POPPER'S THREE WORLDS AND THEIR RELEVANCE TO INFORMATION SCIENCE

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ABSTRACT

In a previous paper (1980) I argued that Popper's philosophy offered information science a firmer metaphysical basis than it could otherwise claim. In doing so I extrapolated from Popper's 'three worlds' to link them with information - a word not used by Popper. Here I mark the point at which Popper paused and from which my own ideas take off in outlining the potential scope of information science.

LES TROIS MONDES DE POPPER ET LEUR APPLICATION A LA SCIENCE DE L'INFORMATION

RESUME

Dans un précédent exposé (1980), je prétendais que la philosophie de Popper offre à la science de l'information une base métaphysique plus solide qu'elle ne peut autrement revendiquer. Ce faisant, j'extrapolais les "trois mondes" de Popper pour les relier à l'information -un terme que Popper n'utilise pas. Dans le présent exposé, je détermine le point précis où Popper s'arrête et d'où partent mes propres idées sur la portée potentielle de sa théorie pour la science de l'information.

The scope of information science (IS)

"Any discipline must define its scope. That is, it must define what matters it will study explicitly. These matters must be studied and talked about in their own terms, not in terms of their applications"

Robert Fairthorne (1967) wrote these simple but forceful words at a time when I was trying to establish the first courses in IS within the University of London. In order to be able to award M.Sc. and Ph.D. degrees in information science I had to persuade a sceptical University Faculty of Science, mainly physicists and chenists, that IS, though not then widely taught, was worthy of admittance to their prestigious Faculty and, even more daring, to a share of their resources. My bid, from the Library School of University College (in the Faculty of Arts), was opposed by a rival bid for the name - for information science - for courses of a very different kind from the Electrical Engineering Dept. of another College of the University.

Jason Farradane had already established courses in IS at the City U. nearby, though not in the Science Faculty. He had argued that IS was needed to help the applied sciences by tackling the problems of documentation which librarians had failed to solve. The main research at that time was devoted to applications - to techniques of indexing documents and to the performance of IR systems. The work of Cleverdon (the Cranfield experiments), of Farradane (relational indexing) and of Salton (mechanised IR models) dominated research at that time. All these activities related to documentation and thus to what I regard as Library Science.

To me it seemed reasonable to assume that a subject called information science would be expected to study information, as did my rivals from Electrical Engineering also. But I knew that the Faculty of Science would not expect me to define information. Their sciences did not begin by defining matter, energy, electricity, the chemical element .... These concepts smerged only after much observation and analysis of phenomena in which such entities interacted. So the scope of IS could be defined as the study of 'information phenomena'. That was simple enough.

But 'what matters must be studied explicitly, and talked about in their own terms'?

Information and knowledge

At this time I was a member of the Library School at UCL,of the Communication Research Centre (CRC), an inter-Faculty group also of UCL, and Secretary of the British Society for the Philosophy of Science (BSPS) which also met at UCL.

My colleagues in the Library School talked much about the

'organization of knowledge' but, when I looked at the outcome of their work, I could see only books arranged on shelves in ways convenient for the users. The 'knowledge' remained embedded between the covers of the books. Similarly, I discovered that information scientists of the time claimed to retrieve information on specific topics but when I asked for some such information, I was given a long list of papers I had to find and read.

Meanwhile, in the CRC, the philosopher A.J.Ayer, best known for his Language, Truth and Logic, talked forcefully about the need to verify every statement, dismissing all non-verifiable statements as nonsense, as he did, for example, a scholarly discourse on Communication through Art, focussed on a picture by Goya, which I had found most illuminating. The biologist J.B.S.Haldane impatiently insisted that in order to understand human communication we should first study communication between animals. His views appeared to be supported by our psychologist who, when pressed to explain any problem thrown up in discussion about human learning, always dismayed the humanists by desribing some recent experiment on rats. My own first task was to dissuade my colleagues in the English Dept. who, hoping to evade Ayer's strictures, proposed to abandon literary criticism and apply Shannon information theory to the works of Shakespeare and so reduce them to 'bits': the results might be of limited human interest but they would at least be verifiable! (Sir Alfred Ayer has since retracted.)

In the midst of all these conflicting arguments, I regarded myself as Rational Man (trying to model myself on Bertrand Russell). Though I was ready to admit that my knowledge was limited, I felt that I knew what I knew, that in any disputation I could remain in cool rational control of all my utterances, that I could define all the key terms I used and apply them with impeccable logic. Then, one day, at a CRC discussion of subliminal perception led by an experimental psychologist, I firmly disputed with him. We reached a stalemate. He then suggested that we postpone further argument until he was able to show me an experiment in his lab. As an empiricist, I gladly agreed.

A day or two later, Rational Man entered the pyschologist's lab and confidently agreed to be subjected to an experiment though I did not know what form it would take. After ten minutes I staggered into the sunlight. Rational Man, wrongly rationalising the reasons for his growing discomfort and anger, had responded to some subliminally presented insults in very explicit like terms (which he never used anyway) very loudly expressed. It had been shown to him that he did not 'know all that he knew' because the instruments linked to the electrodes on his wrists revealed that he had responded physically to subliminal insults without being cognitively aware of them. He was all too clearly not in 'cool rational control' of his utterances. He crept away musing on Hume's dictum: "Reason is the slave of the passions".

POPPER'S THREE WORLDS

At this time, Karl Popper (of LSE) was President of the BSPS and Chairman of the Committee which met monthly to settle Society business. That meant that every meeting was inevitably transformed into a stimulating philosophical seminar. Every minor practical issue on the agenda was somehow elevated into a critical analysis of all its manifold philosophical implications. There was, of course, much discussion of knowledge and of how it grew, at least in science, by the falsification of laws and theories and their replacement by better ones.

But information was never mentioned in any of these discussions. So though I learned much about the uncertainties of knowledge I had to find my own way of relating information to knowledge. I described (1974) information as that which adds to or modifies in any way the knowledge structure with which it reacts. I expressed this as the 'fundamental equation of IS' thus:

$$\Delta I = (S + \Delta S) - (S)$$

in which the ΔI is an increment of information, (S) is the knowledge structure with which it reacts and $(S + \Delta S)$ is the resulting modified structure. "Crudely interpreted, it says that whatever 'goes' in depends on what is already'there'. The private world of subjective knowledge is literally metaphysical".

One implication of this equation is that information and knowledge have the same 'dimensions' i.e. information is a fragment of knowledge but its 'measure' depends on its effect on the particular knowledge structure with which it reacts. The equation thus accommodates both simple cumulation and also dramatic re-structuring of the kind evoked by my experience of subliminal perception.

Another conclusion important to me at this time arise from my work with the CRC on human communication. I concluded that, when two persons A and B meet and talk to each other, it is wrong to assume that the words spoken (and maybe recorded for analysis) convey the whole message. It is safer to say that on the one side there is an overt display by A, which is privately interpreted by B, and vice versa in alternation. There are visual elements in the two displays which also cannot be fully captured by cameras wherever they may be located. Some of the ΔI might well be subliminal too. So the laboratory study of human communication has to rely on very precarious data indeed. I came to distrust all theories of subjective knowledge because the data accessible to the theorist are so superficial.

I therefore argued that one of the "matters to be studied, and talked about in its own terms" within IS was the growth of knowledge as revealed by the contents of the books and journals on the shelves of our libraries. This was the study of what Popper called objective knowledge. All concerned could examine the development of any theory described in the journals and all would share the same basic data. It offered a scientific approach to the study of knowledge at last.

There were other items, mainly concerned with quantification, in my proposed syllabus but they had no direct relation to Popper's philosophy. The Faculty of Science accepted my humanistic proposals for information science and rejected the more technical proposals of my rivals.

Popper's three worlds and my ontology

Initially, Popper's ideas were not well received by British philosophers, especially by those (most of them) engaged in seeking ways to Truth and Certainty through induction or otherwise. So, sensitive to criticism, Popper wrote with awareness that his every word would be closely questioned. He therefore had to write at length, attaching every possible reservation to his challenging statements and making all due scholarly reference to the whole historical corpus of philosophical literature. His books are not easy to read. Every clear line of thought seems to be interrupted by cross-refernces to other writers or to his own earlier papers. So footnotes abound. And if the reader is trapped into reading one, he will often find that it refers him to an appendix which also has footnotes which refer him to another appendix and so on.

So when I introduced Popper's ideas to information scientists I had to condense them into concise statements in a few paragraphs. In doing so, I knew I ran the risk of 'hardening' Popper's ideas. For example, he writes (1972): -

"..... without taking the words 'world' or 'universe' too seriously, we may distinguish the following worlds or universes: first, the world of physical objects or physical states; secondly, the world of states of consciousness or of mental states, or perhaps of behavioural dispositions to act; and, thirdly, the world of objective contents of thought, especially of scientific and poetic thoughts and of works of art." (His italics)

It is an important feature of Popper's writings that he dislikes taking any word 'too seriously': what counts for him are the ideas the words express. Similar accounts of the 'three worlds' appear elsewhere in Popper's works though usually at much greater length than above and with many clarifying comments. But in trying to grasp the key ideas of the 'three worlds' as compactly as possible, I drew a diagram (on the next page) to show their inter-relationships and I described them as presenting an 'ontology'.

I sent a copy of my paper to Popper and received a gracious reply. He liked my diagram but had doubts about 'ontology' - that perhaps was committing him to a harder word than he would use about his 'three worlds'. But if Popper is reluctant to go so far, I am not. I chose the word with some care.

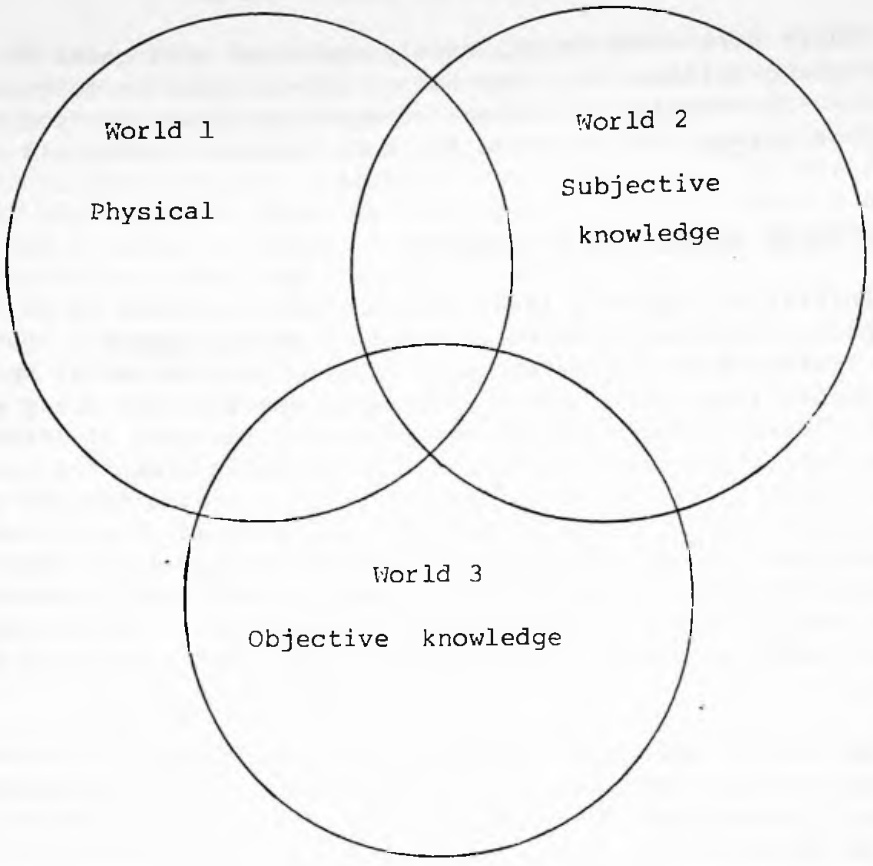

Fig. 1 : Popper's three worlds

The clearest definition of ontology I have found is that by Anthony Quinton (1977):-

"The ontology of a theory or body of assertions is the set of things to which that theory asserts existence by referring to them in a way that cannot be eliminated or analysed out"

Popper's 'three worlds' do constitute my ontology. World 1, the physical world, is real for me as I think it must be for anyone who acknowledges the threat of annihilation by nuclear bombs. World 2 is real for me because here I sit at my desk thinking about this paper. And World 3 is real for me as I reach across my desk to Popper's books to verify what he wrote about his 'three worlds'. He has convinced me that (in our present state of knowledge) these three worlds are distinguishable entities which cannot be 'eliminated or analysed out' (except by nuclear bombs perhaps). And there is nothing I regard as real which I cannot ascribe to one of these worlds. "Where does God come into your diagram?" I was once very seriously asked. I could only reply : "God is to be found equally in all three worlds".

When a human dies, whatever knowledge or wisdom or spiritual insights he may have acquired during his life-time dies with him. The only traces of his thought are what he has expressed in the artefacts that survive him. So these artefacts have an objectivity which is denied to the human who created them.

I have tried to make clear the point at which Popper paused (he is still writing) and from which I have extrapolated my own ideas - my own 'conjectural speculations" (to use Popper's terms). I do so because my immediate objective is to lift IS out of its present concentration on documentation and into the exploration of World 3 which, since Popper discovered it, lies wide open and inviting. I have also been emboldened by a citation from the German poet Novalis with which Popper prefaces one of his books (1959): Theories are nets: only he who casts will catch.

Metaphysics and science

Having thus exposed my metaphysics to full frontal view, I now expect some such question as: "That's fine; I may even be able to accept your metaphysical view of the three worlds, but what has metaphysics to do with science? Popper says that any scientific statement or theory has to be falsifiable, i.e. we should be able to imagine some experiment or test which might falsify it even if we cannot suggest such a test at the moment. But metaphysical statements are beyond the reach of such tests. One can accept or reject them, but one cannot falsify them"

My immediate answer is that I could not discuss the scientific exploration of objective knowledge without first trying to explain how Popper discovered this new world so closely related to library and information science. The point about World 3 that is so important is that its discovery opens the theory of knowledge to scientific exploration.

There are other issues that bear on this matter. But, first, I have to speculate about information - on which Popper has said nothing.

Information and evolution

The word information is now the current 'buzz' word but Popper does not need to use it. My own description of information as that which modifies a knowledge structure implies that information is also an increment of knowledge - but with reservations.

For the detailed study of the growth of theories it is helpful to retain the concept of information. For example, one might be considering two rival theories T1 and T2 when some new result or new datum is published. The objective ΔI in this case would be the same for both theories but its effects on the structures of T1 and T2 might be very

different, or it might be irrelevant to both T1 and T2 and yet be relevant to some other theory T3. There are so many possibilities of this kind, since our data-bases shattered all coherent knowledge into fragments of information, that the concept of information, as some objective ΔI, is an essential element in IS.

In fact, I go further. Popper, unlike many other philosophers, regards humans as evolving forms of life. The subtitle of his Objective knowledge is An evolutionary approach. The earliest inscriptions we have date from about 4000 B.C. And before that? Before they established their alphabets, humans must have talked and so have used information in their World 2. And before that? The cave paintings at Lascaux and elsewhere are artefacts dating from about 10000 B.C. and anyone who has seen them marvels at their 'humanity'. And before that? Before humans emerged there were other forms of life. Did the dinosaurs not respond to the calls of their mates? Did the pterodactyls not track down their prey? And so on. Where then is the line to be drawn? If the theory of evolution is acceptable as a broad generality, there is no obvious stopping point, as we peer back through the mists of time, until we reach the origins of life on Earth. And before that? As far as we know, there was only the bleak physical cosmos, a barren Earth devoid of life - and therefore devoid of information.

I therefore regard information as the primitive element from which human knowledge has evolved - the primitive element from which both Worlds 2 and 3 have been built.

Information and biology

The concept of information is also used to describe non-cognitive processes which occur in humans. The human brain which seeks and analyses information from its external world is itself an organ developed and maintained in serviceable order by a subsidiary information system internal to the body, an intricate neural and hormonal network. Vide Popper and Eccles (1977). We are wholly unaware of this supporting system unless it becomes faulty.

We all begin our lives from a single cell in which the genome - the set of genes we inherit from our parents - appears to carry the program which determines our physical development except for limited modifications imposed by our environment and our activities within it. So here is another basic phenomenon, at the very beginning of life, which geneticists already describe in terms of information processes.

I mention these matters only to point to the central role that

the concept of information plays in biological description and to express my continued astonishment that this concept, seemingly unanalyable, is accepted by biological scientists with no apparent question or challenge. What is it? Is information processing the factor which distinguishes living substance from inert matter? Scientific answers may arise from the current work on genes.

Information and the physical world

We have learned how to extend the limited natural range of our sensory organs by telephone, radio and television to transmit information from locations beyond unaided reach. All these devices transduce the patterns of sound or light they capture, transmit them along some physical channel and, by an inverse transduction at the receiving end, restore the original patterns to their original form (more or less) within our sensory reach.

Telescopes and microscopes capture larger images and therefore more information than our unaided images. Instruments sensitive to wavelengths of the electromagnetic spectrum outside those of the octave of visual light collect their images and transduce them into visual images as, for example, in NASA's recent explorations of Mars and Saturn.

What are we looking for when we search the macro or micro worlds? It seems to me that we search for patterns, for regularities that emerge from the background of 'noise' . We then try to relate these new images, these new ΔI's , to patterns we already know and thus to extend or modify our knowledge structures. The final transduction is the theory expressed in patterns of words which the current scientific consensus accepts as a transduction of the visual images.

Information and the computer

The computer is an electro-mechanical machine which, operated by patterns of electrical impulses (the 'machine language') is able to respond to instructions (the 'program') again expressed in patterns of impulses, and so to analyse the data, again expressed as patterns of impulses, fed into it. The output of the machine is another series of impulses transduced into some 'readable' form such as numbers, words or graphs. We are now beginning to adapt thses machines to simulate the kinds of semantic analysis of linguistic patterns our brains perform. But, if information, as I have argued, is confined to Worlds 2 and 3, what is it doing in a World 1 machine?

There is a vocabulary of information systems - information, message,messenger, signal, ... - which are well-understood by all who have received letters through the mail. So well-known information systems

provide analogies and metaphors for explanatory descriptions of other information systems less well-known.

Analogies and metaphors are delightful in poetry, endearing or damaging in politics, helpfully descriptive in the sciences. But we should not let ourselves be misled by them. There is a transition that can be traced from the analogy B is like A to the metaphor in which B is called A when the contexts of both A and B are recognised for what they are. If the metaphor is maintained there may come a time when the two contexts are no longer distinguished and B has become A by default.

There is a machine used in kitchens to slice, chop, shred, pulverize, emulsify, liquidize,.... the food substances we 'feed' into it. It is often called a food processor. If we fed into it the paper and plastic packing in which the foods are usually bought, the machine would process them too. The machine does not eat the food we give it, we do.

Similarly, the computer is often called an information processor. Is this a metaphor, or is it 'for real' ? The 'information' that we say is processed by the computer is (in my view) an apt and convenient metaphor which hides the fact that it operates on patterns of electrical impulses which we endow with information. The information we find 'in the computer' is something we put there: it is part of us, not part of the machine.

Concluding comments

Starting from Popper's metaphysics, my extrapolations to information qualify to be regarded as scientific hypotheses. As soon as some machine 'thinks' as humans do, Worlds 1 and 2 become indistinguishable and my hypothesis that information is confined to Worlds 2 and 3 will have been falsified. I foresee, however, a long disputation about the kind of criteria we apply in such a case - Turing's arguments will have to be fortified, I guess.

Development of the bio-chip and its application raises another threat to my hypothesis. It is possible that information will be shown to be some purely biochemical entity, but consciousness will still need to be explained in terms of it.

Whatever happens to my hypotheses, Popper's World 3, the heritage of objective knowledge about the physical world and about human life on Earth, will remain for librarians and information scientists to cherish and (perhaps aided by thinking machines) to make more readily accessible for others.

POPPER'S THREE WORLDS

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