

work made upon me. The sturdy intelligence of the pitmen, their determined earnestness, the appreciative and responsive way in which they listened, the downright straightforwardness of their speech, — all these it is impossible fully to express. I am persuaded that in the Northumberland and Durham districts the pitmen are ripe for a scheme that will bring higher education and culture within their reach." The northern population is eager for knowledge, and travels long distances to seek it, in all kinds of weather, over the roughest of roads. Some persons here walked regularly six miles to hear the lectures. At Newcastle some travelled as much as ten miles to hear the lectures. Two pitmen, brothers, attended a course regularly from a distance of five miles: they went there by train, but were compelled to walk home. This they did for three months on dark nights, over wretchedly bad roads, and in all kinds of weather. One miner writes in gratitude, "I deeply deplore the last thirty-four years of my life. Being buried in the mines since I was nine years of age, and taught to look jealously on science as being antagonistic to religion, I little thought what pleasures of thought and contemplation I lost; I have, however, broken loose from my fetters, and am proceeding onwards." It is sad to think that this energy and hunger for learning should be cramped by inability to pay for it. Working-men can seldom afford more than one shilling or one shilling sixpence for a course, yet at two shillings a ticket it would take an attendance of seven hundred to make the lectures pay. Besides, the cost of the ticket is not the only tax on the artisan. Text-books must be bought, weekly papers posted to the lecturer, while wages are lost by attendance at the evening classes. The whole system requires a solid pecuniary basis to make it permanent; and that, up to the present moment, has not been forthcoming.

Although much has been done, we may hope for much larger developments in the future. A staff of thoroughly trained lecturers should grow up, who will make this occupation the work of their lives. The courses of instruction will be more systematic, and will be spread regularly over a number of years. In some cases the lectures will crystallize, as they have already done, into local colleges or small universities; in others they will remain in a more fluid state. Whatever may be the result of the movement, there is no doubt that the problem has been solved of bringing the highest university education within the reach of the lowest classes who are capable of receiving it. Such a movement may be less necessary in countries where education is more democratic, and where no class has been left out; but in England,

where the higher education, like every thing else, is organized mainly for the privileged classes, such an enterprise is an incalculable boon.

Some few years ago, on a summer afternoon, a body of artisans were watching our Cambridge undergraduates amusing themselves on the river which flows by the backs of the colleges. Their conversation was overheard by a passer-by, and it was discovered that they were under the impression that all Cambridge undergraduates were sons of noblemen, and that no one could live at the university under a thousand pounds a year. This was the exaggeration of ignorance, but let us hope that the extension movement will in another generation render all such misunderstandings impossible. OSCAR BROWNING.

THE TRAINING OF THE FACULTIES OF JUDGMENT AND REASONING.¹

I AM going to endeavor to show, as far as I have the power to do so, how the psychological and logical principles which relate to judgment and reasoning may be applied to the treatment of our ordinary school subjects, — what our methods of teaching should be, if we desire those methods to be framed in accordance with the laws and suggestions of mental science. I must refer you to Mr. Sully's indispensable 'Teacher's handbook of psychology,' for the discussion and full exposition of the psychological principles. But also, I shall begin by running over the chief points which require our attention, before I attempt to sketch my lessons, so that you may have the principles on which I work freshly in your minds. My desire, as you know, is not to upset or change this or that method of teaching this or that subject, but to bring the precepts and laws of psychology to bear directly on the actual practice of the classroom. In what I have got to say on the logical side of the matter, I am largely indebted to Mr. Jevons, to whose excellent and suggestive little book, 'Elementary lessons in logic,' I must refer you. And let me say here that I think every teacher ought to own the book, and to make a point of mastering especially the last ten lessons.

To judge is to connect two notions, two representations or mental images of what has been perceived; and the outward expression of this act is a statement in words, or a proposition. Thus, if we have acquired the general notions or concepts, say, of hardness and heaviness, we may connect either or both with any particular thing or class of things, or with any other notion. We may say, 'This ground is hard,' or, 'This table is

¹ From the *Journal of education*, a paper read before the Education society, Oct. 25, 1886.

heavy,' or, connecting two concepts, 'It is wise to be merry.' It does not matter how we have acquired the information, or by what mental process we have reached the assertion: we may say, using direct observation, 'This boy is tall,' or, making an inference, 'There will soon be another general election;': in either case we have given expression to a judgment. Of course, if we merely echo somebody else's statements, we give expression to his judgments, but we do not perform acts of judgment of our own, — a fact which young and old, in and out of school, are always forgetting. The work of connecting the two notions or mental images must be our own before we can be considered to have performed an act of judgment. The connection may be wrong or unwarrantable, but the formation of it will none the less constitute what we here define as judging; that is, if it be made with a certain amount of belief in the reality of the connection. If there be no such belief, we shall not consider the statement as the expression of a judgment. Our statements may either be affirmative or negative; about individuals or about classes, i.e., what are called 'singular' or 'universal' judgments, as, for example, 'This boy loves exercise,' 'Boys are fond of action.' In the case of negative judgments, we may suppose some one to have originally asserted a connection between two notions; and the mind has then to decide whether the assertion be true or not true (untrue). If it decides in the latter sense, the judgment will be a denial, not an affirmation, of the connection between the notions. We may, however, sometimes turn the judgment into the affirmative form, as thus: if we deny that 'this bag is heavy,' we say, 'This bag is not heavy,' i.e., 'This bag is light.' But this is assuming that there is no alternative to 'heavy' but 'light,' while we may easily conceive of a state which could not be described either as the one or the other. If there be several alternatives, still more must the statement remain negative. I cannot transpose, without changing the subject of which I speak, such a statement as 'This leaf is not green.' This is, however, rather a matter of logic than of psychology.

There is another point on which it will be of more importance to touch, — the relation of conception to judgment. We have seen that in the former there is a process of combining. The concept 'metal' is formed by mentally grouping together a certain number of qualities or properties, grouping them so as to make one complex mental image or representation. As Mr. Sully says, "The mind here comprehends the several qualities as together comprising one thing or substance. In judgment, on the other hand, we dis-

tinctly set forth two representations as two, keeping them apart from one another, while at the same time we connect them with one another. We think of certain objects or qualities as distinct, and at the same time explicitly view them as related." Thus, in affirming that 'iron is a metal,' we think of the quality of being a metal as something apart from the iron, something new which we assert to belong to it. In fact, we have here the same distinction as we have in grammar between the name with the attributes of the subject, and the predicate. To express a judgment, we must make use of a predicate, or give some new information about that of which we are speaking: in the case of a concept, we have merely the general notion, simple or complex, corresponding to the name and its attendant describing adjectives, or to the name alone. We must bear in mind, however, that many, if not all, concepts are formed by a succession of judgments. Every addition to our knowledge of the properties or qualities which correspond to a general term takes the form of a judgment. The very bringing of things together on the ground of their likeness, or the separating of them because of their dissimilarity, is a judgment; while, in its turn, the fuller concept becomes an element in our later and more precise judgments.

Like every thing else, our judgment will have various degrees of perfection and imperfection. The most important quality of a judgment is clearness; the next, accuracy; while promptness, stability, and independence are all of considerable value. By a clear judgment we mean one in which the concepts or representations are distinct, and the relations between them distinctly understood. The judgment, 'Poetry is a criticism of life,' will be just so clear, and no more, as the concepts 'poetry,' 'criticism,' and 'life' are distinct, and as the mind clearly discerns the relation between 'poetry' and 'criticism of life' which is implied in the assertion, — how it is equivalent to certain verbally unlike statements, but incompatible with others. It is easy to see that want of proper observation is one of the commonest sources of indefiniteness. If the observation has been faulty, the concepts or representations will be faulty, and so will be our apprehension of the relation of the notions we wish to connect. Memory may play us false by recalling imperfect images, or by recalling them with all the life and reality of the relations between them departed; or feeling may come in, paralyzing our powers of discrimination, and misdirecting our decisions. We must not omit to note, moreover, the tendency that most of us have, and which is particularly strong in children, to accept the judg-

ments of others, though we do not apprehend or realize the meaning of what is asserted, and are somewhat hazy as to what the assertion concerns. We teachers are very liable to produce vagueness and confusion in this way. We impose our judgments on our pupils; we are contented with their ready assurance that 'they see;' we rush on from step to step, and then are astonished to find how hazy and muddled the children's views are. Teachers have even been known to grow quite impatient with the children on this account, resenting delay, and setting all the confusion down to a wilful perversity on the child's own part. The other qualities which characterize sound and serviceable judgments need no particular remark here.

Many of our judgments are arrived at immediately or intuitively, such as, 'This fire is warm,' 'I saw my friend last week.' These are called 'intuitive' judgments. But, on the other hand, it is plain that many of our assertions are reached by a process of reasoning or inference. Just as we connect two concepts or representations to form a judgment, so we may connect two or more judgments to form another judgment in advance of these. Thus, from the assertions that 'all metals are elements' and 'iron is a metal,' we may derive the judgment that 'iron is an element;' or we may infer that 'all material bodies have weight,' because we have found that this and many other material bodies have weight. The resulting judgment we term a 'conclusion,' and the judgments from which it is derived 'premises.' To reason, then, is to pass from a certain judgment or judgments to a new one. This implies that we recognize the relation between the new and the old judgments; that we apprehend the connecting link or similarity between them. Reasoning is, in fact, as Mr. Sully observes, "only a higher and more complex process of assimilation, identification, or classing." From mere difference we can infer nothing. If x and y are both equal to z , we can infer that $x = y$; but if x and y are both greater or less than z , we cannot from these facts infer any thing as to the relation between x and y . Again: in our reasoning the premises and the conclusion may both be particular. A boy may have noticed that on several occasions when the wind was in the east his master was cross, and he may infer, that, the wind being in the east to-day, his master will be cross. Or the premises may both, or one of them, be general, and the conclusion be either general or particular; as when we reason, that oxygen being a material body, and all material bodies having weight, therefore oxygen must have weight; or that all gases have weight,

because all gases are material bodies. The former is called implicit, the latter explicit, reasoning. But the distinction is not of great value to the logician, because we do, as a matter of fact, in implicit reasoning, tacitly assume a general premise: the boy in our example, consciously or unconsciously, assumes that *all* east winds make his master cross. There is another distinction, however, which applies to reasoning, and which will be of great use to us. We may either argue up to a general truth from premises which are particular, or at least less general; or we may apply this general truth to cases which are less general or particular. Thus, having found that gold and silver and copper, etc., are all elements, we may arrive at the conclusion that all metals are elements; or, seeing that all birds die, and all fishes die, etc., we may infer that all animals die. On the other hand, from the general truth that all the radii of a circle are equal, we may infer that two particular straight lines, AB and AC, being the radii of the same circle, are equal to one another. In the former case, our reasoning is said to be inductive; in the latter, deductive.

The chief point to notice in induction is, that in general our conclusion goes beyond what our premises give us the right of asserting as actually true. We can never, therefore, be certain, in such cases, of arriving at absolute truth, but only at a greater or less degree of probability. When we assert that all planets move round the sun in the same direction, the 'all' includes more cases than are mentioned in the premises, — more cases than we have observed. Further experience may prove that some of our general conclusions are wrong. This has been the case with the emission theory of light, which has now been abandoned for the wave theory. Or, to quote a simpler case, Mr. Jevons mentions that Fermat maintained that $1 + 2^x$ always represents a prime number for all values of x ; and so it does, till the product reaches the large number 4,294,967,297, which is divisible by 641. This danger should be a warning to us in our use of inductive reasoning with children at school. We are all of us, young and old, far too much given to generalizing¹ from too few particulars, and to asserting that what has happened in a certain number of particular cases

¹ It will be well to note, in order to avoid confusion, how inductive reasoning, which is a kind of generalization, differs from the generalization of judgment. In each case we trace out a similarity among a number of different things. In judgment, we do so in things viewed as single and apart, in order to connect with one or all of them a general notion applicable to them all: in induction, it is the *relations* of things to one another to which we attend, and we seek to establish some connection between these relations, and thus to arrive at some wider relations between the things themselves.

will always happen in all like cases. This is a habit, or a tendency, not to be encouraged, but to be corrected. The experience of children can never be very great, — never sufficient for a very wide generalization; and to allow them to draw conclusions from insufficient experience, however right our wider experience may have shown that conclusion to be, is to allow them to form a very bad habit indeed. Are we, then, to exclude inductive reasoning from the schoolroom? By no means. Inductions vary almost infinitely in their degrees of generalization, from the narrow inductions with which children themselves spontaneously begin, such as 'Flies die,' to the law of gravitation. Let us follow nature's hint, and restrict our pupils' work at first to the narrower kinds. We shall then be fairly safe, especially if we are careful, as we should be, to afford the young inquirer every possible opportunity of testing and correcting his conclusions. I need scarcely point out here that the inductions of mathematics will be at first even more useful to us than those of physical science. In mathematics the premises are so carefully restricted, and the applications of the conclusions so strictly narrowed, that within their assigned bounds our inductions are absolutely true; so much so, that Mill refused to regard them as real inductions at all. Moreover, we can test them exhaustively, — I will not say *exhaustingly*, — and so make perfectly clear their truth and value. In grammar also, especially in that of the mother-tongue, the inductions are simple and easily made, and the means for testing their accuracy are always ready to hand. Again, the way in which children earliest show their curiosity is in seeking for causes. They have a strong tendency to look upon every thing as having a cause and a purpose. Here, then, is another valuable hint of nature as to the kind of work we should choose. Many easy exercises of the kind we require are to be obtained from among the simpler phenomena of nature, or from mathematics, and even history. The discovery of causes is, however, often a very difficult process, and always implies a method of procedure. For a discussion and exposition of this, I must refer you to two excellent chapters in Mr. Jevons's little book (chapters xxviii. and xxix). For convenience sake, I shall quote here Mill's canons which bear on this matter, and which are to be found in the chapters referred to. The first is the rule for the method of agreement: "If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree is the cause (or effect) of the given phenomenon;" or, more briefly, the sole

invariable antecedent of a phenomenon is probably its cause. The next refers to the method of difference. It runs: "If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former, the circumstance in which alone the two instances differ is the effect or the cause, or an indispensable part of the cause, of the phenomenon."¹ As Mr. Jevons remarks, this is essentially the great method of experiment, and its utility mainly depends upon the precaution of only varying one circumstance at a time, all other circumstances being maintained just as they were. Thomson and Tait remark (*Natural philosophy*, vol. i. p. 307), "In all cases when a particular agent or cause is to be studied, experiments should be arranged in such a way as to lead, if possible, to results depending on it alone; or, if this cannot be done, they should be arranged in such a way as to increase the effects due to the cause to be studied till these so far exceed the unavoidable concomitants that the latter may be considered as only disturbing, not essentially modifying, the effects of the principal agent." The next canon refers to a joint method of agreement and difference: "If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common save the absence of that circumstance, the circumstance in which alone the two sets of instances (always or invariably) differ is the effect, or the cause, or an indispensable part of the cause, of the phenomenon." The next canon relates to what may be called the method of concomitant variations: "Whatever phenomenon varies in any manner, whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomenon, or is connected with it through some fact of causation." Lastly, I will quote the canon relating to what Mill called the method of residues: "Subduct from any phenomenon such part as is known by previous inductions to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents." Those who desire more than Mr. Jevons gives, may find it in Mill's 'System of logic' (book iii. chapters 8, 9, 10).

¹ So, when we are trying experiments on condensation, — of steam, for instance, — we find that a plate held in the steam condenses some of it. What causes this? Perhaps the coldness of the plate's surface. Well, then, let us heat the plate and try: result, no condensation. Let us make the plate very cold by placing it for a little while in the freezing mixture. What is the result now? Increased condensation. Probably, then, cold produces condensation. And so on, through a number of other experiments.

By the processes I have described above, the child reaches a large number of general or universal judgments. To these are added all the general statements made to him by others in the course of instruction. These he can now apply to the explanation of particular or less general cases, as has been already shown; that is, he can make use of deduction. The logical forms of this kind of reasoning are: "All soldiers have to fight; John is a soldier, therefore John has to fight;" or, "No mistakes deserve praise; this is a mistake, therefore this does not deserve praise." But though this is the logical, it is seldom if ever the psychological order of inference. As Mr. Sully points out, "in some cases the conclusion first presents itself to the mind, and the other judgments rise into distinct consciousness later; and in other cases the mind does not at any stage distinctly represent more than one of the two truths making up the premises." Again: besides starting with a general truth and seeking to make applications of it, we may also start with some particular statement or fact, and then seek among the general truths already acquired for that under which it may be brought. In our language work we may have an instance of a noun in the genitive, and we seek to find what rule for the genitive will explain our instance. Or in our geometry work we may have a theorem given us to prove: we assume it to be true, and then seek to attach it to some known and already proved theorem, and then, finally, reverse our work to produce the proof required. This last is the usual way in which children explain things to themselves and others. "Why am I blamed for having done this? Because what I did was called, or was, cruel, and acts called cruel deserve blame," is the clear statement of the reasoning which, more or less confusedly, will pass through the mind of a child. In connection with this, we should note the method by which all our greatest discoveries concerning the laws of nature have been made. The examination of a certain number of particular cases suggests a general principle (or more than one) under which they may be brought. We assume the general principle to be true, and deduce the results for several particular instances. We then compare these results with the results of actual observation in the same cases. If the latter confirm the former, we accept the general principle as true — at any rate, for the time being; if they do not, we either modify our assumption or try another. It was in this way that Newton and Faraday, and numberless others, worked, and that all men of science are now working. It was in this way that the great theory of the conservation of energy

was discovered, and which was verified so admirably by Mr. Joule's experiments. In this, as in nearly all our complex reasoning, you will observe that induction and deduction are mixed; the former suggesting general truths, and the latter deriving conclusions from them. Both these two kinds of reasoning are liable, of course, to error. Both depend on observation, reproduction, imagination; both are processes based on the detection of similarity. If these are faulty, our conclusions will be fallacies. Especially in the case of deduction is a mistaken idea of similarity, or the want of discrimination, a fruitful source of error; the ambiguity, or want of clearness, in the terms employed being also most frequently a great cause of our going astray. Attention as regards all that is employed in our argument, and concentration as regards the special object of our search, will also be necessary parts of our outfit.

As Mr. Sully has pointed out, the powers of judging and reasoning show themselves later than the power of conception. At quite an early age, children will form rudimentary notions of things, and will even go as far as the formation of implicit judgments; but they will not yet be able to form explicit judgments. The order of development appears to be as follows: 1°. Implicit judgments, — the results of observation and memory, involving no inference; 2°. Explicit judgments, involving inference, about individual things, consisting of statements about actual facts then present; 3°. Judgments concerning striking attributes, later with reasons; 4°. Judgments involving consciousness of alternatives, introducing 'no' and 'not'; 5°. Judgments concerning classes, the predicates becoming gradually more general and more abstract; 6°. The curbing of exaggerations and mis-statements, — less tendency to treat fancies as realities, — criticism of the statements of others, or increase of independence. The development of reasoning follows very similar stages: 1°. Reasoning from particulars to particulars; 2°. Then seeking for causes, with the familiar 'why'; 3°. Deductive reasoning, consisting of the application of simple rules to simple particular cases, then to cases requiring a more intimate understanding of the rule, then the application of rules less simple; 4°. Somewhat later will come inductive reasoning, with ever-increasing power of abstraction; 5°. Lastly, complex reasoning and chains of demonstration.

For convenience, let me recapitulate the points on which clear judgment and clear reasoning depend. Clear judgments depend on clear conceptions and representations, and on the clear understanding of the connection stated and the terms

employed, and also on keeping the emotions under due control. Judgments should be clear, accurate, prompt, stable, independent. Clear and sound reasoning depends on clear and sound judgments; on the clear understanding of the relations between judgments and the terms employed; and on clear attention and imagination (involving discrimination), which keep vividly present the relations of the ideas and the objects with which we are concerned. Fallacies arise mainly from mistaken ideas of identity or similarity.

Here I should like to quote the whole of Mr. Sully's section on the training of the powers of judgment and reasoning, the subject is so difficult, and what he says is so clear and sound. Children, as we know, delight in exaggeration: nothing is so attractive to them as vividness and picturesqueness of statement. Their fancies are active. Their curiosity, except as to what directly helps fancy, is fluctuating and easily satisfied. The anthropomorphic nature of many of their views about nature is startling to those who have forgotten their own childhood. To step in, and seek to repress and change and destroy all this, is to act in distinct opposition to the teaching of nature, — a proceeding which some teachers already recognize as ill-advised and unsafe. Surely a teacher who would destroy a child's delight in fairyland, or its happy belief that its pet dog understood every thing said to it, and the like unjustifiable ideas, would deserve a punishment but little less than that of old inflicted on traitors. Again: unless the child himself forms the judgments and does the reasoning, there is no exercise of his faculties, and therefore no development. But his experience is very small, and his conclusions can seldom be justifiable, even when correct. It cannot be right to encourage him to generalize from insufficient data, and to reason without clear discrimination. In the face of these difficulties, I should advise that we be not in too great a hurry to give a systematic training to the reasoning faculty. The eleventh or twelfth year would be quite early enough, I think, to begin. Meanwhile there is much work to be done in exercising the senses, attention, memory, imagination, and conception; while the exercise of judgment, which the later stages of this work will introduce, will be quite enough, at first, for our needs. By all means, let us encourage the child's curiosity by affording him the means of feeding and satisfying it. If rightly treated, it will grow by what it feeds upon. When the child cannot, of himself, attain to the knowledge requisite, let us, using a wise discretion, give him an explanation such as he can understand. In this way we shall not interfere with his fancies, though they, in some cases, when

too vagrant and emotional, must be gently checked. Difference in the temperament of children should make a difference in their treatment. "But" — and here Mr. Sully speaks — "the training of the reasoning powers includes more than the answering of the spontaneous questionings of children. The learners must be questioned, in their turn, as to the causes of what happens about them. A child cannot be too soon familiarized with the truth that every thing has its cause and its explanation. The mother, or teacher, should aim at fixing a habit of inquiry in the young mind, by repeatedly directing his attention to occurrences, and encouraging him to find out how they take place. He must be induced to go back to his past experiences, to search for analogies, in order to explain the new event. The systematic training of the reasoning-powers must aim at avoiding the errors incident to the processes of induction and deduction. Thus, children must be warned against hasty induction, against taking a mere accidental accompaniment for a condition or cause, against overlooking this plurality of causes. This systematic guidance of the child's inductive processes will be much better carried on by one who has studied the rules of inductive logic. In like manner the teacher should seek to direct the young reasoner in drawing conclusions from principles, by pointing out to him the limits of a rule, by helping him to distinguish between cases that do, and those that do not, fall under it, and by familiarizing him with the dangers that lurk in ambiguous language; and here some of the rules of deductive logic will be found useful." Finally, the best subject-matter on which to exercise the child at first will be that connected with common every-day knowledge. Speaking broadly, physical science will best supply us with inductive exercises, and mathematics with deductive exercises. In some subjects of the former, such as botany, chemistry, and physiology, his work will be almost wholly inductive: in some of the latter, such as arithmetic and algebra, his work will be almost wholly deductive.

H. COURTHOPE BOWEN.

THE NATURAL METHOD OF TEACHING LANGUAGES.

THE article on "The 'natural method' of language-teaching," in *Science and education* for Dec. 24, closes with the remark that conservatism is not always to be decried, and all innovation is not necessarily good. This thought is so correct that nobody could justly object to it; and, if all other observations made by the opponents of the natural method be of equal soundness, the cause of this