

## Science Teaching in a Rudolf Steiner School: the Task and the Method

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AMONG the great advances made in the nineteenth century in the understanding of nature, there is the realisation that every organism, including man repeats at the embryonic level the evolution through which it had to pass to reach its present stage of development. Expressed scientifically: phylogenesis is repeated in ontogenesis.

This discovery has thrown new light on the position of man in the kingdoms of nature. But whilst certain long-established illusions have become dispelled by this knowledge, it did not bring forth a new picture of man's own true being. The picture that had been arrived at on the path of external observation was only a half truth.

It remained for Rudolf Steiner to complete this picture by showing that what was true for man's bodily development was also valid for his spiritual. Every man in his early years passes through a development of consciousness which, though shortened in time, is analogous to the development of consciousness of the whole of mankind. Only to understand this properly one must not imagine that human consciousness was ever in any way similar to that of present-day animals.

While man to-day experiences himself as standing opposite his surroundings as an independent and individualised being, there was a time when he knew himself equally surely as being one with his surroundings. A similar experience we have to-day, and then only partly, is our relationship to our own bodies. In this state of consciousness the soul of man was poured out, as it were, over the whole world. He was in the world and the world was in him. Ancient Indian writers describe this condition clearly in the portrayal of Atma and Brahma. Many thousands of years had to elapse before that other state of consciousness was reached, which marked the beginning of our modern "scientific" age.

Before that time it was natural for man to experience nature as he experienced himself that is, as a being endowed with soul and spirit. In order to understand nature he looked first of all at himself since he experienced himself as that being in whom all natural forces were revealed as a totality. Then from the standpoint of his own being he looked out upon the animals, the plants, and the stones as forms revealing in an ever-decreasing degree the spirit which he knew to be living within himself. For his way of comprehending nature, he himself was the most easily understood and the stone the most difficult to grasp.

This changed radically when man awoke to that form of consciousness which we call the intellectual. When possessed of this, man experiences himself as being absolutely enclosed within himself and nature as completely without. The first philosopher to express this form of consciousness was the Frenchman, Descartes (1596-1650), who said: "I think, therefore I am." (Had a man even in Greek times sought to express himself similarly, he would have had to say: "The spirit of the world is in me, therefore I think.")

Intellectual consciousness is bound to the brain, that is, to an organ which does not serve the organism in so far as it lives, but in so far as it dies. This is why the American physiologist, Alexis Carrel says in his book *Man the Unknown*: "Death is the price man has to pay for his brain and for his personality." The intellect, therefore, can most easily grasp that which is dead in the world. In outer nature this is the mineral world, in man his skeleton. Both are governed by the laws of mechanics.

Thus the beginning of the modern age is marked by the intense study of anatomy, by Galileo's investigation into the behaviour of freely falling, inert masses, and by the statement of Malpighi, one of the first botanists, that every true investigation must begin with the mineral kingdom and seek to reach man by passing through the kingdoms of plant and animal. This procedure has been adopted by natural science ever since.

To present a child in the lower classes of a school with natural phenomena in Malpighi's order and with the help of mechanical explanations, would be to outrage his psychophysical organism. For at this time the child is only making his way towards that condition of soul and body which the adult had reached between the fifteenth and seventeenth centuries. Only at about the fourteenth year does the child reach this point of development. The toddler and the very young child live in a condition of oneness with the world, which recapitulates earlier stages in human evolution, although naturally this experience is modified by the conditions obtaining in our times. It is well known that little children will hit an object which they have knocked against.

The psychological reasoning of adults, based as it is upon the experience of the intellect, seeks to explain this by saying that the child endows the outer objects "animistically" with soul, similar to the soul he experiences within himself. Nothing can be further from the truth. At this age the young human being does not distinguish soul from body, nor does he distinguish his own body as bearer of his soul from any other physical object in his surroundings.

Subject and object are as yet in no way distinguished. Put in other words, the child experiences the objects in his surroundings as subjectively as he does himself and equally he experiences himself as objectively as he does his surroundings. Thus a little child will hit his own hand, when he has done something with it which he knows to be wrong. Another example is furnished by the following little event witnessed by the writer.

A mother entered a grocer's shop with her five-year-old son, greeted the assistant standing behind the counter and told the child to do the same. This the boy refused to do. The mother repeated: "Say how do you do to Mr. X." The boy shook his head and remained silent. Further repetitions were of no avail until finally the grocer, speaking kindly to the boy, told him he would like to say how do you do to him, but could only do so after the boy had said it first. Whereupon the child was heard to say softly, but quite clearly to himself: "Head, say how do you do!" Then he repeated the greeting to the grocer aloud and joyfully.

The condition of the child before school age and in the first school years demands that the individual animals, plants, stones, clouds, moon and stars are brought to his consciousness as beings who act and converse together as separate personalities. A mechanically conceived nexus of dead causes and effects has as yet no meaning for the child.

Everything is rather the immediate result of the deeds of beings. When Rudolf Steiner spoke before the opening of the Waldorf School to those who gathered round him at Stuttgart as the future teachers of the school, he gave many an elucidating example of possible conversations between objects of nature. We need not describe them here in detail. Similar examples are to be found in fairy tales known to all. When such tales are invented by the teacher, however, they must never be sentimental nor must they attempt to use nature as a cloak for moral precepts. Whatever tales are composed by the teacher, they must always be drawn from the characteristics of the actual plants, stones, and so on.

The way of describing nature here presented, however, would remain utterly ineffective if the adult were to feel secretly that "in reality" the matter was quite different, and he had to present it to the child in this form, only because the child was as yet too stupid to understand the "real" state of affairs.

To find the proper standpoint, let us consider for a moment what is the place in natural phenomena of the mechanical connection between cause and effect, the only one accessible to adult man's intellect. Here we shall find useful an analogy which Rudolf Steiner occasionally used to stress a similar point. In the mud of a cart-track we notice certain impressions running more or less parallel to another. We investigate their cause and discover that they were made by the wheels of a cart. We push our investigations further and enquire into the cause of the movement of the cart.

This we find in the limb movement of the horses pulling it. The physical causes of these movements we are able to trace to certain energy-processes in the bodies of the animals. To push our investigations further in this direction, however, has obviously no point whatever. For what really set the energy of the horses in motion, giving rise to all the phenomena we have hitherto investigated, was, say, the intention of the farmer to drive his cart to market to sell his produce.

Here we find ourselves in the realm of an individual will governed by a definite thought-content. It is obviously senseless to enquire further along lines of a purely mechanical cause and effect. Our example quickly led us away from the realm of mechanical causation into quite a different nexus of causes.

But such are, indeed, the origins of all seemingly mechanically caused events in nature. Only, the span of time is much greater here and it increases with each lower natural kingdom. Let us be clear about the fact that to speak of cause and effect we must observe certain changes in our surroundings. For instance, we say that a stone becomes warm because the sun shines upon it, we call the sunshine the cause and the warming of the

stone the effect. If some objects were always to remain warm, because they were irradiated by the sun, and others always remained cooler, because they were never met by the sun's rays (for the sake of the example, let us ignore all other possible causes of change of temperature), we could not form the concept of causation as we did a moment ago. In order to become the subject of our observation and judgment, two objects must come into a relationship with each other, which results in a change of state in one (or both). Following our example we would have next to consider the motion of earth and sun and investigate its cause. This leads us into regions, where, indeed, the human intellect has tried to form all kinds of mechanical theories. In reality we are led here to a realm of causation fundamentally similar to that of our first example namely, into the region of purposeful will of individual beings (though of an order higher than man's).

It is by no means to be denied that science is justified in selecting isolated events such as the change of temperature of air object and in considering them as the results of certain energy processes, without pressing the enquiry further into realms of whence and whither. This procedure has led to illusion, only because one has been tempted to regard this as sufficient for "explaining" the world. And in education, it becomes a sin against the living spirit in the child to present the world to him in this way. Tire little child is one with time just as he is one with space. For the child, therefore, we must never divorce the tanner going to market from the ruts of his cart wheels on the track. Indeed, we present him with truth when we reveal to him something of the Mind and Will of the Creator while describing His creation To recognise both as well one may in outer nature, and to clothe one's understanding in words warmed by feeling, is the task of anyone who teaches children of this age in the sense of the Rudolf Steiner pedagogy. The indications which Rudolf Sterner has given can be a guide in this task.

When the child has reached the ninth year, a new task presents itself to the teacher. At this point in the child's life something occurs which, at a different level appears in early childhood when die child first says "I" to himself. This word "I" is the only word of his language which the child does not learn by way of imitation (If he did so, he would-as is sometimes the case with backward children-call other people "I" and himself "You.") A sudden lighting up of the experience of the difference between the child's own individuality and that of another, must underlie the appearance of the use of the first person in relation to the child's self But however strongly this is felt, it remains a deeply subconscious experience.

About seven years later the same experience occurs again, but this time far more consciously, distinguished moreover from the former, in that the child begins to experience himself as divided off from the whole world. He begins to be aware that the world, as mere sense-perception, conceals something.

At the same time he begins to feel the boundless immensity of the world and his own smallness. This calls forth a feeling of impotence ii face of the world, of other people and even of God: a feeling hitherto quite foreign to him

At this moment it is of decisive importance for the healthy further development of the young person whether he is in touch with adults, who can build a bridge of confidence between him and the world. This, however, can only be done by someone who is able to describe to him, by means of the spoken word, those connections with the world which once lived in the child unconsciously, but now no longer do so. Just because this need in the child has to be met, a proper teaching of nature observation is so important at this age.

Rudolf Steiner once said of this ninth year: "Now the force of man's ego-nature begins to stir. As a result of this, a question arises deep in the soul of the growing child. This question can assume one form in one child, another in another. But woe! if this question is not answered correctly by an older person!" What is here referred to may best be illustrated by a conversation which once occurred between a teacher of the Waldorf School and a nine-year-old boy, who boarded with him, as the two were walking through a little copse at sunset:

Boy: Do grown-ups know everything?

ADULT: Why do you ask that?

Boy: Grown-ups ought to know everything.

ADULT: If you really think this, why do you ask me?

Boy: There are grown-ups who do not know everything.

ADULT: Who, for example? .

Boy: Mrs. X. I asked her: If God made everything, who made Him? She said she didn't know.

ADULT: Do you know anyone who you think knows everything?

Boy: Yes, Miss Y. (His class-teacher.) She told us this morning in class that Heaven is not only up there far away from us, where we see the sky, but everywhere (pointing to a bush beside the path), in every leaf And (with great emphasis) that is true! (Short pause, then suddenly turning to his companion): Do you know who made God?

ADULT: (Who had been expecting this question): Do you know everything that God has made?

Boy: No.

ADULT: Do you think you will know everything one day? Yes. .

ADULT: When?

Boy (With great conviction): When I have been right through the school

ADULT: Oh! that would be awful. Then you would have nothing more to learn for the rest of your life! No, the school wants to teach you just enough for you to be able to learn more and more after you have left school It is in your life after you have left school that you will learn so much. And it will take you a long, long time to know everything that God has made. But how can anyone know who made God, before he knows all the things He has made? I know you will understand that a person must know all the things God has made before he can know who made God. You must go on learning more and more in school and later on in life, so that you can know more and more of God's creations. When at last the time comes when you know them all then you will be able to have the answer to your question.

To this the boy replied nothing. But his expression showed well enough that he was satisfied. He never put this question again He had had his answer: an answer which directed him to his own powers of will.

A few indications may be given here as to how the teaching of natural science is approached at this age: For reasons which have already been stated, the teaching starts with man and only reaches the mineral by way of the animal and plant.

In the teaching concerning man, the child's attention is drawn to the outer form of the human body. This is shown to consist of three parts: head, trunk and limbs. All three are formed by the same principle, the spherical form, but this principle does not come to expression equally dearly in each case. Only the head expresses this form completely. Even this is not uniformly round, but slightly flattened where it rests on the trunk. (One brings to the child a strong experience of the dynamic relationship which are at work here by using a ball of wax.) In comparison the trunk represents only part of a sphere. (See Fig. I, which is a copy of a drawing made by Dr. Steiner, when he first described this subject to the teachers. )

The greater part is not visible. The teacher prepares another ball of wax and cuts off a part of it with a knife. He shows the children the portion cut off and points out how the rest of the sphere is now invisible. He then reminds the children that they have often seen a similar shape, when they have looked up at the moon which is sometimes a full disc, but at others only a portion of it.

This indication must not be misunderstood. It is not the intention to suggest a kind of mystical cosmic relationship between the trunk, with its heart, lungs and other organs, and the moon. Rather the intention is to show the child in a visual and convincing way that there are things which are greater than their visible parts, and that to this category belongs a part of his own body. In the earlier years of his life the child was instinctively aware of this. Now he is brought to the point of winning this knowledge once again by observation wisely guided by the teacher. Man belongs with part of his being not to himself but to the outer world. The knowledge of this fact will be of the utmost importance in the future life of the child and is called into his newly awakened consciousness by the teacher, when he shows him the morphological secret of the structure of the middle part of his body. This he makes understandable by his demonstration with the small wax ball and by pointing to a phenomenon observable in the far spaces of the heavens.

This experience is strengthened by a discussion of the third part of the body: the limbs. Here the sphere, which is the basis of the human form, is not visible at all because it is as large as the universe itself The only part of the sphere that is visible in the human form are four radii, which ray down from the circumference to the centre (not the other way round), and of these only the ends are visible. Of this at this point no more is said, for the child at this age could not understand more, being at that time not sufficiently conscious in his limbs. The teacher points the child to a future time, when he will be advanced

enough to understand more. (This is a principle of method which is of pedagogical value especially at this age.)

Instead of further elaboration of this point, the child is made conscious, with all the emphasis at the teacher's command, of the different tasks of the limbs on earth, by being shown the clear differentiation between tire arms and legs, a fact which distinguishes man from all animals. Animals use their limbs only to serve their own bodily needs-theirs are "selfish" limbs. Only his legs does man use in this way. For with his arms he can work for his fellows. In this way the transition is made from the external observation of the head to inward experience of the volitional activity of the soul in the limbs. The child is first shown what he is as the wrought work of his Maker, and is then led to a realization of that part of himself which he can use for Iris own activity.

About the teaching of the animal kingdom which follows, only a few things can be said in the compass of this article. A number of animals are described in such a way that it becomes clear to the child that they represent mere! / one or another part of the human form. This theme is followed up through the other families of animals, so that it becomes obvious to the child what Goethe expressed so pertinently by saying that the animal kingdom was the human form spread out over the world.

Naturally, such a thought must not be presented to the children in air abstract form. Rather are the various kinds of animals to be shown to him in such a manner that a strong intuitive feeling is evoked of their bodily construction and their habits, and of how much these two things belong together. In this way the child learns to know both the parts of his own body and his true relationship to the animal kingdom. He understands that he is the only being who contains within himself all the possibilities of a physical body, which appear in nature as divided out into separate beings.

It will not be difficult to understand what Dr. Steiner meant when he said that through such teaching of zoology the child is helped to develop a sense of moral responsibility which will be very fruitful in later life. Dr. Steiner's other remark will not be so readily understood at first sight: that through a rightly conducted teaching of the plant kingdom a healthy faculty of judgment will be inculcated. The following example may make this clear.

When Rudolf Steiner was discussing with the teachers the introduction to the first beginnings of the teaching of botany, he 'showed how he would do it.

He chose the dandelion as his example and, without naming the plant, began to-describe the various stages of its development, beginning with the last: the round ball of seeds; With a series of simple descriptions, always calling upon the children's own recollections of what they had seen, he took them back through all the stages of the plant. After having thus evoked a picture of the entire plant by passing through is various stages in time, he concluded by saying (now naming the flower for the first time): "Children, this is the Dandelion"

We cannot here attempt to bring forward other examples from the wise suggestions which Dr. Steiner made. It must suffice to explain that the plant is always treated first as an organism in time, and secondly as standing in relationship with all the surrounding elements: earth water, air and fire. Each is shown as having its own peculiar part to play in the forming of the plant. Thus the child is brought to the experience that anything which appears in a transitory form in space presents a rip-die, which can only be solved if one extends one's observation out into space and time. How sorely needed is this very faculty in life, if one is to judge events healthily!

This is not the place to describe the whole curriculum of natural science as it stretches through the twelve classes of our schools. Our aim is only to give some impression of how the curriculum in this as in all other subjects, is conceived in the light of the developing child. When the mineral kingdom is reached, the minerals are so presented that they appear in their relationship with the whole earth, her mountain formations and so on At this point the child is introduced to that realm where nature's purely physical forces hold sway. Here the teaching of physics and chemistry begins After that the path is retraced through the natural kingdoms, beginning with the mineral kingdom in die sixteenth year, followed by the plant world and finally the animal. These are now treated in a more "scientific" way.

Still natural details are never brought forward in such a way that only abstract knowledge is communicated to the pupil but always so that his powers of

thinking, feeling and willing are called upon in a harmonious way. At this stage of school life it is the aim to implant into the young man or woman, standing on the threshold of adulthood, the conviction, which Goethe once put as follows:

If in the moral sphere we are to rise by faith in God, Virtue and Immortality into an upper realm, so draw ing nearer to the Primal Being, why should it not be likewise in the intellectual? By the contemplation of an ever-creative Nature, may we not make ourselves worthy to be spiritual sharers in her production?