THE CHILD'S MIND AND THE COMMON BRANCHES

BY

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INTRODUCTION

A First Talk with the Student

Practical and positively helpful is the motto I have placed before myself in writing this book. If it does not give you vital help for every hour of your busy day of teaching, then it fails of its purpose.

I find those people most practical, in the long run, who have thought their way into at least a moderate amount of "theory." For theory such as the worker wants is no flimsy tissue of dreams, but a structure of ideas that prove themselves true by the results they produce. Logical theory is the hub of the wheel of truth, holding in order a whole circle of facts. A grasp of theory may put us in possession of a great number of related facts which we might otherwise have to acquire singly, if at all.

Let us illustrate. If you were going to teach me to run an automobile, you might proceed in any of three ways: (1) You might take me, in all my ignorance, into the seat beside you, and without explaining anything, show me how to turn this button and push that lever until the thing buzzed and started, how to turn the steering wheel, and so on — just one trick after another. In this way I might get on fairly well for some time, and drive without even knowing what made the car go. Perhaps I should congratulate myself on being a good practical driver; but some day, when something went wrong, I should have no idea of what it was or how to fix it, because I should not understand the machine.

(2) You might begin in the opposite way, and without showing me anything about practical driving, concentrate on the understanding process. As a result, I should be able to pass an examination on the *science* of running a car — the "theory" of it — the chemistry of producing and exploding the "mixture," the plan of engine cycles, the adjustment of differentials, and so on; and I should know just what is going on inside the works whenever the driver pushes a button or turns a lever. "The mere driving of the car," you would tell me, "is a simple knack which any one can pick up for himself." But life is busy, and people do not pick up things so easily and incidentally as they are sometimes supposed to, and I should probably lose a job or two (as many teachers have done) before I could apply in a practical way the complex bulk of knowledge you had given me.

(3) You might steer between the two extremes above described. You might first explain to me what makes the car go, what are the fundamental parts that keep it going, just what is happening inside the "works" whenever I push a button or pull a lever, and so on. This would give me insight. If I then practiced my knowledge by actually running the car, I should know just how to control it, how to avoid injuring it, how to get maximum power out of it under varying road conditions, and how to treat it when it balked. I should also realize the limitations of my own knowledge and power, and call in a specialist when he was needed.

This third plan is of the type we shall follow in studying *The Child's Mind and the Common Branches*. Accordingly, we shall work first (throughout Part I) to get insight. We shall find what makes a child's mind go, how to control it

so as to get most power out of it, what is going on in the brain when we pull our educational levers, and so on.

Psychologists who have experimented on the solving of puzzles, find that a subject will do a great deal of experimenting with a puzzle until he gets insight into the principle according to which the puzzle is worked out. After that, he can usually work the puzzle every time and quickly. Further, if he is given another puzzle somewhat like the first, he masters that quickly. But if he has simply juggled with the first one till he has learned some trick of solving it, without knowing just how or why it works as it does, he may have as hard a time with the second as if he had had no experience whatever with puzzles.

Now, just as different puzzles may have much in common, so that if you can solve one with insight you may be able to solve many others that are similar; and just as different makes of automobile have much in common, so that if you can manage one with insight you can soon manage any other; so the elementary school subjects have many difficulties in common. If you know what is going on in the child's mind when you teach him any one of them, you have caught the cue that will make you master of teaching them all.

This cue of necessary knowledge is simple enough for any teacher to master — James said that it "might almost be written on the palm of one's hand." James is a great simplifier of general psychology, as Thorndike is of educational psychology. In the chapters that follow, you will hear many echoes of both these men. Neither must be blamed, however, for anything that happens in this book. I have taken their simple but sweeping laws of learning and applied them (together with many other contributions from

special investigators too numerous to name) to the daily tasks of the teachers of our common schools — to the teaching of the common branches.

I hope the reading of this book will make your work sweeter and lighter.

D. W. L.

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PART ONE

CHAPTER I

The Nature of Bonds

Exercises. — 1. In colonial days, when the minister was the school examiner and the Bible was a reading book, a certain minister, while examining a school, called on a boy to read. The boy complied, and in his best form began: "And the Lord spake unto Moses, saying *tick*, Speak unto the children of Israel, saying *tick, tick*, and thus shalt thou say unto them, *tick, tick, tick, tick.*"

It is recorded that this response "acted like a shower-bath on the poor teacher, whilst the minister and his friends almost died of laughter."

How do you explain the boy's reading in this fashion? The *ticks* were imitations of clock ticks. The old-fashioned teacher, in the days of slow-ticking clocks, had his pupils imitate the time-piece as a means of pausing the proper number of seconds at the various marks of punctuation. This boy was not expected to "tick" during examination, yet did so innocently. Why?

If this incident suggests any rule that you think could be laid down to guide teachers, state it.

2. A certain horse used to go alone to the railroad station when he heard the whistle of the in-coming train, wait till the train had gone, and then return home.

How do you account for this? Why do not all horses do it? How would you get a horse to do it if you wanted him to?

What is a bond? — A certain lazy student attached a string to his door latch, so that he could pull it from where he sat at his study table and let people in without getting up.

Here was a *bond*, a *connection*, between himself and the door latch. The old-fashioned doorbell worked on the same principle; you pulled a handle, and this was attached to a wire which passed on the pull and so rang a bell within.

Notice, in each of these cases, three simple essentials: (1) a disturbance at the beginning, such as the pull at the bell handle; (2) some means, such as string or wire, for passing on the impulse; (3) a resulting response, as the ringing of the bell, which may seem very different from the original agitation. Number two, the "means for passing on the impulse," is a bond between the original disturbance and the resulting response.

A bond is a connection of some sort. In your automobile, there are bonds which reach from the levers and buttons outside to the machinery inside. In the cash register, there are bonds so built that when the clerk presses the correct keys, just the right figures fly up into sight and show you the amount of your purchase.

Bonds are fundamental in this book. So let us study a few clear cases of them, first in lifeless things, then in plants, and after that in animals, including little human animals.

Bonds in lifeless things. — First, there are *mechanical* connections. When you set your watch, there must be some kind of bond operating between your hand on the stem without, and the watch hands turning within. In your typewriter, there must be a connection from each key that you press, with the type as it comes into contact with the paper. Each key of your piano must be connected with a note — that is, must drive a hammer against a certain wire. Go into a printing shop and watch a linotype machine at work; what a wonderful bond, connection

of some kind, there must be between each letter-key and the casting of that letter in type metal!

In addition to mechanical bonds, we find *chemical*, *photic* (light), and *electrical* connections. The fuse of a firecracker or a skyrocket forms a fire bond, a chemical bond, from the stimulating match outside to the explosive response within. There is a photic connection, a light-bond, between the object you photograph and the picture in the camera. Another light connection extends from the moving-picture machine to the screen on which the picture moves. This age of electricity offers endless examples of electrical connections; what are telephone and telegraph but bonds from sender to receiver? Even the humble doorbell now works most commonly, not by mechanical connection, but by bonds that are electrical.

It was once thought that the human nervous system worked like a mechanical doorbell; that is, that the nerves were strings, corresponding to the wires of the doorbell of days gone by, and produced their effects by actually pulling on the muscles and the glands. Our present idea is that something like an electrical impulse passes over the nerves; or in other words, that the nervous system works more like a modern electrical doorbell. At the same time, it is safe to say that nerves act somewhat like firecrackers; for the nervous impulse has something chemical about it. We may even assert that man's nervous system is much like what a piece of fireworks would be if the fuse and inner powder renewed themselves immediately after burning, so that a certain small explosion could be produced many times over.

Bonds in plants. — Everyone has noticed how plants respond to light and water — to whatever is necessary to

their type of life. And they do all this by means of some kind of bond or connection inside them. There are botanists who even believe that they have discovered nervous systems in plants; but, if such nervous systems exist, they are probably very rudimentary and crude compared with ours. Darwin, in order to test out what a plant could and would do, had a trombone played to it; but it did not seem to respond to sound. It evidently had no sound

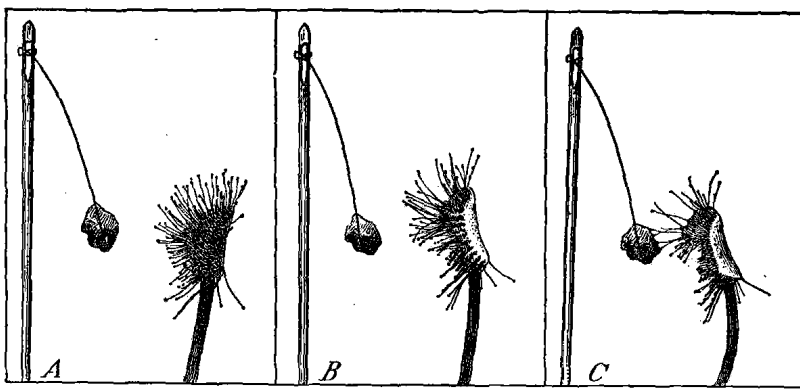

FIG. 1. Showing the action of a remarkable bond in a plant: the sundew bending over to get its meal of meat. (From *The Book of Knowledge*, p. 3539.[1])

bonds. It was even worse off than the pupil whom you may have in your school, who "can't tell one note from another" because nature has not furnished him with a separate nerve bond for each separate note.

Yet plants do wonderful things. See how the touch-me-not responds by flying all to pieces when you stimulate it by tapping its full pods. The English sundew, if you hang a small piece of meat near its flower, bends toward the

[1] By permission of the Publishers of *The Book of Knowledge*, 2 West 45th Street, New York City.

meat slowly, and at length closes upon it and consumes it. A closely related plant, the Venus' flytrap, snaps shut like a flash when an insect lights on its flower. So wonderful are this stimulus, bond, and response that Linnæus, "Father of modern botany," spoke of them as "Nature's miracle."

Nor is the wonder done, for these responses show *discrimination*. The sundew will not close its tentacles on anything that is not food; and it will not close on objects that strike it with impact, but only in response to steady pressure, be that pressure so slight as the weight of a tiny fragment of hair. The Venus' flytrap, being set for a different kind of action, does not respond to pressure, but to impact, such as the lighting of a fly.

Bonds in lower animals. — The more humble animals appear, like the plants, to have no nervous systems. As we should expect, their behavior is very simple and plant-like. When the water brings a bit of the right kind of vegetable matter into contact with an amœba, it puts its "arms" around the particle, encloses it, and thus makes a dinner of it, much as the sundew does with a fragment of meat. The amœba, too, is able to discriminate; it does not put its arms around everything that comes along, but clasps only that for which it has need.

As we pass upward from the more humble to the more exalted animals, the abundance of bonds and the variety of responses become so great that it takes whole libraries to describe them. The earthworm, one of the lowliest of creatures that enjoy the convenience of a nervous system, has a set of nerve connections for every zone of its squirmy body, and another set, running from head to tail, that keeps all these zones coöperating — pulling together instead of pulling apart, or at cross purposes. It responds to food,

to touches of various kinds, to electric shocks, and so on, to such an extent that it is possible to give it something of an education.

Still, if you had to teach a school of wild animals of any kind, you would soon be surprised at the very limited number of different tricks which they can learn to perform. Animal trainers always find it hard to give a varied program without encroaching on another trainer's tricks.[1] It is true that many animals, left to themselves in their accustomed surroundings, show a sort of nature-wit that seems like human intelligence. Burroughs says that the house wren, if he builds in a box that contains two compartments, will fill up the one he does not use "so as to avoid the risk of troublesome neighbors." But no doubt we often give the creatures credit for being more intelligent than they are. For example, a tiger in a circus always grew restless and excited when a certain tune was played by the orchestra, and it was at first thought that he had a fine "ear for music." But it was discovered that this tune was always the last on the program, at the close of which the animals were fed. The bond he had formed was of a different nature from what had been supposed. It was not a connection between music and soulful feeling, but between music and bodily feeding. That tune was the tiger's mess call.

Learning is forming bonds. — Other things being equal, the difference between a creature that has mastered any given piece of learning and one that has not, is that the first is now in possession of a set of bonds, of connections, which the latter yet lacks. Let a waltz be played, and the practiced waltzer is "off with the music." His waltz bonds

[1] Ellen Velvin — *Behind the Scenes with Wild Animals*, p. 126. Moffat, Yard and Company.

are working, from ear to brain and from brain to feet. Could we project his brain and that of the non-waltzer on a screen in such a way as to show all the differences between them, we should observe that certain paths, or connections, stand out strongly in the one; whereas the other, in corresponding areas, remains a blank.

"Educating" the piano and the typewriter. — Suppose all the keys of your piano or your typewriter were disconnected from their respective hammers or type pieces. Then you would have to give the instrument an "education" by forming the proper bonds in it. You would have to "connect up" each key so that when you struck it, an impulse would pass in through that mass of wires and levers, not at random, but *along the one right route that could bring the desired response.*

If your instrument were so made that every time you struck a key carefully and correctly, it did its bit toward forming the right connection, and every time you struck a key carelessly or unskilfully it did just as much to form a false connection, the educating of that instrument would be very much like educating a child. You would be extremely careful about striking a key or letting anyone else strike one; for you would not want your piano to play *b-flat* when you struck *d*, nor your typewriter to print a *j* when you struck an *a*. We ought to be just as careful as to who "plays on" a child, and for much the same reason.

"Why, look you now, how unworthy a thing you make of me!" says Hamlet to Guildenstern, when the latter has insisted that he cannot play on a pipe. "You would play upon me; you would seem to know my stops; you would pluck out the heart of my mystery; you would sound me from my lowest note to the top of my compass: and there is much music, excellent voice, in this little organ; yet cannot you make it speak. 'Sblood, do you think I am easier to be play'd on than a pipe?"

This is good warning for every one of us who attempts to play on a human instrument.

If we could have brain tuners, as we have piano tuners and repair men, educating a child would be easy. All that would be necessary would be to lift off the top of his skull, make the proper connections among the fibers of his brain, and close him up again. He would then behave properly, responding in approved fashion to whatever was done to him — and he could probably be made to think some wonderful, original thoughts besides. But no such miraculous brain surgery as this can be expected; and so teachers will have to work on, making brain connections as best they can by operating from the outside.

Educating a plant. — We could, perhaps, find our way inside of plants to the point where connections are made; but there seems to be no very definite mechanism there, such as wires or nerves, to connect. Yet plants can be educated, within limits. The morning-glory is trained to climb a string. Beans can be made to throw out few leaves or many, few pods or many, produce shriveled beans or plump ones.

Of course, the bonds we form in the plant must be within the limits of its nature; we cannot teach an onion to climb a string. But this is true of children also; they can learn only that which is within the limits of their inborn nature. No one can teach a color-blind child to see color correctly. One girl of about twelve years, normal in most matters, was not only unable to sing, but after five months of training could not even clap her hands rhythmically, as for marching.

In the brain, nature must have *started* the bonds or the teacher can never *complete* them.