of consciousness. Out of this antechamber the ideas most nearly allied to those in the presence-chamber appear to be summoned in a mechanically logical way, and to have their turn of audience. . . . The exclusion of alien ideas is accompanied by a sense of effort. . . . The character of this effort seems to me chiefly to lie in bringing the contents of the antechamber more nearly within the ken of consciousness which then takes more comprehensive note of all its contents, and compels the logical faculty to test them *seriatim* before selecting the fittest for a summons to the presence-chamber." And further: "The thronging of the antechamber is, I am convinced, altogether beyond my control; if the ideas do not appear, I cannot create them, nor compel them to come.

"All this points to the fact that the large stores of accumulated learning which we carry in our heads lie in part near the focus of interest that occupies our immediate attention, in greater part lie in ever widening areas—all permeated by an intricate network of highways and byways along which the goods of our mind come floating. What Mr. Leland remarks of the work of genius is measurably true for the favored periods of all workers, namely, that 'it sweeps along, as it were, in a current, albeit it has enough reason left to also use the rudder and oars, or spread and manage a sail'; and though it is obvious that we cannot create the wind that brings the ship to port, we can guide the rudder and show our skill in using what breeze may come. Such a conception does not deceive itself that it explains what in

fact it only describes; but it places the emphasis at the proper point, and avoids error by assimilating the unusual to the usual; it prevents the cherishing of false theories by shunning the assumption of marvels, and by extending the marvel of the commonplace. In every step of thought there is the unaccountable something, the hidden and individual motive power that supplies the energy; 'in the case of small steps, even the heavy and clumsy thinker feels sure that he does not trip; with greater leaps, however, the danger of stumbling increases, and only the dexterous and nimble attempt them with advantage.'<sup>1</sup> Though in time the flights may seem longer and more daring, and the contact with the earthly realities of consciousness may become so occasional and incidental as to create the feelings not of steps at all but of mysterious flight through the air, we may be assured that the feeling has no other than a subjective basis. The enthusiastic prophet of the Unconscious may tell us that 'the discursive and deductive method is only the lame walking on stilts of conscious logic, whilst rational intuition is the Pegasus flight of the Unconscious, which carries in a moment from earth to heaven'; yet the psychological observer cannot fail to notice the long periods of training and accumulation of experience that prepare the way for the marvelous performances of the expert. Admittedly in the end, the individual endowment remains the unaccountable factor in the problem; and most of us would make a poor showing with the seven-leagued boots of genius, were they suddenly to be placed at our disposal."

"There exists in all intellectual endeavor a period of incubation, a process in great part subconscious, a slow, concealed maturing through absorption of suitable pabulum. Schopenhauer calls it 'unconscious rumination,' a chewing

<sup>1</sup>Hartmann.

over and over again of the cud of thought preparatory to its assimilation with our mental tissue; another speaks of it as the red glow that precedes the white heat. The thesis implied by such terms has two aspects: first, that the process of assimilation may take place with suppressed consciousness; second, that the larger part of the influences that in the end determine our mental growth may be effective without direct exposure to the searching light of conscious life. Both principles enforce the view that we develop by living in an atmosphere congenial to the occupation that we seek to make our own; by steeping ourselves in the details of the business that is to be our specialty, until the judgment is trained, the assimilation sensitized, the perspective of importance for the special purpose well established, the keenness for useful improvisation brought to an edge. When asked how he came to discover the law of gravitation, Newton is reported to have answered, 'By thinking about it.'

"The scientific spirit—the most finished expression of conscious activity—finds its saving balance in the impressible imagination—the richest quarry of the subconscious. In all character, as in all achievement, there are talents more efficient than those consciously exercised, powers deeper than those we wittingly command, that enable us to do better than we know how. This recognition has ever been present in the conception of genius, picturing its incomprehensibility as an unquestioning response to an inspiration, as a surrender to the natural forces that seethe within, though reënforced by experience; as in its labors indifferent to means, oblivious to the why and wherefore, but firmly possessed with the imperative importance of its message, and leaving lowlier tasks to lesser minds that are constrained with painful deliberation to marshal in simple order the

limited resources at their command. In this appraisalment of the constituents of character, of the service of ideals in shaping culture, as of the quality of talents that further mental achievement, do the traditional wisdom of the ages and the analyses of psychology find common issue."

"Conscious utilization of subconsciously elaborated data remains the normal formula of thought. We label the product conscious when the drafts upon the reservoir are frequent and overt; we call them subconscious when fewer and elusive; but we hold the term peculiarly pertinent when the issue conforms more to purpose and interest than to mere capricious revery."

Dr. Morton Prince's experience with multiple personalities lead him to emphasize the phenomenon of coconsciousness; but except for that, his point of view<sup>1</sup> is distinctly less like that of the psychologist and more like that of other scientific men.

"In what I have said thus far I have had another purpose in view than that of a mere exposition of the psychophysiological theory of memory. This other and chief purpose has been to lay the foundation for a conception of the *Unconscious* in its larger aspect. We have seen that thoughts and other conscious experiences that have passed out of mind may be and to an enormous extent are conserved and, from this point of view, may be properly regarded as simply *dormant*. Further we have seen that all the data collected by experimental pathology and other observations lead to the conclusion that conservation is effected in the form of neurographic residua or brain neurograms—organized physiological records of passing mental experiences of all sorts and kinds. We have seen that these neurographic records conserve not only our educational acquisitions and general

<sup>1</sup>Prince: "The Unconscious," 147, 150, 156, 159, 171, 212, 226, 245 (1921).

stock of knowledge—all those experiences which we remember—but a vast number of others which we cannot spontaneously recall, including, it may be, many which date back to early childhood, and many which we have deliberately repressed, put out of mind and intentionally forgotten. We have also seen that it is not only these mental experiences which occupied the focus of our attention that leave their counterpart in neurograms, but those as well of which we are only partially aware—absent-minded thoughts and acts and sensations and perceptions which never entered our awareness at all—subconscious or coconscious ideas as they are called. Finally, we have seen that the mental experiences of every state, normal, artificial, or pathological, whatever may be the state of the personal consciousness, are subject to the same principle of conservation. In this way, in the course of any one's natural life, an enormous field of neurograms is formed representing ideas which far transcend in multitude and variety those of the personal consciousness at any given moment and all moments, and which are far beyond the voluntary beck and call of the personal consciousness of the individual.

“Neurograms are concepts and, by the meaning of the concept, they are unconscious. It is not necessary to enter into the question whether they are in their ultimate nature psychical or physical. That is a philosophical question. They are at any rate unconscious in this sense; they are devoid of consciousness, i.e., have none of the psychological attributes of any of the elements of consciousness, and in the sense in which any physiological arrangement or process is not conscious, i.e., is unconscious. We have here, then, in the concept of brain residual neurograms the fundamental meaning of the *Unconscious*. *The unconscious is the great storehouse of neurograms which are the physiological records of our*

*mental lives.* By the terms of the concept neurograms are primarily passive—the potential form, as it were, in which psychical energy is stored. This is not to say, however, that, from moment to moment, certain ones out of the great mass may not become active processes. On the contrary, according to the theory of memory, when certain complexes of neurograms are stimulated they take on activity and function—the potential energy becomes converted into dynamic energy. In correlation with the functioning of such neurographic complexes, the complexes of ideas which they conserve—the psychological equivalents—are reproduced (according to the doctrines of monism and parallelism) and enter the stream of the personal consciousness. The unconscious becomes the conscious (monism), or provided with correlated conscious accompaniments (parallelism), and we may speak of the ideas arising out of the unconscious.

“Here two important questions present themselves. It is a necessary consequence that when unconscious neurograms become active processes psychological equivalents must be awakened; and when they are awakened, must they *necessarily* enter the stream of the personal consciousness? If both these questions may be answered in the negative, *then plainly in either case such active processes become by definition subconscious processes*—of an unconscious nature in the one case and of a coconscious nature in the other. They would be subconscious because in the first place they would occur outside of consciousness and there is no awareness of them, and in the second place they would be a dissociated second train of processes distinct from those engaged in the conscious stream of the moment. Theoretically such subconscious processes, whether unconscious or coconscious, might perform a variety of functions according to the specificity of their activities.



“Now, in preceding lectures, when marshalling the evidence for conservation, we met with a large number and variety of phenomena (automatic writing, hallucinations, post-hypnotic phenomena, dreams, ‘unconscious’ solution of problems, etc.), which clearly demonstrated that memory might be manifested by processes of which the individual was unaware and which were outside the content of consciousness. Hence these phenomena presented very clear evidence of the occurrence of processes that may be properly termed subconscious. Attention, however, was primarily directed to them only so far as they offered evidence of conservation and of the mode by which conservation was effected. But necessarily these evidences were subconscious manifestations of forgotten experiences (memory), and in so far as this was the case we saw that unconscious neurograms can take on activity and function subconsciously; i.e., without their psychological equivalents (i.e., correlated conscious memory) entering the stream of the personal consciousness. We may now speak of these processes as subconscious memory. But when their manifestations are carefully scrutinized they will be found to exhibit more than memory. They may, for instance, exhibit logical elaboration of the original experiences, and what corresponds to fabrication, reasoning, volition, and affectivity. *Theoretically* this is what we should expect if any of the conserved residual experiences of life can function subconsciously. As life’s experiences include fears, doubts, scruples, wishes, affections, resentments, and numerous other affective states, innate dispositions, and instincts, the subconscious memory process necessarily may include any of these affective complexes of ideas and tendencies. An affective complex means an idea (or ideas) linked to one or more emotions and feelings. In other words, any acquired residua drawn from the general

storehouse of life's experiences may be systematized with feelings and emotions, the innate dispositions and instincts of the organism. Now it is a general psychological law that such affective states tend by the force of their conative impulses to carry the specific ideas with which they are systematized to fulfillment through mental and bodily behavior. Consequently, theoretically, it might thus well be that the residua of diverse experiences, say a fear or a wish, by the force of such impulses might become activated into very specific subconscious processes with very specific tendencies expressing themselves in very specific ways, producing very specific and diverse phenomena. Thus memory would be but one of the manifestations of subconscious processes.

“Now, as a matter of fact, there are a large number of phenomena which not only justify the postulation of subconscious processes but also the inference that such processes, activated by their affective impulses, may so influence conscious thought that the latter is modified in various ways; that it may be determined in this or that direction, inhibited, interrupted, distorted, made insistent, and given pathological traits. There is also a large variety of bodily phenomena which can be explicitly shown to be due to subconscious processes, and many which are only explicable by such a mechanism. Indeed, a subconscious process may become very complex and constellated with any one or many of the psychological mechanisms of the organism. In special artificial and pathological conditions where such processes reach their highest development, as manifested through their phenomena, they may exhibit that which when consciously performed is understood to be *intelligence*, comprising reasoning, constructive imagination, volition, and feeling; in short, what is commonly called thought or mental processes. Memory, of course, enters as an intrinsic element in these

manifestations just as it is an intrinsic element in all thought. The automatic script that describes the memories of a long-forgotten childhood experience may at the same time reason, indulge in jests, rhyme, express cognition and understanding of questions—indeed (if put to the test), might not only pass a Binet-Simon examination for intelligence, but take a high rank in a Civil Service examination. In these more elaborate exhibitions of subconscious intelligence it is obvious that there is an exuberant efflorescence of the residua deposited in many unconscious fields by life's experiences and synthesized into a *subconscious functioning system*."

*"A subconscious process may be provisionally defined as one of which the personality is unaware, which, therefore, is outside the personal consciousness, and which is a factor in the determination of conscious and bodily phenomena, or produces effects analogous to those which might be directly or indirectly induced by consciousness.* It would be out of the question at this time to enter into an exposition of the larger subject—the multiform phenomena of the subconscious, but as its processes are fundamental to an understanding of many phenomena with which we shall have to deal, we should have a clear understanding of the grounds on which such processes are postulated as specific, concrete occurrences. The classical demonstration of subconscious occurrences makes use of certain phenomena of hysteria, particularly those of subconscious personalities and artificial 'automatic' phenomena like automatic writing. The epoch-making researches of Janet<sup>1</sup> on hysterics and almost coincidentally with him of Edmund Gurney on hypnotics very clearly established the fact that these phenomena are the

<sup>1</sup>Pierre Janet: "L'automatisme psychologique" (1889), and numerous other works.

manifestations of *dissociated* processes outside of and independent of the personal consciousness. Among the phenomena, for example, are motor activities of various kinds such as ordinarily are or may be induced by conscious intelligence. As the individual, owing to anesthesia, may be entirely unaware even that he had performed any such act, the process that performed it must be one that is subconscious."

"A subconscious personality is a condition where complexes of subconscious processes have been constellated into a personal system, manifesting a secondary system of self-consciousness endowed with volition, intelligence, etc. Such a subconscious personality is capable of communicating with the experimenter and describing its own mental processes. It can, after repression of the primary personality, become the sole personality for the time being, and then remember its previous subconscious life, as we all remember our past conscious life, and can give full and explicit information regarding the nature of the subconscious process. By making use of the testimony of a subconscious personality and its various manifestations, we can not only establish the actuality of subconscious processes and their intrinsic nature in these conditions, but by prearrangement with this personality predetermine any particular process we desire and study the modes in which it influences conscious thought and conduct. For instance, we can prescribe a conflict between the subconsciousness and the personal consciousness, between a subconscious wish and a conscious wish, or volition, and observe the resultant mental and physical behavior, which may be inhibition of thought, hallucinations, amnesia, motor phenomena, etc. The possibilities and limitations of subconscious influences can in this way be experimentally studied.

Subconscious personalities, therefore, afford a valuable means<sup>1</sup> for studying the mechanism of the mind.”

“One of these two subjects, while in hypnosis and able to recollect what goes on in the secondary consciousness, thus describes the coconscious process during the *spontaneous* subconscious solution of problems. When a problem on which my waking self is engaged remains unsettled, it is still kept in mind by the secondary consciousness even though put aside by my waking self. My secondary consciousness often helps me to solve problems which my waking consciousness has found difficulty in doing. But it is not my secondary consciousness that accomplishes the final solution itself, but it helps in the following way: Suppose, for instance, I am trying to translate a difficult passage in Virgil. I work at it for some time and am puzzled. Finally, unable to do it, I put it aside, leaving it unsolved. I decide that it is not worth bothering about and so put it out of my mind. But it is a mistake to say you put it *out* of your mind. What you do is, you put it *into* your mind; that is to say you don't put it out of your mind if the problem remains unsolved and unsettled. By putting it *into* your mind I mean that, although the waking consciousness may have put it aside, the problem still remains in the secondary consciousness. In the example I used, the memory of the passage from Virgil would be retained persistently by my secondary consciousness. Then from time to time a whole lot of fragmentary memories and thoughts connected with the passage would arise in this con-

<sup>1</sup>The value of subconscious personalities for this purpose has been overlooked, owing, I suppose, to such conditions being unusual and bizarre, and the assumption that they have little in common with ordinary subconscious processes. But it ought to be obvious that *in principle* it makes little difference whether a subconscious system is constellated into a large self-conscious system called a personality, or whether it is restricted to a system limited to a few particular coconscious ideas. In the former case the possibilities of its interfering with the personal consciousness may be more extended and more influential, that is all.

sciousness. Some of these thoughts, perhaps, would be memories of the rules of grammar, or different meanings of words in the passage, in fact, anything I had read, or thought, or experienced in connection with the problem. These would not be logical, connected thoughts, and they would not solve the problem. My secondary consciousness does not actually do this, i.e., in the example taken, translate the passage. The translation is not effected here. But later when my waking consciousness thinks of the problem again, these fragmentary thoughts of my secondary consciousness arise in my mind, and with this information I complete the translation. The actual translation is put together by my waking consciousness. I am not conscious of the fact that these fragments of knowledge existed previously in my secondary consciousness. I do not remember a problem ever to have been solved by the secondary consciousness. It is always solved by the waking self, although the material for solving it may come from the secondary. When my waking consciousness solves it in this way, the solution seems to come in a miraculous sort of way, sometimes as if it came to me from somewhere else than my own mind. I have sometimes thought, in consequence, that I have solved it in my sleep.

“A series of observations conducted with a fourth subject (O. N.) gave the following results, briefly summarized. (This subject, like the others, is practised in introspection and can differentiate her memories with precision.) She distinguishes ‘two strata’ in her mental processes (an upper and lower). The ‘upper stratum’ consists of the thoughts in the focus of attention. The lower (also called the background of her mind) consists of the perceptions and thoughts which are not in the focus. This stratum, of course, corresponds with what is commonly recognized as the fringe of

consciousness, and, as is usual, when her attention is directed elsewhere she is not aware of it. She can, however, bring this fringe within the field of attention and then she becomes aware of, or rather remembers, its content during the preceding moment. To be able to do this is nothing out of the ordinary, but what is unusual is this: by a trick of abstraction which she has long practised, she can bring the memory of the fringe or stratum into the full light of awareness and then it is discovered that it has been exceedingly rich in thoughts, far richer than ordinary attention would show and a fringe is supposed to be. It is indeed a veritable coconsciousness in which there goes on a secondary stream of thoughts often of an entirely different character and with different affects from those of the upper stratum. It is common for thoughts which she *has resolutely put out of her mind as intolerable or unacceptable, or problems which have not been solved, to continue functioning in the lower stratum without entering awareness*. She can, however, at any time become aware of them by the trick of abstraction referred to, and sometimes they emerge apparently spontaneously and suddenly replace the 'upper stratum.' In hypnosis also the content of the lower stratum can be distinctly recalled.

"Now the point I have been coming to is, the subject has acquired the habit of postponing the decision of many everyday problems and giving them, as a matter of convenience, to this second stratum or fringe to solve. She puts one aside, that is, out of (or *into*) her mind and it goes into this stratum. Then, later, when the time for action comes, she voluntarily goes into abstraction, becomes aware of the subconscious thoughts of the second stratum and, lo and behold! the problem is found to be solved. If a plan of action, all the details are found arranged as if planned 'consciously.' If

asked a moment before what plans had been decided upon and decision reached she would have been obliged in her conscious ignorance to reply, 'I don't know.'

"An analysis of these different observations shows, first, that the post-hypnotic phenomena—calculations (a) and actions (b)—were performed by a subconscious process. Of this there can be no manner of doubt, even if the subsequent hypnotic memories of the process be rejected as untrustworthy. The phenomenon—the answer to the mathematical problem in the one case and the motor acts in the other—is so logically related to the suggestion, and can be predicted with such certainty, that only a causal relation can be admitted.

"Second, in the calculation phenomena the process is clearly of an intellectual character requiring *reasoning* and the coöperation of mathematical *memory*. (Reasoning is more conspicuous when the problem is more complicated, as in the calculation of the number of seconds intervening between say twenty-two minutes past eleven and seventeen minutes past three o'clock.) The phenomenon is the solution of a problem."

"I have suggested that the *subconscious intelligence* may be *comparable to the phenomenon of a coconscious personality*. It is worth noting in this connection that in the case of Miss B. the coconscious personality, Sally, who claimed to be awake while Miss B. was dreaming, also claimed that Miss B. sometimes dreamed about what Sally was thinking of at the moment. In other words, the thoughts of a large systematized coconscious intelligence determined the dream just as these thoughts sometimes emerged into Miss B.'s mind when awake. That a coconscious personality may persist awake while the principal personality is asleep I have been able to demonstrate in another case (B. C. A.). It was



also noted in Dr. Barrows' case of Anna Winsor. Moreover, Sally was shown to be a persistent sane coconsciousness while Miss B. was delirious and also while she was apparently deeply etherized and unconscious. After all it is difficult to distinguish *in principle* the condition of sleep with a persisting coconsciousness from a state of deep hypnotic trance where the subject is apparently unconscious. In this condition, although the waking consciousness has disappeared, there can be shown to be a persisting 'secondary' consciousness which can be communicated with by automatic writing and which later can exhibit memories of occurrences in the environment during the hypnotic trance. (B. C. A.).

"What has been said does not touch, of course, the other mechanisms of the Freudian theory nor the unessential, greatly over-emphasized, theory that the subconscious dream is always a sexual wish. On the contrary, the principle throws a strong, *a priori* doubt upon the correctness of this generalization. It is plainly, however, a matter of fact which might be easily determined by observation were it not for the difficulty of correctly referring clinical phenomena to the correct antecedent experiences as their causal factors. In the last analysis it becomes always a matter of interpretation.

"Consider certain facts of every-day experiment. A novel and difficult question is put up to us for decision. We have, we will say, to decide whether a certain piece of property situated in a growing district of a city shall be sold or held for future development: or a political manager has to decide whether or not to pursue a certain policy to win an election; or the President of the United States has to decide the policy of the government in certain land questions in Alaska. Now each of us would probably say that we could not decide such a question offhand; we would want time for consideration.

If we attempted voluntarily, at the moment the question is put, to recall to mind all the different facts involved, to consider the given question from all aspects, to switch the main facts into their different settings, we would find it an impossible thing to do. We consequently take the matter 'under advisement,' to use the conventional expression. We want time. Now what we apparently, and I think undoubtedly, do is to put the problem *into* our minds and leave it, so to speak, to incubate. Then, from time to time, as we take up the matter for consideration, the various facts involved in the different aspects of the question, and belonging to their different settings, arise to mind. Then we weigh, compare, and estimate the value of these different facts and arrive at a judgment. All happens as if subconscious processes had been at work, as if the problem had been going through a subconscious incubation, switching in this and switching in that set of facts, and presenting them to consciousness, the final selection of the deciding point of view being left to the latter. The subconscious garners from the store-house of past experiences, those which have a bearing on the question and are required for its solution, brings them into consciousness, and then our logical conscious processes form the judgment. The degree to which subconscious processes in this way take part in forming judgments would vary according to the mental habits of the individual, the complexity of the problem, the affectivity and conflicting character of the elements involved. Under this theory we see that there is a deeper psychological basis for the every-day practice of taking 'under advisement' or 'into consideration' a matter, before giving judgment, than would appear on the surface. There is considerable experimental evidence in favor of this theory. In discussing above the subconscious solution of problems I cited certain evidence obtained from the memo-

ries of subjects in hypnosis, for coconscious and unconscious processes taking part in such solutions. I have been able to accumulate evidence of this kind showing the co-operation of processes outside of consciousness in determining the point of view and final judgment of the subject when a matter has been under advisement; particularly when the subject has been disturbed by doubts and scruples. It is plain that in the final analysis any question on which we reserve our judgment is a problem which we put *into* our minds. And, after all, *it is only a question of degree and affectivity between the state of mind which hesitates to decide an impersonal question, like a judicial decision, and one that involves a scruple of conscience.* This state often eventuates in hallucinatory and other phenomena involving subconscious processes. Scruples of conscience, it is true, usually have strong affective elements as constituents, but the former may also have them, particularly when involving personal ambitions, political principles, etc.

“If the subconscious processes which perform a mathematical calculation and other problems, which logically determine the symbolism of a dream, etc., can be correctly interpreted as unconscious, they plainly exhibited a higher order of intelligence than any conscious processes in lower animals, or even some conscious processes of man, like brushing away a fly.”

I am glad to have this opportunity to line up with Dr. Holmes and others. In my own case most of the good ideas come as a kind of inspiration and the unconscious reasoning seems to me rather better than my conscious reasoning. If I could draw oftener on the supra-marginal consciousness, it would be distinctly helpful. Of course the ideas that come in from somewhere deal with problems with which I am also struggling consciously. It does not seem to me necessary

to postulate a second personality or a greatly better mental technique. It might be enough that a wider range of facts was available at a given moment.

I have tried to show you that there is nothing uncommon about this, and that a great many scientific men feel the same way. I do not even know whether I am an extreme case or not. Since this feeling of a supra-marginal consciousness is so strong with many people, how does it happen that the psychologists ignore it so completely and so consistently? A possible explanation has occurred to me.

One day after the war I was talking to four chemists and I made some reference to the subliminal self, not knowing at that time that I should have said supra-marginal consciousness. To three of the men the statement was a mere common-place. The fourth did not understand what I meant and said so. It then appeared that he had never had the feeling of an inspiration, of an idea coming unexpectedly from somewhere to the region of consciousness. He had worked consciously for all his results and we were speaking a language which meant nothing to him. I have wondered, since then, whether psychologists as a class are men who either do no unconscious thinking or whose unconscious thinking never comes suddenly into the field of consciousness. That would explain all the facts; but I do not know whether it is the right explanation. The position taken by the psychologists is that the rest of us are deceiving ourselves. That may be true, but it does not appeal to me as being probable. One does not see why the minds of some psychologists should not work like those of other people; but apparently they do not. So far as I know, there is no urge among color-blind people to become physicists and it is queer that an analogous thing should apparently be characteristic of psychologists. In connection with this, one could

very well use the quotation from John Buchan as a test. I think that that paragraph would strike a responsive chord in a great many people and that to others it would be quite meaningless. Would the majority of the psychologists come quite overwhelmingly in one of these classes? I have also wondered whether perhaps feminine intuition may not be due to the fact that the unconscious reasoning comes into consciousness more often with women than with men.

We know that there are many cases where actions take place without there being normal consciousness.<sup>1</sup> "Of conditions conforming to this status the most familiar is somnambulism. As a modification or accident of sleep, it presents an altered disposition of brain-functioning, whereby a part of the mental machinery is set into action without arousing the rest. The mental condition of the somnambulist is an interesting one, and not so much for what it leads him to do, as for his attitude and sensibilities while thus occupied. He is manifestly not wholly awake; his senses respond to a peculiarly circumscribed range of stimuli, and his actions make no report to that phase of consciousness upon which his waking memory depends. Unmistakable circumstantial proof falls short of completely convincing him that it was he who performed in sleep the versatile achievements that the normal memory so completely repudiates, for the very reason that the sleep-acting self is not the self—not the complete self—that conducts the introspective inquiry.

"The objective evidence is fortunately quite definite. There is in the older literature the record of a sleep-walker whose inquiring friends tested his powers while engaged in his nocturnal excursions. With a restricted type of awareness, he saw and felt and recognized familiar objects, and behaved toward them in routine, partly intelligent fashion.

<sup>1</sup>Jastrow: "The Subconscious," 267 (1906).

If a pipe were placed in his hands, the somnambulist handled it correctly, but could not light it; if it were lighted for him, the pipe went out because he did not inhale properly. He could be induced to sit at a table and go through the actual movements of writing. If given a book, he turned its pages, resting his gaze on each page, but without reading; and he continued in this automatic mimicry if the light were withdrawn. When forcibly aroused, he was shocked to find himself out of bed and in the presence of his friends. Had he awakened of his own accord, he might, with equal suddenness, have come to himself and without memory of his immediate occupation.

“Observations of this general import have been sufficiently verified to establish that the somnambulist is suggestible; that to some extent an appeal to his senses arouses appropriate response; that he, in part, appreciates the felt and seen positions and nature of things; and that his reactions, though automatic, reflect a simply intelligent yet limited adaptation to routine situations. They show further that spontaneously he takes cognizance only of that particular area of sensations and movements that fits in with his self-imposed quest. The somnambulist, bent upon finding a lost object, avoids obstacles, manipulates latches and locks and keys and doors and drawers, finds the proper material in the kitchen for washing dishes or baking a pie, but is insensitive to the happenings about him, does not hear or see the person who, with lighted candle, is approaching to awaken him, and is likely to stumble against any familiar object, and unintelligently to fumble about the knob of the door that, without his knowledge, has been locked to prevent his escape. Thus thwarted in his purpose, he may wander back to bed without awakening; yet a sufficiently violent stimulus breaks through the narrow circle of his contracted

perceptions, and brings him to normal wakefulness. Many a somnambulist who is aware of his failing, and who has found it unavailing to lock the door and to hide the key (the nocturnal consciousness being quite equal both to securing the key and to opening the door), has resorted to the expedient of dropping the key into a basin of cold water, relying upon the shock, when the sleeper's hands were plunged into the water, to awaken him. This group of possibilities and limitations of mental behavior sufficiently establishes the close affiliation of natural somnambulism to other conditions, and especially to hypnosis, and indicates that what they have distinctly in common is the general type of mental disintegration that permits the spontaneous or suggested episode to be enacted without sanction or knowledge of the normally directing stage-manager."

Seashore<sup>1</sup> says that "sleep-walking occurs only in deep sleep. Many apparently fabulous stories of feats in sleep-walking are found true. A college student formed the habit of getting up in sleep, dressing, walking down to the Mississippi River three-quarters of a mile distance, undressing, taking a deliberate and enjoyable swim, dressing, walking back to his room, undressing and retiring, only to wake up in the morning without the slightest inkling of remembrance from the escapade of the night. But when his friends constituted themselves detectives and awakened him suddenly in the act, the whole performance stood out clear to him in his memory. Sleep-walking is dream-action. If a sleep-walker is allowed to return to bed without being awakened, he will have no memory of the dream action in the morning."

I had an interesting experience myself in my freshman year. I was playing on the freshman eleven and we were practising with the varsity. The varsity was not a very good

<sup>1</sup>"Introduction to Psychology," 368 (1923).

team that year and on that day it was particularly bad. The men were missing all sorts of tackles. Finally the full-back, who was a good player, made up his mind that he would down the next man who got through to him and down him hard. For some unknown reason I was the next man and the full-back stood me on my head in a good, workman-like manner. I can remember people telling me that I had better stop playing, which did not appeal to me. I finally convinced people that I was not hurt and the game went on. The next thing that I can remember, I could both see and hear. We were lined up in the middle of the field; but the man in front of me was not the man who had been playing opposite me when I got hurt. He was the regular end who had not been able to get out on time. I got that mysterious thing straightened out without asking any questions. The next time I came to, I could hear but I could not see. I had the football in my hands, though I could not see it, and people were discussing some play. By listening I learned that I had made a fair catch; but that perhaps I had been offside. At that time the ball had to be kicked after a fair catch and I remember wondering how I was going to kick a ball I could not see. That difficulty never arose, because it was ruled that I was offside. The ball was taken away from me and my memories cease until the game was over and we started to walk off the field. I was then able both to see and to hear. We had to go across Holmes field to get to the gymnasium. I remember stepping over the low fence surrounding Jarvis field and the next thing I was going up the steps of Hemenway gymnasium. I had walked across Holmes field in a state of apparent unconsciousness without the people I was with noticing anything abnormal. In fact I was told that I had played better football that afternoon than ever before.

If one admits my account of what happened that after-



noon, there must have been a great deal of mental and physical adjustment which was independent of normal consciousness, and the solving of problems in the supra-marginal consciousness may be another form of the same thing. The psychologist takes the ground that my account of what happened is grossly inaccurate. He believes that I could see and hear all the time; but that there were interesting lapses of memory. This may be true. It is well-known that after an accident there is very often a loss of memory as to events preceding the accident. It does not seem to me that the episode of the ball which I could feel but not see comes within that category. I believe that, as a result of shock, I was in a state somewhat analogous to somnambulism or hypnotism, and that things happened substantially as I have described them. The experiments of Dr. Morton Prince on disintegrated personality do not bear directly upon this; but they do illustrate the general principle that one can have thought and knowledge quite independent of normal consciousness.

Since we cannot at present control our unconscious thinking, it seems to be a matter of accident or fate whether a good idea comes into the field of consciousness. It is that, together with the belief in law, that makes scientific men believe more or less strongly in predestination quite apart from golf. That does not mean that we can sit down and wait, because the ideas do not come to those who do not work. It is on the knees of the gods whether there will be a loose ball in the football field in any particular game; but that accident will not mean a touchdown unless there has been a great deal of preliminary training. Mere natural alertness is not adequate.

When I first came back from Germany over forty-five years ago, I started some work on mass law relations in

systems like benzene, alcohol and water, where there could be two liquid layers. I thought then and still think that it was the best work I was ever likely to do. Nobody else, not even my close personal friends, thought it was any good at all. That was quite natural. I had a fractional exponent for which I could not and cannot now account, and fractional exponents were taboo before the days of the adsorption isotherm. I also ran counter, without explanation, to many of the things that the physical chemists held most sacred in those days. People were interested in variations from the gas laws and from normal molecular weights. Alcohol in benzene was known to be thoroughly abnormal. It still is. It was not reasonable to suppose that addition of water, an associated liquid, could do anything but increase the abnormality of the results and yet benzene, alcohol and water fitted into a simple formula over the whole range of concentrations with an error not to exceed one-tenth of one per cent. The thing was impossible and the most charitable view was that I was deluding myself.

If I could have straightened the thing out at that time, people would probably have cited me as another case of genius manifesting itself early. As it is, I am not cited as a case of genius at all. I reached the point where I did not know what to do next, and we dropped the subject for a quarter of a century or more. Quite recently the clouds lifted and I saw what to do next. We are working on the problem again. Even now I do not see through to the end. If the gods are willing, we shall finish the matter up in a few years. If the fog closes down again, as it may, the problem will be left to some better man to solve.

It is because we realize how much of the results depend upon factors outside our control, that the scientific man does not, as a rule, have a swelled head. The night before we

sailed for Galveston we heard Walter Hampden in King Henry V. After the curtain goes down, the English soldiers sing at night on the field of Agincourt. The scientific man might perhaps word it a little differently; but the sentiment would be the same in the two cases. The soldiers sang the 115th Psalm: "Non nobis, domine, non nobis, sed nomini tuo da gloriam."

WILDER D. BANCROFT.

