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Galileo and the Topological Space

In the intellectual history of a discipline combinations of ideas appear almost de novo, and yet upon closer examination they may turn out to have been part of the common store of thought for some time. The search for Galileo and the idea of the topological space are themes which may seem to have little or no necessary connexion. Their appearance as two motifs in Leach (1961) produced a paper of great analytical effect. Its title Rethinking Anthropology was of striking symbolic value: the date of its publication, or perhaps the earlier date of the public address (1959) upon which it was based, mark in retrospect a boundary time between the immediate post-Malinowskian period in British social anthropology, and that phase (however it be characterized) in which it is now. The content of that paper may be assessed, a decade afterwards, in different ways, but its symbolic quality still remains. Rethinking Anthropology is now part of the myth-dream. It is surely not ultimately comprehensible in all its parts to those many undergraduate and graduate students who have read it line by line, with so much apprehension and hope? No more perhaps than it was to its first audience in London in 1959. But a message was received then, and a message is still received now, novelly encoded although it is. However much its argument be dissected, with its maddening semantic jumps and ellipses,the symbolic Rethinking Anthropology remains immune to purely logical analysis. Yet it came into existence from common elements among which were the two I have already mentioned: the'search for Galileo' and 'the idea of the topological space' . Suitably Wagnerian motifs to accompany this, undoubtedly one of the most memorable and influential of those 'episodes in polemical, socio-anthropological tourneys in which the contestants,astride their conceptual systems, canter across the sparse empiric field....'(Derek Freeman, 1962:125).

The Search for Galileo

The comparison of the state of the social sciences with that of the natural sciences at some earlier period has become commonplace. More precisely, there has been the expectation of a revolution in which a figure of the stature of one of the great innovators will appear: 'we are told this revolution has not yet taken place in the social sciences, or at least it is only now in process of taking place. Perhaps social science has not yet found its Newton but the conditions are being created in which such a genius could arise.' (Winch 1958:1).

In 1937, Radcliffe-Brown made a characteristic statement for social anthropology:

'The whole of modern mechanics did not become possible until, as a result of the work of William of Ockham and his followers and of Galileo, Newton was to formulate the concept of mass - a fairly simple and obvious thing - but no one of Newton's time had thought of it, no one had begun to think of it. Only after this concept had been thought out, developed and defined scientifically did we begin to get a science of mechanics. I am suggesting that we have not yet thought of the important concepts for social science. These are still to be discovered and developed and defined.' (1957:29).
He adds:

'There is always beyond (accidental discovery) an imaginative perception of a Newton and (a) Galileo. That is one reason why really important discoveries have to wait on genius' (1957:30).

Although delivered at a Seminar in Chicago in the spring of 1937, these remarks (which the editor refers to as containing Radcliffe-Brown's 'authentic style') were not published until 1957. They were, as a result, prescient in embodying the more typical concern of the '50's with Galileo. He,however, made the further statement: 'Newton's and Galileo's procedures were both fundamentally taxonomic' (1957:35), a view which Leach specifically refuted in 1959.

As Radcliffe-Brown had spoken in 1937, so Malinowski, posthumously in 1944:

'by the advance of modern physics since Copernicus, Galileo, Newton or Faraday, we would find the same differential factors which distinguish the scientific from other modes of human thought and behaviour. Everywhere we find, first and foremost, the isolation of the relevant factors in a given process. The reality and relevancy of these factors are discovered by observation or experiment, which established their permanent recurrence. Constant empirical verification as well as the original founding of scientific theory and experience, is obviously of the very essence of science' (1944:11).

He adds quaintly:

'It is at this point that the claims of anthropology might be pegged out'.

So much for an older anthropological scientism. With Levi-Strauss (1953:540) we find that: 'It is by means of (certain) studies, which exhibit a truly "Galilean" outlook, that one may hope to reach a depth where social structure is put on a level with other types of mental structures, particularly the linguistic one.' He notes that he means by Galilean: 'aiming to determine the law of variation, in contradistinction to the "Aristotelian" outlook mostly concerned with inductive correlations..' a distinction which he specifically derives from Lewin (1935), of whom more later.

It is interesting that in a 1942 paper Lewin also connected 'Galileanism' with the advance upon simple classification that later appears with Leach:

'In the time of the Greeks, geometry shifted from a "classificatory" method (which groups geometric figures according to "similarities") to a "constructive" or "genetic" method (which groups figures according to the way they can be produced or derived from each other).Ever since, the "genetic definition"

> has dominated mathematics. In physics a similar development occurred at the time of Galileo. Biology tried to take a major step in this direction when the system of Linnee was superseded by that of Darwin.' (Lewin, 1942/1952:61).

Although the Galilean image thus in one form enters social anthropology from social psychology, the mainstream of its more analogical use is better illustrated by Popper (1944-45 and 1957:1):

> 'Scientific interest in social and political questions is hardly less old than scientific interest in cosmology and physics; and there were periods in antiquity (I have Plato's political theory in mind, and Aristotle's collection of constitutions) when the science of society might have seemed to have advanced further than the science of nature. But with Galileo and Newton, physics became successful beyond expectation, far surpassing all the other sciences; and since the time of Pasteur, the Galileo of biology, the biological sciences have been almost equally successful. But the social sciences do not as yet seem to have found their Galileo.'

He specifically opposes this analogy with Galileo to Ginsberg's analogy with Newton in the passage (op.cit.:59-60):

> 'My point about the technological approach might perhaps be made by saying that sociology (and perhaps even the social sciences in general) should look, not indeed for "its Newton or its Darwin" but rather for its Galileo, or its Pasteur.'

He asserts:

> 'It must be admitted, however, that the success of mathematical economics shows that one social science at least has gone through its Newtonian revolution.'

With the full emergence of the image of Galileo, comes naturally the contrary image of the Ptolemaic system. Leach (1961:26-27) himself now says:

> 'The trouble with Ptolemaic astronomy was not that it was wrong but that it was sterile - there could be no real development until Galileo was prepared to abandon the basic premiss that celestial bodies must of necessity move in perfect circles with the earth at the centre of the universe.. We anthropologists likewise must re-examine basic premisses and realise that English language patterns of thought are not a necessary model for the whole of human society.'

He says: 'Of such cycles and epicycles there is no end'(p.26). He repeats (1962:240):

> 'The Ptolemaic system of astronomy which finally crumbled under the onslaughts of Copernicus and Galileo was just such a model of ideal types...Some of my anthropological colleagues appear to believe in a similar way that certain traditionally accepted sociological conformations are a "law of nature".'

We may compare this with Wiener (1948, 2nd edition 1961:viii):

> 'When I came to M.I.T. around 1920, the general mode of putting the questions concerning non-linear apparatus was to look for a direct extension of the notion of impedance which could cover linear as well as non-linear systems. The result was that the study of non-linear electrical engineering was getting into a state comparable with that of the last stages of the Ptolemaic system of astronomy, in which epicycle was piled on

> epicycle, correction upon correction, until a vast patchwork structure ultimately broke down under its own weight. Just as the Copernican system arose out of the overstrained Ptolemaic system, with a simple and natural heliocentric description of the motions of the heavenly bodies instead of the complicated and unperspicuous Ptolemaic geocentric system, so the study of non-linear structures and systems, whether electric or mechanical, whether natural or artificial, has needed a fresh and independent point of commencement.'

Wiener acknowledges useful discussions with Dr. K. Lewin.

In the two such different worlds of non-linear electrical engineering and of unilineal descent systems the language of crisis looked back to the destruction of classical astronomy. It is not necessary to add to such quotations to show that the search for Galileo, (or Newton, or Darwin or Pasteur) and the perception of out-of-date Ptolemaic systems crumbling and tottering, were part of a widespread mode of expression in many disciplines - already analogical in its preciser usages: metaphorical or rhetorical in other applications.

The Topological space

Kurt Lewin was responsible for the first important discussion of topology in relation to social studies so it is worth citing him at some length. His major work was the Principles of Topological Psychology (N.Y. 1936). Elsewhere he has this to say about the concept of the topological space in psychology and sociology:

'Psychology has to deal with a multitude of coexisting facts which are interrelated and have a relative position to each other; in mathematical terms, it has to deal with a "space".

> 'Mathematics knows a variety of different types of spaces. It is an empirical question as to what kind of geometry is best suited to represent the dynamic interdependence of that realm of facts which is treated in a particular science. Since Einstein it has been known that Euclidean geometry, which previously was the only geometry applied in physics, is not best fitted for representing the empirical physical space. For psychology, a recently developed non-quantitative geometry, called 'topology', can be used satisfactorily in dealing with problems of structure and position in a psychological field. This space permits representation of the position inside or outside of a certain region, the relation between parts and whole, and a great number of structural characteristics. All of this is done in a mathematically exact way but does not presuppose the quantitative determination of size, which is generally not possible in a psychological field...
>
> 'It is, I suppose, beyond question that sociology, too, deals with a "multitude of coexistent interdependent facts" - in other words with the "empirical space". The sociologists and psychologists should recognize what has been long known, that the empirical space is nothing other than a multitude of facts existing at a given time and showing certain types of interpendence...Better insight into the meaning of space in mathematics and physics should readily lead to the understanding that the social field is actually an empirical space, which is as "real" as a physical one.' (Lewin 1939, reprinted in 1952:150-151).

He goes on:

> 'For in sociology, as in psychology, one is frequently able to determine relations of parts and whole and changes in distance or direction without being able to determine quantitative relations of size, distance, or angle. In addition, these geometries seem to be particularly suitable for representing the peculiar combination of "cognitive" and "dynamic" factors which is characteristic of psychological and social fields, as well as a number of other fundamental properties of the social-psychological dynamic.'(p.152).

Levi-Strauss, in the same essay in which he specifically uses Lewin's 'Galilean' concept, (1953,1964:283), refers to topology as one of the fields in which it has been possible 'to develop a rigorous approach to problems which do no admit of a metrical solution.' He also says that 'social structure may have to deal with prehistory, archaeology, and diffusion processes as well as with psychological topology, such as that initiated by Lewin or Merino's sociometry'(1953:532; 1963:290; cf. also Nadel 1957:145).

When Leach(1961) introduces a topological analogy into his Rethinking Anthropology, it is therefore surprising that he does not refer to Lewin, whose well known system illustrates the complexity (and even the dangers) of a topological model. In this connexion it is worth recalling Braithwaite's criticism that 'to be profitable the system must be representable by a calculus in which formulae are genuinely derived, according to the rules of the calculus, from other formulae'. In referring to Kurt Lewin's Principles of Topological Psychology he says: 'the mere translation of tendency statements into mathematical language is not sufficient to make a quasi-deductive system out of them. The essence of mathematics is not its symbolism, but its methods of deduction.'(Braithwaite,1953,1960:366 note; my emphasis.)

There is absolutely no reason why social anthropologists should not explore these fields. A simple statement of the basic mathematical concepts involved may be cited from one of the most elementary works:

> 'In general any set of objects is called a topological space if a collection of its subsets are singled out so that the collection has the three properties we found in the open sets on the line: 1) The whole space and the empty set belong to the collection; 2) The union of any number of sets in the collection is also in the collection; 3) The intersection of any two sets in the collection is also in the collection. When these three conditions are satisfied, the sets in the collection are called the "open sets" of the "space"'. 'Under this definition, any collection of objects can be converted into a topological space, usually in more than one way.' (Adler,1958,1960: 120).

Leach's presentation of topology through the rubber-sheet analogy was possibly the more evocative one to use to introduce the matter to a group of functionalist anthropologists in 1959. It may be expressed so:

> 'We say that two topological spaces are essentially the same or are homeomorphic if there is a one-to-one correspondence between them that preserves the topological structures embodied in the system of interlocking open sets.'(Adler op.cit.:123).

As is well-known the topological space can thus be approached from set-theory or from geometry; from the latter Euler's Theorem is an illustration.

Science and Myth

Galileo and the topological space were motifs united by Lewin in the thirties. They were united again by Leach in 1959/1961. Levi-Strauss lies somewhere at the heart of the transmission. Lewin's application of the natural scientific analogy was, as we saw, serious enough to be sternly rejected by Braithwaite. The temptation to do the same for Leach should perhaps be resisted. Strangely enough we should, in these less positivistic days, even be prepared to say: 'the essence of mathematics is its symbolism' (by a twisting of Braithwaite's use of the term 'symbolism').

The formal systems of science and the images of science seem to form co-existent and interrelated semiotics. The search for a new synthesis, and for a non-mensurational view of systematic relationships, could be apprehended only symbolically in the fifties by most social anthropologists, given the characteristic bases of their training. Leach's paper, as he no doubt would be the first to agree, is brilliant myth rather than mathematics. Yet the great interest of mathematicians in topology is itself part of the general intellectual movement of our time, of which the structuralist or 'neo-anthropological' trends in social anthropology are another expression. Topology was for Leach as the phoneme was for Levi-Strauss - something good to think with.

We may finally note that Galileo was chosen by Popper, for one, to symbolize the awaited new era for social science because of the essentially experimental and technological breakthrough associated with the invention of the telescope. This sort of expectation is generally less appealing nowadays: the computer once appeared to embody it; but we shall probably need a Newton after all. At least we already have a few Keplers about.

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