

## THE PLACE OF SCIENCE IN THE EDUCATION OF CHILDREN<sup>1</sup>

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IN discussing the Place of Science in the Education of Children, it is most important that we should commence by arriving at a clear understanding with regard to what we mean by Education and by Science. Perhaps this may not be altogether an easy matter, because there is nothing that people quarrel about with greater gusto than definitions. But we may avoid that difficulty if you will agree that for this one occasion, and for the purposes of this lecture, you will permit me, no matter how inadequate my definitions may be, to use the words "science" and "education" in the following sense:—

*I. Education.* By education I do not mean schooling, nor preparation for examinations, nor competition for scholarships. Nor do I mean the discipline and training of the home.

In one sense I mean all of these, and in another sense a great deal more. These are but means to an end, and the end is the bringing out of all the capabilities and faculties of the child—the fruition of the possibilities of a human soul. To this the home life must contribute either help or hindrance—sometimes both—so does the school curriculum, and so do also, to a very marked degree, those childish occupations which we call "play," when the boy or girl, to grown-up people, seems to be doing nothing and taking a great interest in it.

By education, then, I mean all those processes and experiences by which the mind is stored with facts and with ideas, by which the senses are trained and the faculties exercised.

*II. Science.* You will have guessed by this time that my definition of science is to be on similar lines. Science is not "sound, light and heat," nor "electricity," nor even "elementary chemistry," nor learning the Latin names of wild

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flowers, except in the sense that the greater includes the less. Let us consider what may fairly be classed under this head.

Science is by no means the sum total of human interests. Part of the life of every human being, such as we would desire our children to be, must be devoted surely to recreation and to pleasure. And our pleasures are as varied as our pains. Many of them are rightly decorative or artistic—appealing to the eye and ear—some are purely mental—some emotional. Music, painting, poetry, literature, these are not science, though there may be a science of each. They are the Fine Arts.

Then again we have all those interests which concern our relations with each other—the laws of conduct in the home and in the state—the wisdom that should guide us in the daily affairs of life—the wisdom by which we learn when to yield, and when to hold to our course—the philosophy of life and its religion. These things are not science, though there may be a science of each; they constitute Philosophy.

But the knowledge of facts and things—the influence of one thing on another—the natural products of the earth—the ways and means by which we procure and utilize them—the forces of the universe and the turning of them to our own purposes—all these constitute the realm of science.

We are apt to restrict the word science too much to the work that is being carried on by

men who make it their speciality and devote their lives to working in some particular branch. Naturally they know so much more about it than the rest of us that we find it hard to take an interest in what they are doing. So science becomes another name for what is dry and tedious to discuss; but that is simply because they have got beyond the regions in which we take a pleasure. It is always so with specialists. Take any one of the learned societies which deal with more than one science: the botanists seldom come to hear the physicists, and the biologists do not stay to listen to the chemists. It is only now and then that the specialist can come back as it were from the distant places he has been exploring and tell us something really interesting about what he has seen. Then we enjoy listening.

Do you suppose that many of us would have cared to go with Nansen in the far north? We should have been

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bored to death by the long cold winters, even if we had pluck enough to face the dangers; yet we all enjoy travelling to fresh places nearer home.

If I were to go, let us say to Cornwall, for a week's walking tour, that would be to me as truly a piece of scientific exploration as it would for Nansen to go to the North Pole. And so it would to any one of you if you went, not merely to show yourself on the esplanade, or sit on the pier and listen to the band, but to see a place you had never seen before and to get fresh experiences, to note facts you had not known, and to supply your mind with a fresh stock of memories.

Whatever we do for our mental recreation is of the type to which the Fine Arts and *Belles Lettres* belong.

All that concerns our relations with other people, and the general conduct of our life, comes under the head of Philosophy.

But all the means by which we acquire a knowledge of facts, of things, of creatures, and of places—all that we learn of their properties and uses and laws—all this is Science, and is part of the scientific education of every one of us.

This is, I fear, quite the opposite of the general idea of science. Science is popularly supposed to be those things that ordinary people do not know. That is quite a mistake. There is not a fact among the things familiar to each one of us that was not, some time in the far distant past, as much of a new discovery as the Röntgen Rays. You will presently, perhaps, take a box of wax-lights from your pocket and light the gas. Gas, as an illuminant, is not yet a century old. The very word "gas" has only been invented 300 years. Your great grandfather regarded matches as a new discovery. To him, wax meant bees-wax, and he had probably never seen paraffin-wax. The very box in which you carry them—that you throw away when empty—would have been a marvel of ingenuity to him, worthy to be described among the triumphs of modern science. For the discoveries of one age are the common-places of the next. It is hard to imagine the world without railroads, and telegraphs, and daily papers, and the penny post; and we are almost beginning to forget that the bicycle, the telephone, and the dynamo are creations of our own generation. But to the child, the common-places of the man are marvels of

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science. He learns in a few years what the world has taken centuries to learn, and every detail of it may be made as interesting to his mind as it was to the minds of those who brought these discoveries and inventions into use.

To the child, as to the man, there are these three divisions of the things he learns. He learns how to amuse himself and how to enjoy life—that represents, to him, the arts. He learns how to behave, so as to live pleasantly with his kind—that is his philosophy. And he learns about things and places and creatures: their habits, properties and uses—and that is the child's science. When I speak of the place of science in the education of the child, I mean, therefore, by science, all that body of facts concerning the world he lives in, the creatures that inhabit it, the plants that grow in it, the minerals it contains, the forces that act upon and in it, and the laws by which it is governed—that marvellous array of facts—the accumulated treasure of the ages—that is his inheritance to use or to neglect.

There is, I believe, in the present age, a tendency to lay stress upon opinions rather than facts. The studies that are most popular are mainly those which concern themselves with criticism and exercise the critical faculty. To criticise is the birthright of every rational being; but rational criticism must be based upon a broad knowledge of the subject. Yet I fear most of us would have to plead guilty to reading many more reviews than books, and sometimes we even content ourselves with a review of reviews. All this may be very well for a mind well stored with practical knowledge and ripened by experience—it may be in a measure necessitated by the exigencies of a busy life—but it will not do for a foundation. My first point then is that the education of children ought to be directed mainly to giving them a knowledge of facts. In order to explain more clearly what class of facts should be taught, I must call your attention to some of the changes that have taken place in our country within the last hundred years.

*III. Effect of the Altered Conditions of Life in England on the Education Problem.* The purpose of education is to fit us for making the best possible use of our capabilities and opportunities, and it is abundantly evident that our capabilities and our opportunities increase with education

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if that education is directed along useful lines. But what may be useful in one century may not be useful in the next, and what may be possible in one country may be impracticable in another. Hence the character of a good practical education must depend partly on the conditions of life in any particular place or time. On the other hand, it is very certain that the conditions of life will be enormously modified by the education of the people. These two act and react upon each other. Now, whenever two things act and react upon each other, it is a universal law that the changes produced by the reaction are always a little behind time. Sometimes the cause has ceased to act before the effect is produced. In science we are thoroughly familiar with this lagging behind of the effect, but the same thing is true not only of things scientific, but of things social and things spiritual. I want to point out in what respects education has lagged behind the change in the conditions of life.

There are now three people in the land for every inhabitant there was 100 years ago. But London, which had then 865,000 inhabitants, is now five times as big. Reading had a population of 10,000—it has now six times that amount. Liverpool, Manchester, Leeds, Bradford, Birmingham, Plymouth, all the large towns, have increased more rapidly than the population of the land, showing that the tendency is to crowd closer together. This has an effect on the education of the young. They see less of the world they live in, and learn less in many respects. A generation ago many a village lane had a broad strip of waste land between the roadway and the hedge, and only those who remember the delights of hunting for flowers,

and animals, and insects in those wild playgrounds, can appreciate how much the children of our own day have lost. Even those who live in the villages and country towns find the way barred with notices against trespassers in many a place that in our young days was free to all. It is, perhaps, the unavoidable result of a denser population. But to the dwellers in towns the conditions are much harder. Mile after mile of pavement, houses in close rows, until it seems a treat to get out far enough to reach the semi-detached villas with gardens, and a perfect paradise to go into a park where you mustn't pick a flower—what sort of an education is this for the young

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child?—what store of memories can such a one lay up compared with those whose early lives are spent in hourly familiarity with the wild life of the fields and hedgerows? Daily exercise in these prison-yards of civilization can never replace the liberty of the country. Yet it is not so very long since the prison grew up around us.

A century ago, salmon were netted in the Thames—80 in one haul. Where Clapton Station (on the Great Eastern Railway) is, you might stroll, with your rod and line, down the muddy lane by which the cattle were driven to the marsh and get as good salmon fishing in the Lea as any you can find in Scotland.<sup>2</sup>

London was not in sight. Hampstead was then a “village in Middlesex, nine miles N.N.W. of London, “famous for its medicinal waters, its heath, and its highway robberies. Kensington is described as “a village in England, in which is a royal palace purchased by William III. Genteel families reside there by permission of the king.”

South of the river you got into the country at once. I have an old water-colour sketch of Camberwell Gate, when there was no house in sight.

London, then as now the biggest town, was still of a manageable size. You could get out of it. Even in the heart of it there were parts not built upon—waste ground, such as children love. In spite of the lack of railways and bicycles, which alone make large cities bearable, you could get out into the country.

But, as I said, there is always a certain lag or delay between the growth of an evil and the finding of the remedy. Quite two generations lived and died after London became too big to walk out of, before a means was discovered of enticing men and women away for recreation among the fields and woods.

And two generations of people have grown up out of sympathy with the wild life of the country, and unable to understand the yearning of the child's heart to see the nesting birds, to learn the colour of their eggs, and recognise their notes. The reaction began when Richard Jefferies, as a last resource, after a vain effort to earn his daily bread as a novelist, wrote his first newspaper article on “The game-

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keeper at home.” Just the ways of the wild animals described not from books, but from the life—the hedgerow, beautiful with what we scornfully call weeds—the bristly hedgehog, quaintest of British beasts, shrilly whistling to its mate—the restless rabbit hopping from tuft to tuft—the stealthy weasel slowly and patiently tracking him to the death—the hooting of the owl and the cry of the wild duck overheard at night. He wrote of what he had seen and loved, and woke up in the hearts of many the love of nature that was dormant. He won fame and recognition in a day, because he chose a subject that the world had forgotten, and yet

hungered after. Our forefathers knew it well. In the more thinly populated land, these things make up half the interest of life; the dwellers in the town lost sight of them, and forgot too that the children love to know them.

It has been well said, that the town child is not nearly so well informed as the country child. He may be sharper, and better versed in the ways of men, but he has a much more limited range of knowledge than his brother of the country. I am told that among men and women who have become famous as great thinkers, by far the larger number spent their childhood in the country. The town life forces an early mental development; the country life lays a more solid foundation. And if this is so, is not the reason probably that the country life has wider opportunities of learning the facts of the world we live in?

*IV. The Remedy.* The advantages of letting boys and girls learn something of natural history, have been brought before the Natural History Society quite recently, in a paper by Mrs. Hart Davis, which probably some of you have heard. I agree with every word of it, and especially do I agree that each subject ought to be taught—can only be taught—practically. Nay, more—and this I think is the grand point of that paper—these natural history subjects can be taught, and ought to be taught practically, by the parents themselves taking a personal, active interest in the natural history recreations of their children.

If you are scared by the idea of its being science, call it a hobby and pursue it. It will be science all the same. And I agree too that familiarity with the life problems of the lower animals should form part of the training of every child.

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But I want to go farther into my subject; natural history is but one branch of science, there are many others of which every child should know something, and that something should be acquired not from books, but from the thing itself. There is an admirable article by Mrs. Grindrod, in the *Parents' Review* for June and September, 1897, bearing on this subject, which I commend to your attention, especially in regard to what she says about the practical teaching of geology. That difficult problem, "Where shall we take the children for their summer holiday," is easily solved if once you interest them in geology. You live on the chalk, or the clay—take them on to the red sand-stone, or the lias, or the lime-stone, or the slate. Give them an interest in the place they are going to.

You do not understand these subjects, and do not know where to go to find the red sand-stone, or the lias, or the limestone or the slate? Very well then, find out. I will merely tell you that each of these formations has a characteristic scenery of its own, characteristic fossils, and characteristic wild flowers. Find out and visit them all in succession: that will take you four years; by that time you will be quite as much interested in it as your children.

Let us leave natural history for a time. The altered conditions of life have done away with many minor occupations of the home which a century ago aided in the education of the children.

We buy things ready made: the family medicine chest of to-day is a shelf of patent medicines; last century it was a collection of drugs which you mixed yourself. Nowadays you buy your Gregory's powder ready made-up, but how much more interested the little patient felt in the old days when you got out your paper of magnesia, and your little flat packet of powdered rhubarb, and debated whether the proper dose for a child was a teaspoonful of magnesia, and as much rhubarb as would lie on a fourpenny piece, or as much magnesia as

would lie on a fourpenny piece, and a teaspoonful of rhubarb.

In many households such things as elderflower ointment, cold cream for chapped hands, lavender water, and pleasant smelling pomatums were made at home. What good housewife ever thought of buying jam? or was to be found without her elderberry wine for winter nights, her mushroom ketchup, and her own special make of pickles? All these domestic

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manufactures afforded so many object lessons to the children, and accustomed them to the idea of making things for actual use. It is wonderful what interest children take in such pursuits. If I were to suggest that the little ones should sometimes be admitted to the kitchen, possibly sedition, conspiracy and rebellion might be excited in that important portion of the empire. That would depend partly on the children and partly on yourself. There are children who feel themselves, at a very early age, to be not made of one blood with the dwellers below stairs—I doubt if they would be welcome. But there are many more, thank God, who recognise the kindly heart wherever they find it, and are welcomed by the Highest Teacher and the humblest. It is a matter of education. The child who has not eaten the pastry that its own hands have rolled, has missed one of the joys as well as risks of life. Even a king once wondered how the apple got into the dumpling, but I doubt if he ever knew that you must pare apples—when you pare them—thin, and turnips thick.

Of course, some one will tell me that all this is applied science and comes under the head of Technical Instruction, but cannot be aided by the State because you must not make things for use in your technical classes. So much the better. If it were practicable to give all our technical instruction by letting people see and perform some of the actual practical work, it would be a very great improvement.

This brings me to another branch of the subject—more in the line of fathers than of mothers. We ought to teach the young more about the industries and manufactures of their country. Has it ever occurred to you how greatly the demand for fiction has increased among the young within the last generation? Story-books, story-books—nothing but story-books. Boys who cheat at school, crib each others [sic] essays, get into all sorts of impossible scrapes, do anything except turn highwaymen—because London magistrates say that stories about highwaymen have a bad influence—these are the things that children read about. Have you ever counted up the number of stories your children get through in a year, and counted up the criminal statistics of those stories? Do not imagine I would have you keep fiction from them. It is healthy reading if the plot is healthy and not

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morbidity introspective. But there are many other subjects which will keenly interest children if they get hold of them. Books about animals and birds, books about foreign countries and peoples, books about different manufactures and machines. There used to be such books in the days of our grandfathers, and they would soon come into favour again if the right kind of book were written, and if parents encouraged the children to read them.

“Father, how do they bend iron?” says your little boy. Take him to see a smith working at the forge. Show him how bricks are made in the brickfield, how the clay is dug and tempered by the winter’s frost, how it is ground up again and moulded, how the bricks are first dried and then burnt. Show him how they change colour, how, where the heat is strong, clinker is formed, how in parts they seem to turn into [sic] a kind of glass. Show him how the builders slake lime

for mortar, and give him some to try how it sets. Let him see the stonecutters sawing stone and the carpenters sawing wood, and point out how the one saw is rounded on the cutting edge and the other straight. Let him learn what different tools are used for cutting different materials. Let him see the glazier with his diamond that could not by any possibility cut the finger of the most careless boy, and yet cuts glass, over [sic] which your knife would slip without even scratching it. Rejoice his young heart with a lump of putty. And when you bring him home thoroughly tired and magnificently dirty, make your excuses to the higher powers by pleading that you have been laying the foundation of his scientific education. Then, when your boy begins his course of elementary chemistry, it will not be a lesson to him but play. He will not have to cram up the names and properties of the elements and compounds, for he will know half of them already, and learning the rest will come easy. The reason why most elementary science school books are tedious reading is that they are so condensed as to be merely the dry bones of science. Children who have no other knowledge of such subjects, save what is contained in manuals of this kind, cannot be expected to find them interesting. But if they recognise that these books treat of processes they have seen, and objects that have amused them, they will regard science as a recreation.

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Francis Galton showed, some twenty years ago, by a series of ingenious experiments described in the *Nineteenth Century*, that the great bulk of our memories of things and facts are acquired in childhood. Let it be our business then to nourish the growing intellect with a knowledge of the facts and things concerning the world we live in. Science, as I have ventured to define it, is, in very truth, brain-food, and its function in the education of the young is to build up the thews and sinews of the mind.

One word in conclusion. It is not always, in fact it is perhaps the exception, that a boy or girl develops a taste for just that subject which the parents thought most desirable when it was quite young. You may foster a taste—you cannot always impart one. You may educate, but you cannot create. It does not always happen that the tastes a child appears to have when young, will persist when it begins to grow up. We should, I think, bear constantly in mind that we are dealing, not with a machine, but with a living mind, a soul, that has the faculty of choosing and the right to choose the lines along which to spend the energies it has been endowed with. Above all we should remember that there is one danger to which we may expose the child, to which no other creature but man is liable. We may make it self-conscious. And against that danger, all who take a real interest in the education of their children should be on their guard. No child should even know the depth of purpose which underlies the training given it. Theories of education should never be discussed in its presence. Its young life must be fed with new experiences, even as the sparrows are fed, by the care of a loving father. The season of care and forethought has not yet come for the child-mind. Youth is the receptive time, when we learn about facts and things. Opinions and ideas come later with experience. But if we feed the mind with the knowledge of the world we live in, its products, its forces and its laws, if we instil into the heart that feeling of veneration for its wonders, which comes surely from the early contemplation of them, then, when the time is ripe for the boy to stand up among men and work, he will be ready to do his share in aiding the progress of the race.

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<sup>1</sup> Read before the Reading Branch of the P.N.E.U.

<sup>2</sup>My great-grandfather often went there, and salmon were still occasionally seen in those waters by my grandfather when a young man.