MICHAEL POLANYI

# Personal Knowledge

## *Towards a Post-Critical Philosophy*

# PERSONAL KNOWLEDGE

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by

*MICHAEL POLANYI*


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*To*
SIR THOMAS AND LADY TAYLOR

# PREFACE

THIS is primarily an enquiry into the nature and justification of scientific knowledge. But my reconsideration of scientific knowledge leads on to a wide range of questions outside science. I start by rejecting the ideal of scientific detachment. In the exact sciences, this false ideal is perhaps harmless, for it is in fact disregarded there by scientists. But we shall see that it exercises a destructive influence in biology, psychology and sociology, and falsifies our whole outlook far beyond the domain of science. I want to establish an alternative ideal of knowledge, quite generally.

Hence the wide scope of this book and hence also the coining of the new term I have used for my title: Personal Knowledge. The two words may seem to contradict each other: for true knowledge is deemed impersonal, universally established, objective. But the seeming contradiction is resolved by modifying the conception of knowing.

I have used the findings of Gestalt psychology as my first clues to this conceptual reform. Scientists have run away from the philosophic implications of gestalt; I want to countenance them uncompromisingly. I regard knowing as an active comprehension of the things known, an action that requires skill. Skilful knowing and doing is performed by subordinating a set of particulars, as clues or tools, to the shaping of a skilful achievement, whether practical or theoretical. We may then be said to become Subsidiarily aware' of these particulars within our 'focal awareness' of the coherent entity that we achieve. Clues and tools are things used as such and not observed in themselves. They are made to function as extensions of our bodily equipment and this involves a certain change of our own being. Acts of comprehension are to this extent irreversible, and also non-critical. For we cannot possess any fixed framework within which the re-shaping of our hitherto fixed framework could be critically tested.

Such is the *personal participation* of the knower in all acts of understanding. But this does not make our understanding *subjective*. Comprehension is neither an arbitrary act nor a passive experience, but a responsible act claiming universal validity. Such knowing is indeed *objective* in the sense of establishing contact with a hidden reality; a contact that is defined as the condition for anticipating an indeterminate range of yet unknown (and perhaps yet inconceivable) true implications. It seems reasonable to describe this fusion of the personal and the objective as Personal Knowledge.

Personal knowledge is an intellectual commitment, and as such inherently hazardous. Only affirmations that could be false can be said to

convey objective knowledge of this kind. All affirmations published in this book are my own personal commitments; they claim this, and no more than this, for themselves.

Throughout this book I have tried to make this situation apparent. I have shown that into every act of knowing there enters a passionate contribution of the person knowing what is being known, and that this coefficient is no mere imperfection but a vital component of his knowledge. And around this central fact I have tried to construct a system of correlative beliefs which I can sincerely hold, and to which I can see no acceptable alternatives. But ultimately, it is my own allegiance that upholds these convictions, and it is on such warrant alone that they can lay claim to the reader's attention.

*Manchester* M.P.

*August 1957*

# ACKNOWLEDGMENTS

THIS book is based on my Gifford Lectures 1951–2, delivered in the University of Aberdeen. I wish to thank the University for this opportunity to develop my thoughts. Since subsequent work has not essentially changed my views, large parts of the lectures could be retained unchanged; other parts have been reconsidered, some cut out and others amplified.

Manchester University has made it possible for me to accept the invitation of Aberdeen and to spend nine years almost exclusively on the preparation of this book. The generosity of Senate and Council in allowing me to exchange my Chair of Physical Chemistry for a Professorial appointment without lecturing duties, has placed me deeply in their debt. I want to thank particularly Sir John S.B.Stopford, then Vice-Chancellor, and Lord Simon of Wythenshawe, then Chairman of the Council.

Many of my colleagues at the University have helped me in my enquiries; I have never ceased to admire their patience. May I thank them here once more. I recall also with gratitude the weeks spent on two occasions with the Committee on Social Thought in Chicago, where I lectured on these subjects.

This work owes much to Dr. Marjorie Grene. The moment we first talked about it in Chicago in 1950 she seemed to have guessed my whole purpose, and ever since she has never ceased to help its pursuit. Setting aside her own work as a philosopher, she has devoted herself for years to the service of the present enquiry. Our discussions have catalysed its progress at every stage and there is hardly a page that has not benefited from her criticism. She has a share in anything that I may have achieved here. Dr. J.H.Oldham, Mr. Irving Kristol, Miss Elizabeth Sewell and Professor Edward Shils have read the whole manuscript; Mr. W.Haas, Dr. W.Mays, Professor M.S.Bartlett and Dr. C.Lejewski have read parts of it. They have all suggested improvements, for which I thank them. Miss Olive Davies has carried the burden of secretarial work connected with this book for ten years. Her skill and hard work have given me invaluable assistance. Expenses of books, travel and assistance in the service of this enquiry were covered by grants received from the Rockefeller Foundation, the Volker Fund and the Congress for Cultural Freedom.

Finally, I want to express my admiration for a person who unhesitatingly shared with me the risks of this unusual enterprise and sustained year after year the stresses radiating from me as the centre of this unaccustomed activity; I mean my wife.

I have published the following papers in the period of 1952–8 on the subject of this book. The corresponding pages of the book are given in brackets.

‘The Hypothesis of Cybernetics’, *The British Journal for the Philosophy of Science*, **2,** (1951–2). (Chapter 8, pp. 261–3.)

‘Stability of Beliefs’, *The British Journal for the Philosophy of Science*, November, 1952. (Chapter 9, pp. 286–94.)

‘Skills and Connoisseurship’, *Atti del Congresso di Metodologia*, Torino, December 17–20th, 1952. (Chapter 4, pp. 49–57.)

‘On the Introduction of Science into Moral Subjects’, *The Cambridge Journal*, No. 4, January, 1954. (Survey of one aspect of the argument.)

‘Words, Conceptions and Science’, *The Twentieth Century*, September, 1955. (Chapter 5, passim.)

‘From Copernicus to Einstein’, *Encounter*, September, 1955. (Chapter 1, pp. 3–18.)

‘Pure and Applied Science and their appropriate forms of Organization’, *Dialectica*, **10,** No. 3, 1956. (Chapter 6, pp. 174–84.)

‘Passion and Controversy in Science’, *The Lancet*, June 16th, 1956. (Chapter 6, pp. 134–60.)

‘The Magic of Marxism’, *Encounter*, December, 1956. (Chapter 7, pp. 226–48.)

‘Scientific Outlook: its Sickness and Cure’, *Science*, **125,** March 15th, 1957. (A brief survey of the main argument.)

‘Beauty, Elegance and Reality in Science’, *Symposium on Observation and Interpretation*, Bristol, April 1st, 1957. (Survey of Chapters 5 and 6.)

‘Problem Solving’, *The British Journal for the Philosophy of Science*, August, 1957. (Chapter 5, pp. 120–31.)

‘On Biassed Coins and Related Problems’, *Zs. f. Phys. Chem.*, 1958. (Chapter 3, pp. 37–40; Chapter 13, pp. 390–402.)

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# PART ONE
# THE ART OF KNOWING

# 4
# SKILLS

## 1. THE PRACTICE OF SKILLS

THE exact sciences are a set of formulae which have a bearing on experience. We have seen that in accrediting this bearing, we must rely to varying degrees on our powers of personal knowing. I shall now try to elucidate the structure of such personal acts further, by analysing the forces engaged in them. Science is operated by the skill of the scientist and it is through the exercise of his skill that he shapes his scientific knowledge. We may grasp, therefore, the nature of the scientist's personal participation by examining the structure of skills.

I shall take as my clue for this investigation the well-known fact *that the aim of a skilful performance is achieved by the observance of a set of rules which are not known as such to the person following them*. For example, the decisive factor by which the swimmer keeps himself afloat is the manner by which he regulates his respiration; he keeps his buoyancy at an increased level by refraining from emptying his lungs when breathing out and by inflating them more than usual when breathing in: yet this is not generally known to swimmers. A well-known scientist, who in his youth had to support himself by giving swimming lessons, told me how puzzled he was when he tried to discover what made him swim; whatever he tried to do in the water, he always kept afloat.

Again, from my interrogations of physicists, engineers and bicycle manufacturers, I have come to the conclusion that the principle by which the cyclist keeps his balance is not generally known. The rule observed by the cyclist is this. When he starts falling to the right he turns the handlebars to the right, so that the course of the bicycle is deflected along a curve towards the right. This results in a centrifugal force pushing the cyclist to the left and offsets the gravitational force dragging him down to the right. This manœuvre presently throws the cyclist out of balance to the left, which he counteracts by turning the handlebars to the left; and so he continues to keep himself in balance by winding along a series of appropriate curvatures. A simple analysis shows that for a given angle of unbalance the curvature of each winding is inversely proportional to the square of the speed at which the cyclist is proceeding.

But does this tell us exactly how to ride a bicycle? No. You obviously cannot adjust the curvature of your bicycle's path in proportion to the ratio of your unbalance over the square of your speed; and if you could you would fall off the machine, for there are a number of other factors to be taken into account in practice which are left out in the formulation of this

rule. Rules of art can be useful, but they do not determine the practice of an art; they are maxims, which can serve as a guide to an art only if they can be integrated into the practical knowledge of the art. They cannot replace this knowledge.

## 2. DESTRUCTIVE ANALYSIS

The fact that skills cannot be fully accounted for in terms of their particulars may lead to serious difficulties in judging whether or not a skilful performance is genuine. The extensive controversy on the 'touch' of pianists may serve as an example. Musicians regard it as a glaringly obvious fact that the sounding of a note on the piano can be done in different ways, depending on the 'touch' of the pianist. To acquire the right touch is the endeavour of every learner, and the mature artist counts its possession among his chief accomplishments. A pianist's touch is prized alike by the public and by his pupils: it has a great value in money. Yet when the process of sounding a note on the piano is analysed, it appears difficult to account for the existence of 'touch'. When a key is depressed, a hammer is set in motion which hits a string. The hammer is pushed by the depressed key only for a short distance and is thereby flung into free motion, which is eventually stopped by the chord. Therefore, it is argued, the effect of the hammer on the chord is fully determined by the speed of the hammer in free motion at the moment when it hits the chord. As this speed varies, the note of the chord will sound more or less loudly. This may be accompanied by changes in colour, etc., owing to concurrent changes in the composition of overtones, but it should make no difference in what manner the hammer acquired any particular speed. Accordingly, there could be no difference as between tyro and virtuoso in the tone of the notes which they strike on a given piano; one of the most valued qualities of the pianist's performance would be utterly discredited. Such is indeed the conclusion you find in standard textbooks like Jeans' *Science and Music* (1937) and A.Wood's *Physics of Music* (1944). Yet this result relies erroneously on an incomplete analysis of the pianist's skill. This has been demonstrated (to my satisfaction) by J.Baron and J.Hollo, who called attention to the noise that the depression of a key makes when all chords are removed from a piano.[1] This noise can be varied while the speed imparted to the hammer remains unaltered. The noise mingles with the note sounded by the hammer on the chord and modifies its quality, and this seems to account in principle for the pianist's capacity to control the tone of the piano by the art of his touch.

[1] J.Baron and J.Hollo, *Zeitschr. fur Sinnesphysiologie*, **66** (1935), p. 23. A renewed presentation of this view has been recently prepared for publication in *Journ. Accoust. Soc., Amer*, by Dr. J.Baron. The manuscript, which I have seen, mentions that O.R. Ortmann (*Physical Basis of Piano Touch and Tone*, 1925) has to some extent anticipated the conclusions of Baron and Hollo.

This example should stand for many others which teach the same lesson; namely that to deny the feasibility of something that is alleged to have been done or the possibility of an event that is supposed to have been observed, merely because we cannot understand in terms of our hitherto accepted framework how it could have been done or could have happened, may often result in explaining away quite genuine practices or experiences. Yet this method of criticism is indispensable, and without its constant exercise no scientist or technician could keep a steady course among the many spurious observations which he has to set aside unexplained every day.

Destructive analysis remains also an indispensable weapon against superstition and specious practices. Take for example homeopathy. In this case the efficacity of an alleged art, still widely practised today, can be wholly refuted, in my opinion, by a mere analysis of its claims. Medicinal substances used homeopathically can be shown, on the evidence of homeopathic prescriptions, to be diluted to concentrations as low as, or below that, in which they are present in ordinary food and drinking water; it seems impossible that an additional spoonful of them administered in a similar dilution would be medically effective.

A desperate situation may arise if a new skill, the efficacy of which is open to doubt, is given a false interpretation by its discoverers. This is illustrated by the tragic failures of the pioneers of hypnotism during the century from Mesmer to Braid. The critics of Mesmer and later of Elliotson found it easy to demonstrate that the manipulations which these men said they were performing were in themselves ineffectual. Elliotson had expounded a whole system of laws governing the alleged transmission of animal magnetism. He claimed that the magnetism of a glass of water, the drinking of which caused cataleptic trance, could be graded by dipping one finger into it, or two fingers, or the whole hand. Another ‘law’ declared that mucous surfaces of the subject, like those of the tongue or the eyeball, were capable of receiving a greater mesmeric stimulus than the skin. Later Elliotson announced that gold and nickel were more sensitive to mesmeric influences than base metals like lead. All this was nonsense and was easily proved to be nonsense. And since the assumption had not yet dawned upon anyone that hypnotic suggestion was the effective agent of Mesmerism, the conclusion seemed inevitable that Elliotson’s subjects were impostors, who were either deluding him or

colluding with him.[1] In vain did Elliotson bitterly appeal: 'I have given details of 76 painless operations in the name of common sense and humanity, what more is wanted?'[2] Not until the concept of hypnosis was established as a framework for the facts, could these facts be eventually admitted to be true. Indeed, whenever truth and error are amalgamated in a coherent system of conceptions, the destructive analysis of the system can lead to correct conclusions only when supplemented by new discoveries. But there exists no rule for making fresh discoveries or inventing truer conceptions, and hence there can be no rule, either, for avoiding the uncertainty of destructive analysis.

A process similar to that of the critique of Mesmerism, but without its obvious miscarriages, has been continuously fostered during the past decades by technical research laboratories. Great industries, like the tanneries, the potteries or steel mills, like the breweries and the whole range of textile manufactures, as well as agriculture in its numberless branches, have realized in these days that they were carrying on their activities in the manner of an art without any clear knowledge of the constituent detailed operations. When modern scientific research was applied to these traditional industries it was faced in the first place with the task of discovering what actually was going on there and how it was that it produced the goods. This situation was penetratingly recognized from the start as early as 1920 by W.L.Balls for the scientific study of cotton spinning.[3] The hitherto accepted practice of spinning Balls described as 'a thing in itself, scarcely related to physical knowledge at all', so that 'most of the initial decade's work on the part of the scientist will have to be spent merely in defining what the spinner knows'. This prediction was confirmed to me by Dr. F.C.Toy, then Director of the Shirley Institute, the world's leading cotton research laboratory.[4] The attempt to analyse scientifically the established industrial arts has everywhere led to similar results. Indeed even in the modern industries the indefinable knowledge is still an essential part of technology. I have myself watched in Hungary a new, imported machine for blowing electric lamp bulbs, the exact counterpart of which was operating successfully in Germany, failing for a whole year to produce a single flawless bulb.

[1] Harley Williams, *Doctors Differ*, London, 1946, pp. 51–60. The tests which destroyed Eiliotson's claims and exposed him to ridicule and suspicion were conducted by Thomas Wakley, founder of the *Lancet.* The experiments were in fact a striking demonstration of hypnotic suggestion.

[2] *ibid.*, p. 76.

[3] 'The Nature, Scope and Difficulties of Industrial Research with particular reference to the Cotton Industry', by W.Lawrence Balls, presented to the Tenth International Cotton Congress at Zurich, June 9th–11th, 1920.

[4] In a letter dated March 13th, 1951, Dr. Toy wrote to me: 'There is no question whatever that in our early years by far our most important work was to discover the scientific bases of the technical processes used in the industry, and not at that time attempt to improve on them by *ad hoc* methods.'

## 3. TRADITION

An art which cannot be specified in detail cannot be transmitted by prescription, since no prescription for it exists. It can be passed on only by example from master to apprentice. This restricts the range of diffusion to that of personal contacts, and we find accordingly that craftsmanship tends to survive in closely circumscribed local traditions. Indeed, the diffusion of crafts from one country to another can often be traced to the migration of groups of craftsmen, as that of the Huguenots driven from France by the repeal of the Edict of Nantes under Louis XIV. Again, while *the articulate contents of science* are successfully taught all over the world in hundreds of new universities, *the unspecifiable art of scientific research* has not yet penetrated to many of these. The regions of Europe in which the scientific method first originated 400 years ago are scientifically still more fruitful today, in spite of their impoverishment, than several overseas areas where much more money is available for scientific research. Without the opportunity offered to young scientists to serve an apprenticeship in Europe, and without the migration of European scientists to the new countries, research centres overseas could hardly ever have made much headway.

It follows that an art which has fallen into disuse for the period of a generation is altogether lost. There are hundreds of examples of this to which the process of mechanization is continuously adding new ones. These losses are usually irretrievable. It is pathetic to watch the endless efforts—equipped with microscopy and chemistry, with mathematics and electronics—to reproduce a single violin of the kind the half-literate Stradivarius turned out as a matter of routine more than 200 years ago.

To learn by example is to submit to authority. You follow your master because you trust his manner of doing things even when you cannot analyse and account in detail for its effectiveness. By watching the master and emulating his efforts in the presence of his example, the apprentice unconsciously picks up the rules of the art, including those which are not explicitly known to the master himself. These hidden rules can be assimilated only by a person who surrenders himself to that extent uncritically to the imitation of another. A society which wants to preserve a fund of personal knowledge must submit to tradition.

In effect, to the extent to which our intelligence falls short of the ideal of precise formalization, we act and see by the light of unspecifiable knowledge and must acknowledge that we accept the verdict of our personal appraisal, be it at first hand by relying on our own judgment, or at second hand by submitting to the authority of a personal example as carrier of a tradition.

The subject of traditionalism cannot be pursued at length here; but some peculiarities of traditional procedure are of immediate interest for the understanding of personal knowledge. They are to be found in the practice of the Common Law, which is the most important system of

strictly reasoned traditional activities. Common Law is founded on precedent. In deciding a case today the Courts will follow the example of other courts which have decided similar cases in the past, for in these actions they see embodied the rules of the law. This procedure recognizes the principle of all traditionalism that practical wisdom is more truly embodied in action than expressed in rules of action. Accordingly, the Common Law allows for the possibility that a judge may interpret his own action mistakenly. The judicial maxim which sometimes goes by the name of the 'doctrine of the dictum' lays it down that a precedent is constituted by the decision of a court, irrespective of its interpretation implied in any *obiter dicta* of the judge who made the decision. The judge's action is considered more authentic than what he said he was doing.[1]

In the course of the seventeenth and eighteenth centuries British public life developed a political art and a political doctrine. The art which embodied the exercise of public liberties was naturally unspecifiable, the doctrines of political liberty were maxims of this art which could be properly understood only by those skilled in the art. But the doctrines of political freedom spread from England in the eighteenth century to France and thence throughout the world, while the unspecifiable art of exercising public liberty, being communicable only by tradition, was not transmitted with it. When the French Revolutionaries acted on this doctrine, which was meaningless without a knowledge of its application in practice, Burke opposed them by a traditionalist conception of a free society.

## 4. CONNOISSEURSHIP

What has been said of skills applies equally to connoisseurship. The medical diagnostician's skill is as much an art of doing as it is an art of knowing. The skill of testing and tasting is continuous with the more actively muscular skills, like swimming or riding a bicycle.

Connoisseurship, like skill, can be communicated only by example, not by precept. To become an expert wine-taster, to acquire a knowledge of innumerable different blends of tea or to be trained as a medical diagnostician, you must go through a long course of experience under the guidance of a master. Unless a doctor can recognize certain symptoms, e.g. the accentuation of the second sound of the pulmonary artery, there is no use in his reading the description of syndromes of which this symptom forms part. He must personally know that symptom and he can learn this only by repeatedly being given cases for auscultation in which the symptom is authoritatively known to be present, side by side with other cases in

[1] Arthur Goodhart, *Essays in Jurisprudence and the Common Law*, Cambridge, 1931, p. 25, writes: 'The principle of a case is not found in the reasons given in the opinion. The principle is not found in the rule of law set forth in the opinion.' T.B.Smith, in *The Doctrines of Judicial Precedent in Scots Law*, Edinburgh, 1952, shows that this doctrine does not hold equally in Scotland.

which it is authoritatively known to be absent, until he has fully realized the difference between them and can demonstrate his knowledge practically to the satisfaction of an expert.

Wherever connoisseurship is found operating within science or technology we may assume that it persists only because it has not been possible to replace it by a measurable grading. For a measurement has the advantage of greater objectivity, as shown by the fact that measurements give consistent results in the hands of different observers all over the world, while such objectivity is rarely achieved in the case of physiognomic appreciations.[1] The large amount of time spent by students of chemistry, biology and medicine in their practical courses shows how greatly these sciences rely on the transmission of skills and connoisseurship from master to apprentice. It offers an impressive demonstration of the extent to which the art of knowing has remained unspecifiable at the very heart of science.

## 5. TWO KINDS OF AWARENESS

What I have said of the unspecifiability of skills is closely related to the findings of Gestalt psychology. Yet my evaluation of this material is so different from that of Gestalt theory, that I shall prefer not to refer here to this theory, even though I shall continue to draw on its domain and pursue some arguments on lines closely parallel to that of its teachings. This should be borne in mind for the following analysis of the often discussed situation in which we find ourselves when using a tool, for example when driving in a nail by the strokes of a hammer.

When we use a hammer to drive in a nail, we attend to both nail and hammer, *but in a different way*. We *watch* the effect of our strokes on the nail and try to wield the hammer so as to hit the nail most effectively. When we bring down the hammer we do not feel that its handle has struck our palm but that its head has struck the nail. Yet in a sense we are certainly alert to the feelings in our palm and the fingers that hold the hammer. They guide us in handling it effectively, and the degree of attention that we give to the nail is given to the same extent but in a different way to these feelings. The difference may be stated by saying that the latter are not, like the nail, objects of our attention, but instruments of it. They are not watched in themselves; we watch something else while keeping intensely aware of them. I have a *subsidiary awareness* of the feeling in the palm of my hand which is merged into my *focal awareness* of my driving in the nail.

[1] For an account of the competition between connoisseurship and grading by measurement in the process of cotton-classing see M.Polanyi, ‘Skills and Connoisseurship’, *Atti del Congresso di Metodologia*, Turin, 1952, pp. 381–95.

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 the use of a stick, which involves transposing the shocks transmitted to his hand and the muscles holding the stick into an awareness of the things touched by the point of the stick. We have here the transition from 'knowing *how*' to 'knowing *what*' and can see how closely similar is the structure of the two.

Subsidiary awareness and focal awareness are mutually exclusive. If a pianist shifts his attention from the piece he is playing to the observation of what he is doing with his fingers while playing it, he gets confused and may have to stop.[1] This happens generally if we switch our focal attention to particulars of which we had previously been aware only in their subsidiary role.

The kind of clumsiness which is due to the fact that focal attention is directed to the subsidiary elements of an action is commonly known as self-consciousness. A serious and sometimes incurable form of it is 'stage-fright', which seems to consist in the anxious riveting of one's attention to the next word—or note or gesture—that one has to find or remember. This destroys one's sense of the context which alone can smoothly evoke the proper sequence of words, notes, or gestures. Stage fright is eliminated and fluency recovered if we succeed in casting our mind forward and let it operate with a clear view to the comprehensive activity in which we are primarily interested.

Here again the particulars of a skill appear to be unspecifiable, but this time not in the sense of our being ignorant of them. For in this case we can ascertain the details of our performance quite well, and its unspecifiability consists in the fact that the performance is paralysed if we focus our attention on these details. We may describe such a performance as *logically unspecifiable,* for we can show that in a sense the specification of the particulars would logically contradict what is implied in the performance or context in question.

Take for example the identification of a thing as a tool. It implies that a useful purpose can be achieved by handling the thing as an instrument for that purpose. I cannot identify the thing as a tool if I do not know what it is for—or if knowing its supposed purpose, I believe it to be useless for that purpose. Let me denote by *p* the affirmations which are implied in qualifying a thing as a tool. If I know or at least hypothetically entertain *p,* the thing is a tool to me; if not, it is something else. It may be an animal, like Alice's croquet hammer which walked away because it was a flamingo. But in most cases, if I come across a tool of which I do not know the use, it will merely strike me as a peculiarly shaped object. To regard it merely as such is to imply that I do not believe and do not even hypothetically entertain *p;* which of course denies that I believe or at least hypothetically entertain *p*. And since *p* asserts something very uncommon, my not believing *p* virtually amounts to my asserting not-*p*.

[1] Comp. e.g. Henri Wallon, *De l'acte à la pensée,* Paris, 1942, p. 223.

An extension of this scheme may allow us to apply it also to the classic theme of Gestalt psychology, which is that the particulars of a pattern

or a tune must be apprehended jointly, for if you observe the particulars separately they form no pattern or tune. It may be argued that my attending to the pattern or tune as a whole implies its being appreciated as a pattern or a tune, and this would be contradicted by switching my focal attention to the single notes of the tune or the fragments of the pattern. But it is perhaps more appropriate to formulate the contradiction in this case in more general terms, by saying that our attention can hold only one focus at a time and that it would hence be self-contradictory to be both subsidiarily and focally aware of the same particulars at the same time.

This scheme can be easily reformulated and expanded in terms of *meaning*. If we discredit the usefulness of a tool, its meaning as a tool is gone. All particulars become meaningless if we lose sight of the pattern which they jointly constitute.

The most pregnant carriers of meaning are of course the words of a language, and it is interesting to recall that when we use words in speech or writing we are aware of them only in a subsidiary manner. This fact, which is usually described as the *transparency* of language, may be illustrated by a homely episode from my own experience. My correspondence arrives at my breakfast table in various languages, but my son understands only English. Having just finished reading a letter I may wish to pass it on to him, but must check myself and look again to see in what language it was written. I am vividly aware of the meaning conveyed by the letter, yet know nothing whatever of its words. I have attended to them closely but only for what they mean and not for what they are as objects. If my understanding of the text were halting, or its expressions or its spelling were faulty, its words would arrest my attention. They would become slightly opaque and prevent my thought from passing through them unhindered to the things they signify.

## 6. WHOLES AND MEANINGS

Gestalt psychology has described the transformation of an object into a tool and the accompanying transposition of feeling, as for example from the palm to the tip of a probe, as instances of the absorption of a part in a whole. I have covered the same ground in somewhat modified terms in order to bring out the logical structure in which a person commits himself to certain beliefs and appreciations, and accepts certain meanings by deliberately merging his awareness of certain particulars into a focal awareness of a whole. This logical structure is not apparent in the automatic perception of visual and auditory wholes from which Gestalt psychology has derived its prevailing generalizations.

But it is illuminating to recast our analysis now in terms of parts and wholes. When focusing on a whole, we are subsidiarily aware of its parts,

while there is no difference in the intensity of the two kinds of awareness. For example, the more sharply we scrutinize a physiognomy, the more keenly are we alert to its particulars. Also when something is seen as subsidiary to a whole, this implies that it participates in sustaining the whole, and we may now regard this function as its *meaning*, within the whole.

Indeed, we now see coming into view two kinds of wholes and two kinds of meaning. The more clear-cut cases of meaning are those in which one thing (e.g. a word) means another thing (e.g. an object). In this case the corresponding wholes are perhaps not obvious, but we may legitimately follow Tolman in amalgamating sign and object into one whole.[1] Other kinds of things, like a physiognomy, a tune or a pattern, are manifestly wholes but this time their meaning is somewhat problematic, for though they are clearly not meaningless, they mean something only in themselves. The distinction between two kinds of awareness allows us readily to acknowledge these two kinds of wholes and two kinds of meaning. Remembering the various uses of a stick, for pointing, for exploring or for hitting, we can easily see that anything that functions effectively within an accredited context has a meaning in that context and that any such context will itself be appreciated as meaningful. We may describe the kind of meaning which a context possesses in itself as *existential*, to distinguish it especially from *denotative* or, more generally, *representative* meaning. In this sense pure mathematics has an existential meaning, while a mathematical theory in physics has a denotative meaning. The meaning of music is mainly existential, that of a portrait more or less representative, and so on. All kinds of order, whether contrived or natural, have existential meaning; but contrived order usually also conveys a message.

[1] I am referring to Tolman's Sign-Gestalt Theory in his *Purposive Behavior in Animals and Men*, New York, 1932.

## 7. TOOLS AND FRAMEWORKS

As a next step I shall try to strengthen and widen the distinction between subsidiary awareness and focal awareness by identifying it with another commonly known and universally accepted distinction, namely that which we feel between parts of our own body and things that are external to it. We usually take it so much for granted that our hands and feet are members of our body and not external objects, that this assumption is brought home to us only in case they happen to be disturbed by disease. There are certain psychotic patients who do not feel part of their body as belonging to them. They have all the normal sensations transmitted to them from their limbs on both sides, but they do not identify themselves with all the limbs from which these messages originate; they feel some of them, e.g. the right arm and right leg, as external objects. When stepping out of a bath it may happen that they forget to dry these unadopted limbs.[2]

Our appreciation of the externality of objects lying outside our body, in contrast to parts of our own body, relies on our subsidiary awareness of processes within our body. Externality is clearly defined only if we can examine an external object deliberately, localizing it clearly in space outside. But when I look at something, I rely for my localization of it in space on a slight difference between the two images thrown on my retina, on the accommodation of the eyes, on the convergence of their axis and the effort of muscular contraction controlling the eye motion, supplemented by impulses received from the labyrinth, which vary according to the position of my head in space. Of all these I become aware only in terms of my localization of the object I am gazing at; and in this sense I may be said to be subsidiarily aware of them.

Our subsidiary awareness of tools and probes can be regarded now as the act of making them form a part of our own body. The way we use a hammer or a blind man uses his stick, shows in fact that in both cases we shift outwards the points at which we make contact with the things that we observe as objects outside ourselves. While we rely on a tool or a probe, these are not handled as external objects. We may test the tool for its effectiveness or the probe for its suitability, e.g. in discovering the hidden details of a cavity, but the tool and the probe can never lie in the field of these operations; they remain necessarily on our side of it, forming part of ourselves, the operating persons. We pour ourselves out into them and assimilate them as parts of our own existence. We accept them existentially by dwelling in them.

[2] W.Russell Brain, *Mind, Perception and Science,* Oxford, 1951, p. 35. For other variants of ‘depersonalization’ see e.g. Henderson and Gillespie, *A Textbook of Psychiatry,* Oxford Medical Publications, 7th Edn., 1951, p. 127.

## 8. COMMITMENT

We are faced here with the general principle by which our beliefs are anchored in ourselves. Hammers and probes can be replaced by intellectual tools; think of any interpretative framework and particularly of the formalism of the exact sciences. I am not speaking of the specific assertions which fill the textbooks, but of the suppositions which underlie the method by which these assertions are arrived at. We assimilate most of these pre-suppositions by learning to speak of things in a certain language, in which there are names for various kinds of objects, names by which objects can be classified, making such distinctions as between past and present, living and dead, healthy and sick, and thousands of others. Our language includes the numerals and the elements of geometry, and it refers in these terms to laws of nature whence we can pass on to the roots of these laws in scientific observations and experiments.

The curious thing is that we have no clear knowledge of what our presuppositions are and when we try to formulate them they appear quite unconvincing. I have illustrated already in my chapter on probability how ambiguous and question-begging are all statements of the scientific method. I suggest now that the supposed pre-suppositions of science are so futile because the actual foundations of our scientific beliefs cannot be asserted at all. When we accept a certain set of pre-suppositions and use them as our interpretative framework, we may be said to dwell in them as we do in our own body. Their uncritical acceptance for the time being consists in a process of assimilation by which we identify ourselves with them. They are not asserted and cannot be asserted, for assertion can be made only *within* a framework with which we have identified ourselves for the time being; as they are themselves our ultimate framework, they are essentially inarticulable.[1]

It is by his assimilation of the framework of science that the scientist makes sense of experience. This making sense of experience is a skilful act which impresses the personal participation of the scientist on the resultant knowledge. It includes the skill of carrying out correctly the measurements which verify scientific predictions or the observations by which scientific classifications are applied. And it includes also connoisseurship, by which the scientist appreciates a mathematical theory in the abstract—such as the theory of space groups was until 1912—and equally, the appositeness of such a theory to the appraisal of observed specimens, for which the theory of space groups has served since the discovery of the diffraction of X-Rays by crystals in 1912.

[1] The subject of the Premisses of Science will be dealt with at length in Part Two, ch. 6, see. 6 (pp. 160–71).

The tracing of personal knowledge to its roots in the subsidiary awareness of our body as merged in our focal awareness of external objects, reveals not only the logical structure of personal knowledge but also its dynamic sources. I have analysed previously the beliefs which are implied in using an object as a tool. In the new scheme which I have just drawn up of the process by which an external thing is given a meaning by being made to form an extension of ourselves, these beliefs are transposed into more active intentions which draw on our whole person. In this sense I should say that an object is transformed into a tool by a purposive effort envisaging an operational field in respect of which the object guided by our efforts shall function as an extension of our body. My reliance on it for some end makes an object into a tool, even though it may not achieve that end. The burning of a man's nail pairings for the purpose of bewitching him is an instrumental action based on a mistaken integration of supposed means to supposed ends. Similarly, to pronounce a magic formula, to utter a curse or give a blessing, are verbal actions into which the speaker, confident in their efficacy, pours meaning. Conversely, where the ends are achieved by means which are not intended to produce that result, these means have no instrumental character. If a rat accidentally depresses a lever which releases a food pellet it has not used it as a tool; only after the rat has learned to use it for that purpose does the lever become its tool. Buytendijk has described (as others have done in less detail before him) the radical change in the behaviour of a rat when it has learned to run a maze.[1] The animal ceases to explore the details of the walls and corners on its way and attends to these now merely as signposts. It seems to have lost its focal awareness of them and developed instead a subsidiary awareness of them which now forms part of the pursuit of its purpose.

I have said that a tool is only one example of the merging of a thing in a whole (or a gestalt) in which it is assigned a subsidiary function and a meaning in respect to something that has our focal attention. I generalized this structural analysis to include the recognition of signs as indications of subsequent events and the process of establishing symbols for things which they shall signify. We may apply to these cases also what has just been said about a tool. Like the tool, the sign or the symbol can be conceived as such only in the eyes of a person who *relies on them* to achieve or to signify something. *This reliance is a personal commitment which is involved in all acts of intelligence by which we integrate some things subsidiarily to the centre of our focal attention.* Every act of personal assimilation by which we make a thing form an extension of ourselves through our subsidiary awareness of it, is a commitment of ourselves; a manner of disposing of ourselves.

[1] F.J.J.Buytendijk, 'Zielgerichtetes Verhalten der Ratten in einer Freien Situation', *Archives Neerlandaises de Physiologie,* **15** (1930), p. 405.

But the context of purpose and commitment, as found inherent in the personal contribution of the knower to his knowledge, yet lacks dynamic character. The pouring out of ourselves into the particulars given by experience so as to make sense of them for some purpose or in some other coherent context, is not achieved effortlessly. Take the way we acquire the use of a tool or a probe. If, as seeing men, we are blindfolded, we cannot find our way about with a stick as skilfully as a blind man does who has practised it for a long time. We can feel that the stick hits something from time to time but cannot correlate these events. We can learn to do this only by an intelligent effort at constructing a coherent perception of the things hit by the stick. We then gradually cease to feel a series of jerks in our fingers as such—as we still do in our first clumsy trials—but experience them as the presence of obstacles of certain hardness and shape, placed at a certain distance, at the point of our stick. We may say, more generally, that by the effort by which I concentrate on my chosen plane of operation I succeed in absorbing all the elements of the situation of which I might otherwise be aware in themselves, so that I become aware of them now in terms of the operational results achieved through their use.

When the new interpretation of the shocks in our fingers is achieved in terms of the objects touched by the stick, we may be said to carry out unconsciously the process of interpreting the shocks. And again, in practical terms, as we learn to handle a hammer, a tennis racket or a motor car in terms of the situation which we are striving to master, we become unconscious of the actions by which we achieve this result. This lapse into unconsciousness is accompanied by a newly acquired consciousness of the experiences in question, on the operational plane. It is misleading, therefore, to describe this as the mere result of repetition; it is a structural change achieved by a repeated mental effort aiming at the instrumentalization of certain things and actions in the service of some purpose.

## 9. UNSPECIFIABILITY

We can now answer the problem of unspecifiability with which I started on this examination of skills. If a set of particulars which have subsided into our subsidiary awareness lapses altogether from our consciousness, we may end up by forgetting about them altogether and may lose sight of them beyond recall. In this sense they may have become unspecifiable. However, this seems only a minor reason for unspecifiability, which is accounted for essentially by a somewhat different, if closely related process.

A mental effort has a heuristic effect: it tends to incorporate any available elements of the situation which are helpful for its purpose.

Köhler has described this for the case of a practical effort, made by an ape in the presence of an object which may serve as a tool. The animal's insight, he says, reorganizes its field of vision so that the useful object meets his eye as a tool. We may add that this will hold not only of objects which are made use of as tools, but also of the performer's own muscular actions which may subserve his purpose. If these actions are experienced only subsidiarily, in terms of an achievement to which they contribute, its performance may select from them those which the performer finds helpful, without ever knowing these as they would appear to him when considered in themselves. This is the usual process of unconscious trial and error by which we *feel our way* to success and may continue to improve on our success without specifiably knowing how we do it—for we never meet the causes of our success as identifiable things which can be described in terms of classes of which such things are members. This is how you invent a method of swimming without knowing that it consists in regulating your breath in a particular manner, or discover the principle of cycling without realizing that it consists in the adjustment of your momentary direction and velocity, so as to counteract continuously your momentary accidental unbalance. Hence the practical discovery of a wide range of not consciously known rules of skill and connoisseurship which comprise important technical processes that can rarely be completely specified, and even then only as a result of extensive scientific research.

The unspecifiability of the process by which we thus feel our way forward accounts for the possession by humanity of an immense mental domain, not only of knowledge but of manners, of laws and of the many different arts which man knows how to use, comply with, enjoy or live by, without specifiably knowing their contents. Each single step in acquiring this domain was due to an effort which went beyond the hitherto assured capacity of some person making it, and by his subsequent realization and maintenance of his success. It relied on an act of groping which originally passed the understanding of its agent and of which he has ever since remained only subsidiarily aware, as part of a complex achievement.

All these curious properties and implications of personal knowledge go back to what I have previously described as its logical unspecifiability; that is to the disorganizing effect caused by switching our attention to the parts of a whole. We can now appreciate this effect too in dynamic terms.

Since we originally gained control over the parts in question in terms of their contribution to a reasonable result, they have never been known and were still less willed in themselves, and therefore to transpose a significant whole into the terms of its constituent elements is to transpose it into terms deprived of any purpose or meaning. Such dismemberment leaves us with the bare, relatively objective facts, which had formed the clues for a supervening personal fact. It is a destructive analysis of personal knowledge in terms of the underlying relatively objective knowledge.

I have described the effort which we put into acquiring the art of knowing as the attempt to assimilate certain particulars as extensions of our body, so that by becoming imbued with our subsidiary awareness they may form a coherent focal entity. This is an action, but one that has always an element of *passivity* in it. We can assimilate an object as a tool if we believe it to be actually useful to our purposes and the same holds for the relation of meaning to what is meant and the relation of the parts to a whole. The act of personal knowing can sustain these relations only because the acting person believes that they are apposite: that he has not *made them* but *discovered them*. The effort of knowing is thus guided by a sense of obligation towards the truth: by an effort to submit to reality.

Moreover, since every act of personal knowing appreciates the coherence of certain particulars, it implies also submission to certain standards of coherence. While the athlete or the dancer putting forward their best, act as critics of their own performances, connoisseurs are acknowledged as critics of the goodness of specimens. All personal knowing appraises what it knows by a standard set to itself.

## 10. SUMMARY

Let me sum up my argument so far. I started with the exact sciences, defining them as a mathematical formalism with a bearing on experience. There appeared to be present a personal participation on the part of the scientist in establishing this bearing on experience. This was least noticeable in classical mechanics and I accordingly accepted that chapter of physics as the closest approximation to a completely detached natural science. Its statements could indeed be so formulated as to admit of strict falsification by experience. There followed two sets of examples for a more massive and not conceivably negligible personal participation in the exact sciences. The first of these comprised the knowledge of probabilities in science; and more particularly of the degrees of coincidence involved in assuming that an apparently significant pattern of events had come about as the result of chance. The second set demonstrated the assessment of orderly patterns in the exact sciences and showed that standards of orderliness, though bearing on experience, cannot be conceivably falsified by it. On the contrary, as in the case of statements of probability, they themselves appraise any relevant samples of experience.

Experience can of course offer clues to encourage or disappoint statements of probability or standards of order and this effect is important, but not *much* more important than the factual theme of a novel is for its acceptability. Yet personal knowledge in science is not made but discovered, and as such it claims to establish contact with reality beyond the clues on which it relies. It commits us, passionately and far beyond our comprehension, to a vision of reality. Of this responsibility we cannot divest ourselves by setting up objective criteria of verifiability—or

falsifiability, or testability, or what you will. For we live in it as in the garment of our own skin. Like love, to which it is akin, this commitment is a 'shirt of flame', blazing with passion and, also like love, consumed by devotion to a universal demand. Such is the true sense of objectivity in science, which I illustrated in my first chapter. I called it the discovery of rationality in nature, a name which was meant to say that the kind of order which the discoverer claims to see in nature goes far beyond his understanding; so that his triumph lies precisely in his foreknowledge of a host of yet hidden implications which his discovery will reveal in later days to other eyes.

My argument was clearly overflowing already at that stage into domains far beyond the exact sciences. In this chapter I have pursued the roots of personal knowledge towards its most primitive forms which lie behind the operations of a scientific formalism. Tearing away the paper screen of graphs, equations and computations, I have tried to lay bare the inarticulate manifestations of intelligence by which we know things in a purely personal manner. I have entered on an analysis of the arts of skilful doing and skilful knowing, the exercise of which guides and accredits the use of scientific formulae, and which ranges far further afield, unassisted by any formalism, in shaping our fundamental notions of most things which make our world.

Here, in the exercise of skill and the practice of connoisseurship, the art of knowing is seen to involve an intentional change of being: the pouring of ourselves into the subsidiary awareness of particulars, which in the performance of skills are instrumental to a skilful achievement, and which in the exercise of connoisseurship function as the elements of the observed comprehensive whole. The skilful performer is seen to be setting standards to himself and judging himself by them; the connoisseur is seen valuing comprehensive entities in terms of a standard set by him for their excellence. The elements of such, a context, the hammer, the probe, the spoken word, all point beyond themselves and are endowed with meaning in this context; and on the other hand a comprehensive context itself, like dance, mathematics, music, possesses intrinsic or existential meaning.

The arts of doing and knowing, the valuation and the understanding of meanings, are thus seen to be only different aspects of the act of extending our person into the subsidiary awareness of particulars which compose a whole. The inherent structure of this fundamental act of personal knowing makes us both necessarily participate in its shaping and acknowledge its results with universal intent. This is the prototype of intellectual commitment.

It is the act of commitment in its full structure that saves personal knowledge from being merely subjective. Intellectual commitment is a responsible decision, in submission to the compelling claims of what in good conscience I conceive to be true. It is an act of hope, striving to fulfil an obligation within a personal situation for which I am not responsible and which therefore determines my calling. This hope and this obligation

are expressed in the universal intent of personal knowledge. The sense in which this may be said to be the case will be made more definite as I proceed further and it will be summed up at the close of Part Three.