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*The Study of Man**

By Michael Polanyi

IN the days when religious dogma controlled all knowledge, religious dogma was a source of many errors. Now that the scientific outlook exercises predominant control over all knowledge, science has become the greatest single source of popular fallacies. This is not to denigrate science. Scientific genius has extended man's intellectual control over nature far beyond previous horizons. By secularizing man's moral passions, scientific rationalism has evoked a movement of reform which in the last hundred and fifty years has improved almost every human relationship, both public and private. A rationalist concern for welfare and for an educated and responsible citizenship has created an active mutual concern among millions of previously submerged and isolated individuals. Scientific rationalism has indeed been the main guide to intellectual, moral, and social progress since the idea of progress first gained popular acceptance about a hundred and fifty years ago.

But unfortunately the ideals of science are nonsensical. Current biology is based on the assumption that you can explain the processes of life in terms of physics and chemistry. And of course physics and chemistry are both to be represented ultimately in terms of the forces acting between atomic particles. So all life, all human beings, and all works of man including Shakespeare's sonnets and Kant's *Critique of Pure Reason* are also to be so represented. The ideal of science remains what it was in the time of Laplace: to replace all human knowledge by a complete knowledge of atoms in motion. In spite of much that is said to the contrary, quantum mechanics makes no difference in this respect. A quantum mechanical theory of the universe is just as empty of meaning as a mechanical theory.

This is the heart of the matter. This is the origin of the whole system of scientific obscurantism under which we are suffering today. This is why we corrupt the conception of man, reducing him either to an insentient automaton or to a bundle of appetites. This is why science denies us the possibility of acknowledging personal responsibility. This is why science can be invoked in support of totalitarian violence; why science has become the greatest source of dangerous fallacies today.

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I have said this so often that I tend to forget that to most people such talk must still sound fanciful or at least wildly exaggerated. So let me show you some examples of the absurdities imposed by the modern scientific outlook. Listen to three authoritative voices denying the existence of human consciousness. (1) 'The existence of something called consciousness is a venerable hypothesis: not a datum, not directly observable...' (2) 'Although we cannot get along without the concept of consciousness actually there is no such thing.' (3) 'The knower as an entity is an unnecessary postulate.' These three statements were made respectively by Hebb, Kubie and Lashly at a Symposium on Brain Mechanism and Consciousness in 1954. It is not that these distinguished scientists really believe that consciousness does not exist. They know for example that pain exists. But they feel obliged to deny the existence of consciousness for it eludes explanation in terms of science, and so as scientists they must deny its existence in the interest of science.

You meet the same situation in the study of society. Anthropologists must try to describe social groups in strictly scientific terms. So most anthropologists will insist on carrying out their analysis of society without mention of good and evil. A distinguished anthropologist has represented the unspeakably cruel murder of supposed witches, as a cultural achievement. 'Some social systems—he writes—are much more efficient than others in directing aggression into oblique or non-disruptive channels. There is no doubt that witchcraft is Navaho culture's principal answer to the problem that every society faces: How to satisfy hate and still keep the core of society solid.' Another anthropologist has described head-hunting as fulfilling an essential function to the societies in which it is practiced. 'The religion of Eddystone Islanders' writes Gordon Childe, 'provided a motive for living and kept an economic system functioning.' Eddystone culture only proved wrong in this view because head-hunting kept down numbers, and so made technical progress superfluous, eventually leaving the islanders a prey to British conquerors.

For this kind of scientific anthropology social stability is the only accepted value and becomes therefore the supreme social value. Yet all the time we know, and the anthropologists know it like everybody else, that the stability of evil is the worst of evil. They ignore this vital fact only for the sake of scientific detachment. The more absurd their attitude, the more it adds to their reputation of scientific severity.

The roots of this perversion go deep. The rebellion of scientific rationalism which overthrew religious authority was based on the appeal to facts against dogma. Positivism merely pursued this movement to its logical conclusions by repudiating metaphysics along with dogma. The Viennese school of philosophy carried out this programme by rejecting as metaphysical any statements about the world that are not verifiable, or at least falsifiable, by experience. This view discredits all ethical statements. For if you say that it is wrong to bear false witness, you say something that cannot be proved or disproved by any facts. No conceivable occurrence, no measurement or observation, can decide whether any action is moral or immoral, just or unjust, good or evil. Hence to call something immoral, unjust or evil has no empirical meaning; and it appears doubtful then whether it has any other meaning than the kind of exclamation one may utter when biting at a worm inside an apple or when shouting 'boo!' to stop others from doing things which you find disgusting, or for any other reason want to prevent from being done.

Admittedly, this conception of moral judgment is felt to be unsatisfactory. For whenever we utter moral condemnation or approval, or else seek guidance in a moral dilemma, we always refer to moral standards assumed to be generally valid. And we revere men like Socrates or Gandhi who faced death to uphold such standards. Hence the later disciples of philosophic positivism are engaged now in great efforts to save moral standards from being cast out as altogether unfounded. But in vain. So long as science remains the ideal of knowledge and detachment the ideal of science, ethics cannot be secured against sceptical doubt.

In earlier ages philosophers could keep their gravest doubts among themselves; Hume brushed them aside for a game of backgammon; his great successor Kant still thought that there was no danger of philosophic scepticism ever gaining popular influence. But ours is an age of philosophic mass-movements. Any glance at my bookcase or at this mornings newspaper reveals the same corrosive passion for destroying man's moral image of himself. Two little English books were written simultaneously in 1942 one entitled *The Abolition of Man*

* This is a slightly revised version of Professor Michael Polanyi's opening address before the Bombay seminar on *The Place of Science and Humanities in Higher Education.*

the other *The Annihilation of Man;* the first by C. S. Lewis, the second by Leslie Paul. C. S. Lewis takes a school-book on English as a specimen of the debunking of moral and esthetic sentiments by the teachings of our time. Lewis acknowledges that this debunking had started after the first world war with the purpose of saving men from being swayed by nationalist propaganda. But he warns that the dishonouring of traditional ideals will merely divert man's moral passions into baser channels. Leslie Paul's book bears out this view. He quotes the following lines of Oswald Spengler by which he acclaimed Hitler in 1934: 'Man is a beast of prey. ....would-be moralists... are only beasts of prey with their teeth broken...remember the larger beasts of prey are *noble* creatures...and without the hypocrisy of human morals due to weakness.' Observe the argument: (1) man is a beast (2) his hypocrisy is revolting (3) beastliness alone is honest and noble. You may think this moral approval of brutality to be a German vice. But Simone de Beauvoir hails the glorification of crime and lust by the Marquis de Sade as great moral pronouncements; and then identifies these teachings of crime and lust with the exposure of bourgeois ideologies by historical materialism. So the French Marxist writer transmutates bestiality into moral rebellion even as the Nazi historian does. We see here how scepticism drives men's moral sentiments underground, whence they re-emerge combined with sadism as a creed of salvation by violence. Fascism thus converted patriotism into a cult of brutality, even as Marx has converted Utopianism into a science. Our age is racked by the fanaticism of unbelievers.

This is what C. S. Lewis meant by the Abolition of Man; it is what I had in mind when saying that science is the greatest source of dangerous fallacies today. The question is: Can we get rid of all these malignant excrescences of the scientific outlook without jettisoning the benefits which it can still yield to us both mentally and materially?

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In this talk I shall suggest that we should try to mend the break between science and our understanding of ourselves as sentient and responsible beings, by incorporating into our conception of scientific knowledge the part which we ourselves necessarily contribute in shaping such knowledge. I shall proceed by a critique of the exact sciences in order to displace quite generally the ideal of detached observation by a conception of personal knowledge.

Laplace's ideal of embodying all knowledge of the universe in an exact topography of all its atoms, remains the heart of the fallacies flowing from science today. Laplace affirmed that if we knew at one moment of time the exact positions and velocities of every particle of matter in the universe, as well as the forces acting between the particles, we could compute the positions and velocities of the same particles at any other date whether past or future. To a mind thus equipped all things to come and all things gone by would be equally revealed. Such is the complete knowledge of the universe as conceived by Laplace.

This ideal of universal knowledge would have to be transposed into quantum mechanical terms today, but this is immaterial. The real fault of the kind of universal knowledge defined by Laplace is that it would tell us absolutely nothing that we are interested in. Take any question to which you want to know the answer. For example, having planted some primroses today, you should like to know whether they will bear blossoms next spring. This question is not answered by a list of atomic positions and velocities at some future moment on May 1st, 1961. It must be answered ultimately in terms of primrose blossoms. The universal mind is utterly useless for this purpose unless it can go beyond predicting atomic data and tell us whether they imply the future blossoming or the failure to blossom of the primroses planted today.

Never mind for the moment whether we could actually infer something about primroses, or about anything else that we may be interested in, from a topography of atomic positions and velocities. It is enough to realize in the first place that Laplace's representation of the universe ignores as it stands all our normal experience and can answer no questions about it. I shall show that this shortcoming of the Laplaceian scheme is due to a misunderstanding of the very nature of experimental science.

Consider the use of a geographical map. A map represents a part of the earth's surface in the same sense in which experimental science represents a much greater variety of experience. To use a map to find our way we must be able to do three things. First we must identify our actual position in the landscape with a point on the map, then we must find on the map an itinerary towards our destination and finally identify this itinerary by some landmark in the landscape aroud us. This map reading depends on the skill of the person using the map. No map can read itself.

Turn now to the exact sciences which Laplace had in mind when defining universal knowledge. The map is replaced here by formulae like the laws of planetary motion and we find that these are applied once more in three stages. First we make some measurements which yield a set of numbers, representing our experience at the start; from these numbers we then compute by the aid of our formulae, a future event; and finally we look out for the experience predicted by our computation. Both at the beginning and at the end we identify numbers with observed events and this is a kind of map-reading for which we must rely once more on our personal skill.

People miss this point when they speak of the exact predictions made by the mathematical sciences. Take for example astronomy which was very much in the mind of Laplace when he formulated his ideal of universal knowledge. You might think that Newton's laws predict the exact position of the planets at any future moment of time. But this they can never do. Astronomers can merely compute from a certain set of numbers which they identify with the position of a planet at a particular time, another set of numbers, which will represent its position at a future moment of time. But no formulae can foretell the actual readings on our instruments. These readings will rarely, if ever, coincide with the predicted numbers as computed from Newton's laws, and there is no rule—and *can be* no rule – on which we can rely on for deciding whether the discrepancies between theory and observation should be shrugged aside as observational errors, or be recognised on the contrary as actual deviations from the theory.

Even the most modern instruments are affected by this uncertainty. There is ample evidence that even by using these highly automatised recorders, we cannot exclude a personal bias that might affect a series of readings. So even the most exact sciences must rely on some degree of personal skill and personal judgment for establishing a valid correspondence with – or a real deviation from – the facts of experience.

And we may conclude quite generally that no science can predict observed facts except by relying on an art, the art of establishing by the trained delicacy of eye, ear and touch, a correspondence between the explicit predictions of science and the actual experience of our senses to which these predictions shall apply.

You may feel that I am attributing undue significance to a small and perhaps altogether negligible co-efficient in the structure of science. But this is like excusing the house-maid's baby on the grounds that it was so small. It is the principle that matters, and in fact, the slight gap between theory and instrument readings will turn out to be but the thin end of a wedge – and of a very bulky wedge indeed.

Look at the building which compose a modern university. You see rows upon rows of laboratories and dissection rooms, and

you see a whole array of teaching hospitals. Students of chemistry, biology and medicine spend a good half of their time in these places attending practical classes. All this time is spent by them in an effort to bridge the gap between the printed text of their books and the facts of experience. They are training their eyes, their ears and touch to recognise the things to which their text-books refer. They are acquiring the skills for testing by their own hands the objects of which their text-books speak. There can be no question here any longer of shrugging aside as a marginal factor the purely personal judgements by which the theoretical body of science is brought to bear on experience. Text-books of chemistry, biology or medicine are so much empty talk without the personal knowledge of their subject matter. A distinguished medical consultant's, or surgeon's, excellence is not due to his more diligent reading but to his skill as a diagnostician and healer, a skill acquired by his practical experience. His professional distinction lies in a massive body of personal knowledge.

Remember also that the fundamental concepts of the biological sciences are drawn from every day experience in which exact measurement plays no part. The existence of animals was not discovered by zoologists, nor that of plants by botanists. We learn to distinguish living beings from inanimate matter long before we study biology and we continue to use our original conception of life within biology. Psychologists must know from ordinary experience what intelligence is before they can devise tests for measuring it scientifically. It was ordinary people, knowing the sufferings of sickness and the joy of recovery, who set medical science its task.

It is true that the progress of science is ever moulding and modifying our everyday conceptions. But when this is allowed for it still remains true that there is a vast range of everyday knowledge conveying delicate and complex conceptions, which serves as guide to biology, medicine, psychology and to the manifold disciplines which study man and society. And this knowledge is transmitted by adults to the child as he grows up, in the manner of a practical art, in the very same way as a student is taught scientific skills and expert knowledge at the bedside and in the laboratory.

This brings out squarely the general principle which limits the scope of the exact sciences of which the Laplaceian vision is the extreme idealization. Most of the questions in which we are interested are of the same kind as that about the blossoming of newly planted primroses. Answers to these questions must be given in terms of *personal knowledge* available to the layman, as corrected and expanded by sciences relying in their turn on the *personal knowledge* of experts. Laplaceian predictions would convey none of this personal knowledge. To claim that a world-wide topography of atoms represents universal knowledge is indeed to contradict the very principle by which a mathematical theory can bear upon experience. Hence, if the Laplaceian vision, or a corresponding ideal of the exact sciences, succeeded in establishing themselves as the total of man's knowledge, they would impose complete ignorance on us.

We must revise therefore our ideal of science by accrediting skills and connoisseurship as valid, indispensable and definitive forms of knowledge. And this I believe would open the way to a far reaching relaxation of the tension between science and the non-scientific concerns of man. We shall see this by enquiring into the essential structure of knowing as an art.

A striking feature of knowing a skill is the presence of *two different kinds of awareness* of the things that we are skilfully handling. When I use a hammer to drive in a nail, I attend to both, but quite differently. I *watch* the effects of my strokes on the nail as I wield the hammer. I do not feel that its handle has struck my palm but that its head has struck the nail. Yet in another sense I am highly alert to the feelings in my palm and fingers holding the hammer. They guide my handling of it effectively, and the degree of attention that I give to the nail is given to the same extent in a different way to these feelings. The difference may be stated by saying that these feelings are not watched *in themselves*, but I watch something else by keeping aware of them. I know the feelings in the palm of my hand *by relying on them for attending the hammer hitting the nail.* I may say that I have a *subsidiary* awareness of the feelings in my hand which is merged into my *focal awareness* of my driving in the nail.

We may think of the hammer replaced by a probe, used for exploring the interior of a hidden cavity. Think how a blind man feels his way by use of a stick, transposing the shocks transmitted to his hand and to the muscles holding the stick into an awareness of the things touched by the point of the stick. We have here the transition from practical to descriptive knowing and can see how similar is the structure of the two. In both cases we know something focally by relying subsidiarily on our awareness of something else.

Let us confront this conclusion now with the fact that there is one single thing in the world we normally know only by relying on our awareness of it for attending to other things. Our own body is this unique thing. We attend to external objects by being subsidiarily aware of things happening within our body. The localization of an object in space is based on a slight difference between the two images thrown on our retina, on the accommodation of the eyes, on controlling the eye motion, supplemented by impulses received from the labyrinth, which vary according to the position of the head in space. Of all these things we become aware only in terms of our localization of the objects we are gazing at and in this sense we may be said to be subsidiarily aware of them. We may say in fact that to know something by relying on our awareness of it for attending to something else, is to have the kind of knowledge of it as we have of our body by living in it. It is a manner of being.

Our subsidiary awareness of tools and probes can be regarded then as a condition in which they form part of our body. The way we use a hammer or a blind man uses a stick, shows that in both cases we shift outwards the points at which we make contact with things that we observe as objects outside ourselves. While we rely on a tool or a probe, these instruments are not handled or, scrutinised as external objects. Instead, we pour ourselves into them and assimilate them as part of ourselves.

We may generalize this to include the acceptance and use of intellectual tools offered by an interpretative framework and in particular by the text books of science. While we rely on a scientific text, the text is not an object under scrutiny but a tool of observation. For the time being we have identified ourselves with it and so long as our critical faculties are exercised by relying on this text we shall ever continue to strengthen our uncriticized acceptance of them.

There is no mystery about this. You cannot use your spectacles to scrutinise your spectacles. A theory is like a pair of spectacles; you examine things by it and your knowledge of it lies in this very use of it. You dwell in it as you dwell in your own body and in the tools by which you amplify the powers of your body.

This conception of knowledge by indwelling will help to forge the final link between science and the humanities. But before we approach that point we must yet enlarge our scheme of personal knowledge to include the kind of everyday knowledge we have of plants and animals, of life and death, of health and sickness as well as the kind of expert knowledge which students of biology and medicine acquire in practical classes. We shall achieve this by observing that the two kinds of awareness which we found interwoven in the use of a hammer—or a probe—are present in the same way in our own

awareness of a set of particulars received as a whole.

Take the case of a practical skill. It consists in the capacity for carrying out a great number of part movements with a view to the achievement of a comprehensive result. The same applies to skilful knowledge, like that of a medical diagnostician; he too comprehends a large number of details in terms of a significant entity. In both kinds of skilful knowing we are aware of a multitude of parts in terms of a whole. The two kinds of skilful knowing are actually always interwoven: a skilful handling of things must rely on our understanding them—and on the other hand —intellectual comprehension can be achieved only by the skilful scrutiny of a situation. The kinship between the process of tool-using and that of perceiving a whole has in fact been so well established already by gestalt-psychology that it may be taken for granted here without further argument.

The characteristic structure of all personal knowledge will come out even more vividly when we realise that all knowing is action—that it is our urge to understand and control our experience which causes us to rely on some parts of it subsidiarily in order to attend to our main objective focally. As we shall watch the operation of this urge we shall see emerging another important feature of personal knowledge; it will appear that all personal knowing is intrinsically guided by impersonal standards of valuation set by itself to itself.

Take first the process of mastering a skill. In this case the emphasis of our knowing lies on producing a result. The effort of acquiring knowledge and of skilfully applying this knowledge may be then said to be guided by a purpose. It is in the light of this purpose that certain things are made to serve us as tools and that certain movements of our body are skilfully coordinated. The economical and effective achievement of this purpose sets a standard to our skill. It is by striving for the fulfilment of this standard that we pick up in practice, usually without any focal awareness of doing so, the elements of a successful performance. Thus the striving by which we extend our person in achieving a skill is in the nature of a purpose.

When on the other hand, the emphasis of our knowing lies in recognising or understanding a thing, the effort of acquiring such knowledge may be said to be guided by our attention. A biologist, a doctor, an art dealer or a cloth merchant, each acquire their expert knowledge in part from text books but these texts are of no use to them without the accompanying training of the eye, the ear and touch. Only by attentively straining their senses can they acquire the right sense or feel for identifying a certain biological specimen, or a case of a certain sickness, or a genuine painting by a certain master, or a cloth of a distinctive quality. By such training the expert develops an exceptional fastidiousness which enables him to act as valuer for certain objects.

So every act of personal knowing sets up a standard of excellence. While the athlete or the dancer putting forward their best are acting as critics of their own performances, experts are the acknowledged critics of certain things. And when a person is acknowledged as an expert, if he is believed to know whether such things fulfil the standard of good specimens of their own kind.

Thus the observer's participation in the act of knowing leads to a point where observation assumes the functions of an appraisal by standards which he regards as impersonal. Even courts of law will rely on their capacity to appreciate the presence of a degree of ingenuity in a new device and on this appreciation they will base the granting of a patent. And mathematics can be said to exist as a science only if we trust ourselves with the capacity for appreciating the profundity and ingenuity of certain processes of inference.

We are now ready for the final step which combines personal indwelling with an appraisal according to standards accepted as universal. See how a naturalist appreciates a healthy plant or animal by a standard to which he attributes universality. And how he appreciates in the same way the coherent behaviour of animals and their intelligent performances. Our appreciation is based here on entering into another individual's purpose and action. Feats of intelligence can be observed only by identifying ourselves with the person whose intelligence we appraise. Our capacity for understanding another person's action by entering into his situation and of judging his actions from his own point of view thus appears to be but an elaboration of the technique of personal knowing the elements of which we had first identified in the way we read a map, or hammer in a nail, or grope our way in the dark by using a stick.

This conclusion fulfils at least part of my programme. We see that the shortcomings of the Laplaceian ideal of science must be remedied by acknowledging our personal knowing as an integral part of all knowledge accepted as such, and that this amendment bridges the gap between the natural sciences and the study of man. Having recognised personal participation as the universal principle of knowing and having determined the structure of this knowledge, we have come to recognise that our evaluation of human actions from the point of view of men as sentient, intelligent and morally responsible beings is a legitimate extension of scientific knowledge.

We may then go further. We have seen that our personal knowing operates by an expansion of our person into a subsidiary awareness of particulars merged into our attention to a whole and that this manner of living in the parts results in our critical appraisal of their coherence. We may also accredit therefore our living within an historical situation and our acceptance of a certain role in it as legitimate guides to our responsible participation in the problems presented by these situations. Science no longer requires then that we study man and society in a detached manner but restores us instead to an acceptance of our position as human members of a human society.

The transition from observation to appraisal has been reached by following up the knowing of increasingly complex and delicate things. I believe that this is the path along which the widest contacts can be established between the exact sciences and other domains of the human mind, but I must yet mention a shorter route leading from observation to appraisal, which is found, rather surprisingly, within the exact sciences themselves. I am referring to the system of geometrical crystallography.

Here we have a theory which applies to the facts of experience without making any unambiguous predictions about them and offering instead a systematic framework for the appreciation of any possible facts. Crystallography predicts that there are 230 geometrically different types of atomic lattices underlying all crystals. It determines all possible types of symmetry and distinguishes between higher and lower grades of symmetry. All this would remain true even if no specimen of any crystal could ever be observed in fact. Yet actually the theory has been validated by a wide area of experience. It has controlled the collection, description, classification and structural analysis of an immense variety of crystals. And this has established crystallographic theory as part of the exact sciences, and has done so without ever exposing the theory to the hazards of refutation by the facts of experience. For the theory merely prescribes a process of appraising the regularity of any solid specimen in the light of the standards set by itself. Our confidence in such a system of appraisals increases of course with the number of instances in which it has been found distinctly apposite to experience, but it is not in the least weakened by the much larger number of instances to which the system does not apply.

To sum up. The line of thought which I have pursued in this paper suggests that in order to reconcile science with the true nature of man we must first revise our

conception of science in accordance with the true nature of science. Science does not require that we study man and society in a detached manner. On the contrary, the part played by personal knowledge in science suggests that the science of man may rely on an extended use of personal knowing.

A personal knowledge of man may consist in putting ourselves in the place of the people we are studying and in trying to solve their problems either as they see them or as we see them. That opens the door for our entry into man's personality in its whole moral, religious and artistic outlook, as the bearer of an historical consciousness, a political and legal responsibility. It introduces us through an extension of scientific enquiry into the whole sentient, creative and responsible life of human concerns.

A system of ethics or a code of laws can no longer be regarded as unscientific in a derogatory sense because it predicts nothing that could be true or false, for science is seen to accredit us with the capacity for authentic appreciation of other values than the truth or falsity of a statement. As we know order from disorder, health from sickness, the ingenious from the trivial, we may distinguish with equal authority good from evil, charity from cruelty, justice from injustice.

This may sound a faint answer to my rousing challenge. But let me recall that it was the small voice of philosophic scepticism which has eventually swollen to the roar of modern philosophic mass movements. In any case, our responsibility as thinkers and teachers is to think and teach. If it is true that science has become the greatest single source of dangerous fallacies today, our task must be to revise the scientific outlook so that it should once more inspire rather than corrupt men's thoughts. In our age of vast responses, it may not take very long for such a change in philosophy to exercise its influence throughout our culture.

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