REITH LECTURES 1950: Doubt and Certainty in Science

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Lecture 5: How We Learn to Communicate

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When I was in Paris preparing these lectures I went one Sunday afternoon to the cathedral of Notre-Dame. As I looked up at the tremendous vertical lines of the nave I found that there were tears in my eyes. Why is it that one is sometimes moved in this way by a great church? I have felt the same in St. Peter's in Rome.

When I left Notre-Dame that Sunday I walked around the outside and looked at the mountain of stone supported by its flying buttresses. Then, sitting in the sun, I speculated on this extraordinary human habit of making great buildings. As a biologist I naturally considered, first, what may be its significance for human survival. Secondly, why do such works move us in this way? I have been maintaining in earlier lectures that a special characteristic of modern man is the faculty of communication between individuals. I believe that it is possible to show that the symbols of society, such as churches, form a link in the process of ensuring communication. They play an essential part in establishing the rules of brain action that make co-operation possible. Our emotion when faced with them confirms the importance of communication in our lives. The symbol gives a sudden powerful reminder of our dependence upon others and elicits one of our earliest responses—crying. I want now to try to use these ideas to help in tracing the development of communication both in the history of the race and in each individual person. In doing so I shall suggest one of the main reasons why these symbols of religion become the 'most important features of our lives.

Wild animals in nature co-operate very little. They usually react to each other by attack or by flight. Yet the earliest stages of communication were present before the coming of man. Reproduction involves co-operation between individuals of two sexes. In each sort of animal, therefore, the males and females display particular signs that produce mating reactions in members of the opposite sexes. For this end animals draw attention to themselves in most fantastic and complicated ways, from the wonderfully coloured feathers and the displays of birds to the evening dresses and dances of man. All, of these demonstrations may be called sign stimuli. They constitute primitive means of communication. The intensity and vigour of our reactions to them is perhaps a result of their antiquity. For literally hundreds of millions of years our ancestors have reacted to such mating signs. It is not surprising that sex enters unexpectedly into so many aspects of our thoughts, speech and actions. It is indeed the old Adam.

But in each individual person the mating reactions develop rather slowly. Before they are fully active the individual has already learned other ways of co-operating. The baby communicates with its mother, with a cry and a smile; that is to say in the least sexual way imaginable. Later, the child gradually develops sexual reactions to other individuals, but only after its brain has learned different ways of activity. These non-sexual ways of communicating, especially by the use of words, have been acquired

relatively recently in evolution, with the development of the cerebral cortex. But the sexual communicating system was already well developed millions of years before the calculating powers of the cortex had reached their present stage. The sexual system gradually comes into operation as a child matures and approaches puberty. But it may not always fit easily into the rules that the cortex has been learning since earliest childhood. A result of the confusion may sometimes be the partial or complete failures of communication that we call neurosis. So with these ideas we can put sex in its right place as the earliest form of co-operation between individuals. They also suggest a biological setting for some of the recent great discoveries of psychology.

But what we especially want to know about are the characteristically human methods of communication. How does the brain make us speak and therefore think as we do? We can compare the use of the words we speak with that of tools and other indirect means of satisfying need. Even an ape will get food that is out of reach by dragging a box beneath and standing on it. He may make a pile of as many as four boxes. He can use a stick lying near the boxes to pull food into his cage. He may join two bamboo sticks together for the purpose. These are examples of indirect solutions by the use of very simple tools.

There have been many speculations about the origin of language. I want to follow the simple suggestion that a name or a sentence functions as a tool, to produce an appropriate reaction in another person. Sexual responses are produced by sign stimuli. For the non-sexual ways of communicating words and other signs are used in the same way. The words appropriate to each object, action or situation are first learned by hearing them and uttering them. Each human brain learns a set of rules for producing words. It also learns to react appropriately to the word signs given by others. In my last lecture I showed how the brain must have such rules of operating. With them it selects those parts of the sensory input that are significant. A man born blind, on acquiring his sight, has to learn to pay attention to the outlines of things. He does this as a child does, by learning to select those features of the sensory input that have names. Have you noticed, for example, that when children make drawings they tend to put in only parts that they can name? In learning a language, therefore, a person not only gains the advantages of communication with his fel1ws. He also sharpens his own observation. This is a truism that follows from the fact that through the use of words men are able to use the observations of others. What it amounts to is that by the use of words we learn to see the connections between things that are not obviously related to each other. In fact, like all tools, words lead to the satisfaction of needs in indirect ways.

I have explained earlier the suggestion that the brain works by fitting the input that comes to it into the models it has already learned. The use of words helps enormously in this process of fitting. With a word we extract from any situation the feature referred to. Then by using the same word again we can compare things seemingly unlike. To take a very simple example. We can compare an orange with the sun by holding the one up towards the other. But we can do it when neither is present by saying of each that it is ‘round’. Then we can go on to discuss ‘roundness’, with all that it involves. The point is that words, besides making other people do things for us, also form a means of pursuing the brain habit I have mentioned of connecting things not obviously alike—of getting a living by indirect means. I hope to show later that the whole recent history of the intellectual evolution of man has been a process of

making wider and wider brain associations in this way. Man has been acquiring better and better models, so that he can fit together ever more and more experience. As a result, he can now understand, as we say, the cause of much that goes on around him. With this knowledge, properly used, he can take ever more courage from recognition of his own place in the scheme of things. Moreover he can use this knowledge to do all sorts of practical things that once would have seemed miraculous.

Teaching a Child

The essence of the whole process is learning to conform to the conventions of the group in which the individual lives. When we ask a child to name something, we are teaching him to make a response that ensures communication. We are also, as I say, passing on to him our own ways of observing. We have various means of rewarding him when he is right, punishing him when wrong. We can do it by feeding or beating him, but the first can only be infrequent and the second tends to cut off all connection with him. We do it much more subtly by establishing first a special behaviour sequence, that of communication. The child's most important lesson is that of the stimuli reaching its brain, those which can be fitted into a communicable form are satisfactory. It is difficult to appreciate how deeply this first way of responding controls all the others, which are later learned through it. Once this is established it is not necessary to set up an elaborate apparatus of rewards and punishments to teach each new association. By giving the signs of approval or disapproval the child can be shown instantly whether he has produced the right reactions or not. His 'whole brain system is trained so that it seeks to organise all the sensory input into some communicable output—to put it into words. From his earliest days cutting off means hunger and cold, whereas communication means satisfaction. The smile becomes the symbol of completion and satisfaction and the cry that of disorder and pain. By association with these signs that communication has or has not been achieved, the names and hence ways of selecting, of observing, that are 'right' are built into the brain system.

It would be possible to follow out how the whole pattern of a child's brain action is built up as successive rules are learned, first during family and then during social life. This is the field of psychologist, educationist, sociologist and anthropologist. The, sequence is something like this. Early on the child finds that there are rivals in the field with whom he must compete if his wants are to be satisfied. He uses his growing talents of communication to attract the attention that he needs and even to prevent that attention being given to others. Everyone who has been reared in or who has reared a family knows how deep these influences are. A complete psychological theory has been developed as to the way in which position in the family influences the development of character. The point is that as the child grows it develops its methods of response to other members of its own species. In a well-organised community these responses form a continuous series, so that by the time a person is adult he is a well-trained social creature. This is achieved by carrying over into adult life the practice of obtaining the satisfaction of our needs by co-operation, a habit originally developed, only for the young.

It is not known what was the essence of the first social invention, but a very important stage must have been the development of communication to a point where it was possible for large numbers of people to work in harmony. Remember that animals do

not come together spontaneously; they usually tend to repel each other. If we modern men are different it is, because we have been trained to react to particular sign stimuli that serve as the means of bringing people together, of communicating. Each of the social species of animal has its own special way of doing this; dogs keep together by smell, ants by touch, bees by special forms of dance. In the case of man the cement for the formation of societies was already to hand in the use of facial expression and of speech in family groups. The individual depends in adult life for the satisfaction of his needs on others. This is a relationship that in animals does not usually extend beyond childhood. Biologists have seen many other signs that adult men are like unborn apes. We have sparse hair, weak muscles, and thin bones of the skull. Moreover, sexual maturity is reached much later in man than in any ape. So it is no surprise to find in adult man behaviour that in apes occurs only in childhood.

The great new societies that grew up with the development of irrigation and other special forms of agriculture came to use some striking new means for keeping individuals together. By study of the remains left by these early civilisations and by comparison with modern man we can make a plausible reconstruction of how this came about. The methods that emerged were based on a continuation of the ways of brain action used by mammals for millions of years already. To find out what these new methods were let us look at two of the characteristic actions of social man.

First, there is a tendency for large numbers to assemble together at one place. There is evidence of this from earliest times to the great crowds that gather today for rallies, congresses, processions, football matches and many other events. Secondly, much effort is spent in building great structures within or around which these assemblies take place. The largest and most durable buildings that men make are not generally mainly for use in the daily business of life, but are symbolic or religious. It is curious that biologists have paid so little attention to these two peculiar human characteristics. In no other animal is the habit of assembly quite so well developed as in man. The biological significance of the habit is this. By it the brain associations necessary for communication are formed. Some of the earliest of these assemblies occurred at prominent hills of suitable shape, on and around which large numbers of people came together. And one of the clearest pieces of evidence that we have about early social man is that he soon began to build large artificial hills. Objects nearly as big as anything that we build now were the product of some of the early agricultural communities nearly 10,000 years ago. Such huge objects are found all over the world—an English example is Silbury Hill in Wiltshire.

I suggest that the value of building these objects was this: they were the signs by which men were trained to react to each other in such a way as to make society possible. At first, this must have been learned by all coming together at one place. Ritual feasting at such assemblies would indicate the satisfaction to be derived from association. Perhaps sacrificial ceremonies indicate the dangers of separation from the community—for this purpose, human sacrifice is no doubt best of all. Such ceremonies are occasions of training of the brains of the members of the community, so that they shall continue to react correctly, and hence get a living by co-operation and communication. Mankind has gone on assembling and building assembly places ever since. It is assuredly one of those features that the biologist should notice about him, that he tends to come together at intervals in huge swarms. And generally he puts on his finest clothes for the occasion— to watch some display, into whose symbolism

I cannot now enter but which often involves a struggle in which someone is victorious over someone else.

The Hill as a Symbol

All sorts of other habits grew up around the central symbol of the hill. What more obvious, for instance, than to bury the dead in it, thus giving them eternity by placing them within the very sign of society? Indeed, this is a further reason why the sign itself must be large—it must include the past as well as the present. In fact there is a complicated relation between allaying pop1e's anxiety about their future by burying the dead, and training their brains to co-operate while living. The two activities have been connected from such early times that we cannot say which came first. The hill is a very convenient symbol because it is easy to ensure that the association is quickly formed. Everyone can stand or sit on the symbol while the ceremonies are performed. There have been, of course, many variants of the place of assembly; an early one is perhaps a huge stone circle such as Stonehenge, a symbol that everyone can get into. But there are obvious disadvantages about large symbols too. If they are to act as a sign for the whole of a big population it soon becomes hardly possible to get everyone on or in. You can, however, have a lot of rather smaller objects or temples in place of the original natural holy mountain. Their construction may be reckoned as the first act of making tools of communication, the direct ancestor of television engineering we might say. To be effective the places of worship must be alike and similar ceremonies must be performed at them, otherwise the association with the group is not reinforced.

A similar way of action may have led to other inventions of the same sort, namely still smaller symbols, such as images. These must also have standard form, and their significance can be learned by exhibiting them in temples and naming them, after which they, or others of the same form, can be carried away and yet still preserve the associations. I need not pursue this subject here into its endless ramifications, but I would have you notice how use of one method of communication leads to another, still more efficient for the purpose of reinforcing the association with the group. We shall find this alternation between new associations and new inventions and new names proceeding continuously up to the present day.

Thus places of assembly, or images connected with them, became the symbols of co-operation. These cruder manifestations of unity were the only cement by which, in early times, man the individual was associated with the group. He has come to find much more powerful methods later, but they are not quite so easy to use and the old methods survive for those who have not yet quite mastered the new. Human brains, having learned to use the model of hill or temple, then proceeded to explore the possibility of further comparisons. We have seen that man speaks about himself by the use of a visual model, supposing that the special entity 'I' of which he wishes to talk lies inside the body, as a person lives in a room. This model was very early extended to all sorts of other objects which are supposed to be tenanted by ghostly entities. It was obvious to apply it to the assembly hills or temples; each was given its own inhabitant. The essential feature of the assembly place was thus expressed by a comparison—with a named person who lives in it, and the person in question is like a father The father is already the symbol, not only of co-operation in the family, but also of the source of power, food and the means of life generally. The model of a

ghostly father resident in the temple therefore serves to emphasise not only the unity of the group but also the value of the unity.

But here there is a difficulty; each temple has its own spirit. How then can all temples serve as a means of association for a large group? At some stage arose the habit of speaking of a single god, resident not in one but in many temples. This was a discovery of very great power. The peoples who first learned it produced one of the greatest of all human advances. Notice that it has the characteristic feature of all comparisons; it seems at first quite illogical. The model stretches credulity so far that, like many new abstractions, it seems on the face of it absurd. How could one person live in many places? You remember the dilemma of David, driven out of Israel to live among the Philistines? His god was associated with the particular soil from which he had been expelled, so he felt separated from his god and actually— and this is the point—he felt unable to worship him. Naaman overcame a similar difficulty by carrying two sacks of hallowed soil with him on a mule. But the real solution of the problem came by emphasis on the name of the god. I have already shown how, by naming, we abstract the feature that we want to emphasise in any situation. The worship of the name of one god, not associated with any particular place, was surely the symbol that provided the cement for the next stage of human evolution, in which we partly still are. It was a wonderful discovery, much more powerful than the use of visual symbols, which require giant hills, or temples, or images.—though these had been great inventions in their time.

We can imagine how in this way modern religious and ethical systems have come into being and given great strength to the communities that have them. We do not know whether this development occurred once only or many times separately. But in these lectures I am mainly concerned to trace the ways of human action that have led up to our present scientific age. For this purpose it is sufficient to notice that, in spite of the clues taken from Greek and Arab thought, science developed mainly out of the Christian communities worshipping one god. Ever since it has flourished chiefly in the more strictly monotheistic parts of the Christian world. In later lectures I shall be dealing with this development of science. Before we go on to these newer ways of speaking that are current today, 1 should say a word or two about symbols other than religious ones. Mankind uses symbols, especially words, at all levels in his daily life, to convey his wishes and intentions to others. I have been so interested to follow the use of the more central symbols that I have perhaps seemed to forget the innumerable humbler ones. It is the daily uses which are important and practical. My thesis is that the use of words to ensure co-operation is the essential biological feature of modern man, the way he gets his living. The general symbols of religion have had a special importance in this respect because they have been the cement that has kept society together. Another set of symbols that tends to do this arises round the use and exercise of the power that society wields—the symbolism of king and state. The symbols of religion and of power have much in common. The central and most important ways of acting are the so-called theoretical ones, those of religion and pure science. The applications of these are the affairs of practical men and kings, of soldiers and engineers.

My purpose in this lecture has been to show you how it is possible to use our knowledge of brain functioning to understand even the highest activities of man. Of course I have not been able to make anything like a complete survey. But I hope that

by these ways of thinking it may be possible to see the common factors that influence our behaviour in early childhood, as we grow and feel the influence of sex, and even in the development of our religion. By tracing the history of communication by the individual and by the race, one can see the continuity of the process of change, not only from childhood to old age but also from the earliest men to our present social system. At each stage the rules of communication control much of our observation as well as our action. Therefore we cannot fail to respect, promote and improve them, as rules. But by the same token we learn to try to avoid their tyranny. Communication is important to us as a means, but it is not the end of existence.