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FLECK'S CONTRIBUTION TO EPISTEMOLOGY

PATRICK A. HEELAN
Georgetown University
Washington, DC 20057

Abstract

Ludwik Fleck opposed the two most prominent schools of the philosophy of science of his time: the Logical Positivism of Carnap, Schlick and others of the Vienna Circle, and the Historicism of Durkheim, Levy-Bruhl, Jerusalem and the sociologists of knowledge. Fleck objected to two of the fundamental principles of Logical Positivism:

- (1) the strict separation it imposed between scientific fact (expressed by sentences in a purely observational language) and both logic and theory; and
- (2) the dogmatizing of extensional logic as the unique and normative logic for scientific theory construction. In contrast, he stated the inner dependence of fact, theory and logic, and the dependence of both on a historical socially-conditioned process.

Fleck objected to the strict separation made by Historicism between the natural sciences (*Naturwissenschaften*) and the social sciences (*Geisteswissenschaften*), stemming from the assumed fixity or objectivity of established scientific facts in the natural sciences and the assumption that in contrast 'social facts' were the changing product of conventional and historical *Weltanschauungen* that leave the facts of natural science, however, unchanged. He stated that the descriptive frameworks of scientific facts in the natural sciences were themselves the product of intentional processes that were both culturally conditioned and historical; they were not, however, mere conventions, but the products of a hermeneutics of experimental experience.

I. SITUATION OF FLECK

Ludwik Fleck situated himself epistemologically in opposition to the two most prominent schools of the philosophy of science of his time: the Logical Positivism of Carnap, Schlick and others of the Vienna Circle, and the Historicism of Durkheim, Levy-Bruhl, Jerusalem and the sociologists of knowledge (46—51)¹. A brief statement of where he stood with respect to each is helpful.

Fleck objected to two of the fundamental principles of Logical Positivism:

- (3) the strict separation it imposed between scientific fact (expressed by sentences in a purely observational language) and both logic and theory; and
- (4) the dogmatizing of extensional logic as the unique and normative logic for scientific theory construction. In contrast, he stated the inner dependence of fact, theory and logic, and the dependence of both on a historical socially-conditioned process.

Though clearly much influenced by the sociologists of knowledge, Fleck objected to the strict separation made by Historicism between the natural sciences (*Naturwissenschaften*) and the social sciences (*Geisteswissenschaften*), stemming from the assumed fixity or objectivity of established scientific facts in the natural sciences — or better, the descriptive frameworks of the natural sciences — and the assumption that in contrast 'social facts' were the changing product of conventional and historical *Weltanschauungen* that leave the facts of natural science, however, unchanged (46—51)². In contrast, he stated that the descriptive frameworks of scientific facts in the natural sciences were themselves the product of intentional processes that were both culturally conditioned and historical; they were not, however, mere conventions (84—98)³.

Fleck then is not *a scientific realist* in the contemporary sense: in his account scientific reality is not what exists independently of human systems of inquiry; scientific facts are recognized by being the passive response of the world (experienced as 'given') to the active deployment of a historically changing system of perceptual inquiry — a performance — initiated and perfected by a collective of scientific researchers. Neither is Fleck a *conventionalist* (8—9, 100): the consensual character of a scientific account is constrained both by logical considerations (in the broad sense) and by 'irrational' conditions (96—97), that is, by conditions that are not reasons or elements reachable by rational analysis; such, for example, are the perceptual skills for the successful performance of acts of scientific observation that are learned under the supervision of experts. Nor is Fleck a *pragmatist*, though influenced indirectly by Peirce and James: for him, the cash value of a scientific account is directly in the power of perceiving new scientific facts, not just indirectly in the ability to infer useful or verifiable

(Postprint; Cohen and Schnelle (eds.), *Cognition and Fact — Materials on Ludwik Fleck*, 287—307. Reidel 1986.)

consequences. Historical and sociological studies of the development of scientific knowledge are important for Fleck: "epistemology without historical or comparative investigations," he writes, "is no more than an empty play on words, an epistemology of the imagination." (41) His main interest then is in epistemology, more specifically, in the inner logic (*Denkstil*) that connects the subject and object of scientific inquiry with its embodied conditions — intentional, behavioral, instrumental and genetic — in the historical evolution of the *Denkkollektiv*. His work then is not just a piece of the history or sociology of a particular science or scientific fact — in this case in the history of the descriptive frameworks used to define syphilis — it attempts to state universal conditions of a logical kind valid for all scientific development; it is as a consequence authentically philosophical.

II. FLECK'S EPISTEMOLOGY

Fleck's fundamental position is that facts (including scientific facts in the natural sciences) are always and necessarily correlative to powers of perception (perception, observation, scientific observation not distinguished), "a form to be directly experienced" (101), that new facts become known by changes ("stylization") in our perceptual powers, that such changes are always culturally and historically conditioned (84—99 and *passim*). Because essentially related to embodied intentions and special performance skills, they are never objective in the sense of being definable independently of human systems of inquiry, and never just personal and private (38—46, 127). In other words, for Fleck, the progress of a scientific inquiry is nothing other than the gradual transformation ('stylization') of the perceptual powers of the scientific collective (scientific researchers and their public). The relevant ('stylizing') conditions are for him: (1) anticipating intentions or 'proto-ideas' (23—25); (2) confused, often chance beginnings where a conceptual model and an experimental procedure meet (74—78, 89); (3) a certain 'mood' composed of feelings (of satisfaction or dissatisfaction with values to be realized by the inquiry) associated with a performance (the performance of scientific observations) (99); and (4) the acquisition of performance skills (called 'irrational' elements) in carrying out experimental procedures (96—97). Without the performance (in which scientific facts are made manifest to perception), Fleck says we have no more than "the words of a song" without "the tune" (96). Such *stylized perceiving* is what he calls a "*Denkstil*"; this is "[the readiness for] directed perception, with corresponding mental and objective assimilation of what has been so perceived" (99). The unique importance in Fleck's analysis of the conditions — intentional-behavioral, genetic-historical and physical-procedural — for the *performance* of scientific observation sets him off strongly from practically all contemporary schools of the philosophy of science.⁴ Fleck's emphasis was no doubt motivated by his professional experience as a microbiologist and physician, but the elements of his analysis are clearly relevant to all branches of natural science.

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Fleck's analysis is *epistemological*: it is a study, he says, in comparative epistemology (27-38). It is a study of the inner logic of the descriptive intentions that govern the receptivity of the knower to the presentations of facts: the 'unthinkability' of a fact that does not fit the descriptive intention, the 'unseen' 'unnoticed' character of contradictory evidence, the tendency to see only corroboratory evidence and to be blind to non-corroboratory evidence, indicate that Fleck is concerned with the logical constraints and normative conditions of possibility for the recognition of facts, thus, with philosophy, rather than with a reporting that such phenomena occur, and thus with history or sociology (27—38, 86, 104, 106).

Fleck describes the process of developing a scientific account as a process of developing *powers* of scientific observation and perception, "becoming 'experienced' " (96), it starts with protoideas — often mutually incompatible — these are intentions or heuristic notions accompanied by feelings of values to be realized by the inquiry, that are initially vague but nevertheless sufficiently specific to direct the design, performance, interpretation and gradual perfecting of experimental inquiry, the process, though animated by possibly a manifold of different intentions (Fleck enumerates four or more for the history of syphilis [17, 79—811), begins in deep obscurity and confusion but as the procedures of inquiry become better understood, better designed and more skillfully accomplished, experience is sharpened and clarified. Eventually one forgets the obscurity and confusion that accompanied the process. Depending on one's place in the *Denkkollektiv*, if, for example, one belongs to the core ('esoteric') group of researchers, one may come to enjoy the ability to perceive directly, and — as it were — with objectivity the scientific structures that the process of inquiry has made manifest. (If we take *objectivity* in a classical sense as independently of individual, cultural and historical biases, the objectivity may only be seeming.) If, however, one is distant from the core research group, one does not enjoy direct perceptual access to the scientific facts, but one may come nevertheless to accept on the authority of the culture the reports of scientific experts about such facts as objectively true.

The outcome of the process whereby new scientific knowledge is constituted is a *Denksstil* and like the process itself, it is a social entity possessed fully only by a group — a *Denkkollektiv* — in which it resides and through which it operates (125—142, 158—159). Thus, though individuals make acts of perception, the content, possibility and significance of an act of scientific observation does not depend only on the object but also in certain inescapable and necessary ways on the *Denkkollektiv*: no individual then can come to perceive a scientific structure or discover a new one without the cooperation of a collective that articulates its results descriptively, and publicly shares, monitors and promotes the process of inquiry by a set of common interests, feelings and emotions, or, to use Fleck's term, a certain 'mood.' (49, 99) Thus, the content of what any individual comes to perceive is stated in terms constructed by the collective; this content then is public, not private, and the event referred to and so

described by the individual is verifiable by any member of the collective (86). Scientific facts experienced by the *Denkkollektiv* can be expressed in reports: these reports, when true, are *true* (100), not in the sense of conforming to an objective reality (in the classical sense), but in the sense of conforming to what is made manifest as a perceptual object within a *Denkstil*. Scientific reality for Fleck consists then in these scientific facts as correctly reported (126-127).

The developing inquiry is always multi-contextual. "Worlds as such," Fleck writes, "do not have fixed meanings. They acquire their most proper sense only in some context or field of thought." (53) Truth is not a "convention," "not 'relative' ", "not 'subjective' in the popular sense" but "(1) in historical perspective an event in the history of thought, and (2) in its contemporary context, stylized thought constraint" (100). A "fact," he writes, "must be expressed in the style of the *Denkkollektiv*" (102).

A *Denkstil* is shared by the members of the *Denkkollektiv* in different ways. There are esoteric circles, circles of expert researchers close to the facts and experienced in the performance of acts of scientific observation; there are also exoteric circles, circles of non-experts and of the general public who are not experienced in scientific observation, but who dogmatize the facts to a greater or lesser extent because they lack historical awareness of the genetic process through which the facts came to be made manifest to expert observers. A *Denkstil* is also shared in different ways by writers of journal articles, of *vademecum* textbooks and of popular science (112—125).

A characteristic of every *Denkstil* is that it is concerned with the multiple appearances of common identifiable structures (such as the signatures of a positive Wassermann reaction) and also with systems of mutually related structures (such as the biological organization that is being sampled by the experiment). Thus, the validity of the Wassermann reaction — as an identifiable structure correlated with the bacterial agent (*T. pallidum*) of syphilis — depends (1) on a theory or model involving a number of known and to a degree controllable variables, and also (2) in a very crucial way on the skills ("the state of being experienced [*Erfahrenheit*] " [96]) of the scientific workers who perform the test. The former articulate a theory or model explaining the reaction and its connection with syphilis; this describes a system of related microbiological and chemical structures — of bacteria, antigens, antibodies, complements, chemical solvents, etc. The latter comprise those (unspecifiable, 'irrational') conditions necessary for the 'empiricization'-Törnebohm's word — of the model in the case at hand and for the reliable execution of the test: these involve being 'experienced' in preparing a good sample of serum, making accurate titrations, in noting the biochemical signs (flocculation, color changes, etc), in matching reagents, in performing the control experiments with skill and accuracy, etc. (96—97).

The sharing of a common *Denkstil* is a necessary condition for unambiguous communication: clearly, only to the extent that persons share *Denkstilen* will they inhabit a common world of reality (126—127).

Persons using different *Denkstilen* will fail to communicate, no one will see reality as the others see it, and each will believe that the others are somehow in a land of fantasy (109—111).

According to Fleck's account, scientific inquiry is *embodied*: it involves the organs of sensory perception and changes that take place in them in order to make possible the establishment of a new perceptual system, it involves feelings and emotions relative to the values to be realized by the inquiry, and it involves schemes of action, sometimes with instrumental and other technological procedures. All of these embodied structures, all 'irrational' in the sense that they are neither reasons nor transparent to reason, help to 'stylize' the trained perceptual powers of the inquirer, and create that "state of being experienced (*Erfahrenheit*)" (96) that "alone enables a [researcher] to perceive [for example] the relation between syphilis and blood as a definite form" (96). The technological instruments and circumstances are important because, when the *Denkstil* is fully established, they "automatically carry out the greatest part of our mental work for us" (84): they become part of a structured embodied probe through which the scientist feels out the scientific facts, and in so doing receives perceptual information about actual states of affairs.

The inquiry is, in addition, a *historical* process. It moves from a state of obscurity and confusion, false assumptions and irreproducible initial experiments to one of relative stability and clarity under the guidance of a *Denkstil*. The process, though usually re-interpreted by hindsight as a continuous forward path, has on the contrary, Fleck holds, no inevitability; its success being explained neither by historical fact (the passive side of cognition) nor by cognitive intention or theory (the active side of cognition), but only by an inseparable embodied dynamic involving the two under the guidance of a common 'mood' (set of feelings, emotions, values, aims, etc.) (99) The process induces changes in the individual and collective subjects, not merely in the acquisition of formal or theoretical understanding but in embodied perceptual and technological skills connected with the learning of new experimental procedures. What it is one comes to perceive is, or can — and should — be recognized as the achievement of a cultural and historical process that is never complete, and never fixed. It is not fixed because old scientific interests may be deserted in favor of new ones, and the old ones may be forgotten because of changes in the 'mood' of the scientific collective; it is never complete because some constraints may be removed that permit more complex systems to be sampled experimentally, systems that may be more general and inclusive than the original ones discovered. Thus, "even specialized knowledge does not simply *increase*, but also basically changes" (64), Fleck says, "At the moment of scientific genesis, the scientific researcher personifies the totality of his physical and intellectual ancestors and of all his friends and enemies," (95) the scientific fact that has been generated then "becomes an event in the history of thought" (97).

The inquiry, finally, is *hermeneutical*: it involves for the research community the interpretation and discernment, that is, the *reading*, of experimental signs.

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Fleck describes some experiments he and his assistant performed with colonies of streptococci in which he attempted to establish the existence of different strains on the basis of color and transparency. The outcome was different from what he had anticipated: he was able to establish the existence of different strains but not on the basis of the characters that originally suggested the inquiry. From this example, he draws some conclusions about epistemology: It shows (1) the material offering itself by accident; (2) the psychological mood determining the direction of the investigation; (3) the association motivated by collective psychology,⁵ that is, professional habits; (4) the irreproducible 'initial' observation, which cannot be clearly seen in retrospect, constituting a *chaos*; (5) the slow and laborious revelation and awareness of "what one actually sees" or the *gaining of experience*; (6) that what has been revealed and concisely summarized in a scientific statement is an artificial structure, related but only genetically so, both to the original intention and to the substance of the 'rust' observation. The original observation need not even belong to the same class as that of the facts it led towards. (87).

From confusion about what should constitute the set of relevant experimental signs, and obscurity about the precise meaning of those signs, order and clarity gradually prevail by a process of coming to understand, that is much like the hermeneutical process of learning to read a strange text. Apprenticeship for the novice scientist is by way of the same route by which a language is taught, the trainee is initiated under a dogmatic didactic authority inculcating the constraints of correct procedures and correct principles of interpretation (54, 104). Fleck says, "The Holy Ghost as it were descends upon the novice who will now be able to see what has hitherto been invisible to him" (106). The comparison between the biblical interpreter or hermeneut reading the scriptures under the enlightening influence of the Holy Ghost and the experimental scientist 'reading' his instrumental procedures under the enlightening influence of the *Denkkollektiv* is clearly drawn.

Fleck, as a historian of science, has much to say about archaic *Denkstilen* and their interpretation. An archaic *Denkstil*, no longer in current use, can be recovered, he says, only by returning to original sources, that is, to original texts and illustrations (120—126); from these a hermeneutical study will reveal the intentions, models, feelings, goals etc. of the archaic inquiry. The history of science is full of such *Denkstilen*, now forgotten and abandoned or, as Fleck believes, continuing in a changed and disguised form in the midst of contemporary science; the modern idea of syphilis, for example, contains residues of all the earlier accounts, of the mystical-ethical framework (syphilis as the 'carnal scourge'), of the notion of 'syphilitic blood,' of the theory of a causative agent like a miasma, and of other accounts. Old medical and biological descriptions of such items as the clavicle bone, the qualities of urine, the character of the metal phosphorus, etc., reveal the conceptual models, he says, that unwittingly constrained the writer. Likewise, old illustrations, such as, for example, Vesalius's, that purport to picture scientific facts reveal the artefactual character of the representation, for what is pictured is always selective of what was

thought relevant according to some conceptual model and important to the interests of the time (127—145).⁶

To summarize: the process of inquiry is *perceptual* — and hence oriented towards direct knowing; it is *social* — and hence, mediated by a collective, by common empirical procedures and by a common descriptive language; it is *multi-contextual* — and hence, governed by a specific interest in probing the variable observational profiles of specific experimental invariances; it is *embodied* in the performance of standardized instrumental procedures (or technologies) of scientific observation and in learned bodily skills to manipulate and read those instruments in order to satisfy the feelings that motivate the inquiry; it is *historical*, because it is both a product of a developmental process and a stage in a continuing development under the guidance of the *Denkstil*, and it is *hermeneutical*, because it learns to make and interpret a system of signs that, like a text, serve as a 'transparent' medium between the scientist and the empirical objects of scientific investigation.

III. HERMENEUTICAL-PHENOMENOLOGICAL INTERPRETATION OF FLECK

The summary given above of Fleck's epistemology was guided by my own set of philosophical interests, just as Trenn's translation reflects his own. Any translation of a work like Fleck's will reflect the dominant interests, the *Denkstilen*, of the translator, and any philosophical critical paraphrase will likewise do the same. Fleck's own philosophical work is not sufficiently rich in content or background allusions to fix unambiguously the philosophical tradition within which he was working or within which preferably he is to be read. A critic and interpreter, no less than a translator, has to choose a tradition within which to elucidate the work. Trenn's choice was slanted towards an empiricist sociology of knowledge, and one with which, I surmise, Fleck would have had some trouble. The tradition within which I shall choose to elucidate Fleck is that of hermeneutic-phenomenology. This is a tradition usually held to be particularly appropriate to the *Geisteswissenschaften* and not at all appropriate to the natural sciences with which Fleck is primarily concerned. It is then a matter of great interest and importance to find that Fleck's account of the natural sciences follows closely the kind of description that is given by hermeneutic philosophers of the social sciences or *Geisteswissenschaften*, and so Fleck's account in a revolutionary move would seem to place the natural sciences among the social sciences, in some respects eliminating the distinction between the two.

Hermeneutic Phenomenology 'Hermeneutic-phenomenology' (H-P) is a term that refers to a philosophy that has the aims and methods of both a phenomenology of perception and a hermeneutic of textlike materials. In the account that follows, I am not claiming for my theses, textual support from the writings of Husserl, Heidegger and Gadamer, but only support from the tradition

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that they have mediated.

As a phenomenology, the concern of H-P is with the critical analysis of perceptual content in order to identify perceptual invariants in the appropriate manifold of profiles; thus, its aim is apodicticity relative to what is given essentially in perception; what is given essentially and apodictically is a perceptual essence, and how it is given is through a system of profiles.

By perception, I mean any form of direct knowing issuing in a descriptive statement about an object or situation that is directly manifest in terms of critical perceptual essences, with a presence mediated by an appropriate physical embodiment in somatic and technological processes, and in appropriate structures of the ambient energy fields. I do not mean visual perception alone.

As a hermeneutic, the philosophical concern of H-P switches from the perceptually given to the process and structure that results in the categorization of those objects given in experience; this process is described as a 'reading' of experience, and hence, it is interpretative and hermeneutical. Since a hermeneutic is always performed in a cultural and historical setting, it never attains an absolute trans-cultural apodicticity of meaning; there is then a certain relativizing of phenomenology vis-a-vis its original claim of being a 'rigorous science.'

But just as the claims of phenomenology are weakened somewhat, so the claims of hermeneutics are strengthened, when they are given a critical empirical basis in perception; no arbitrary 'reading' of experience, however interesting and stimulating it may be, is acceptable unless it can be verified in experience. The phenomenological component takes away the arbitrariness, the conventionalism, of much that passes for hermeneutics today, and gives it roots and criteria in perceptual experience — even in the way the natural sciences are rooted in experience. Hermeneutics, without phenomenology, is arbitrary; phenomenology, without hermeneutics, is rigid and sterile.

Since I am concerned with a phenomenology of scientific objects, I want at the start to distinguish two classes of perceptual objects given in naive experience, or in the natural attitude. Some have well-determined (or determinable) essences, each with its characteristic manifold of profiles, and others are pseudo-profiles and pseudo-essences destined to be supplanted at some future time by other more authentic perceptual structures. These classes are rooted out only by a phenomenological inquiry performed in the critical reflective attitude. Such inquiries often extend over time, sometimes over generations, or even over centuries. Those that are authenticated by this kind of inquiry, I shall refer to as 'authentic essences,' 'authentic profiles,' or 'authentic perceptual objects.' With the help of this distinction, we can divide 'revolutions' in science into those which definitively terminate an ambiguous tradition of inquiry and end the search for objects of a certain kind, and those that transform the current state of a tradition of inquiry in a notable way, retaining continuity in the reference objects of the inquiry. Examples of the first kind of scientific revolution are theories about phlogiston and caloric — these were replaced by theories about more appropriate

physical structures — also theories about 'humors,' 'bad blood,' 'carnal scourge,' etc. all of which have been definitively abandoned. Fleck, however, writes as if all *Denkstilen* — even those that have been lost for whatever reason — are or were in their own time authentic ways of perceiving; for him it seems there are no pseudo-profiles and pseudo-essences, but only authentic essences, and these for him become incorporated into future projects and survive in those projects.

Turning now to hermeneutics: this is the science and art of interpreting texts and text-like materials in order to arrive, as Heidegger says, at the 'things themselves' about which the text speaks.⁸ The task of interpretation is led by fore-structures of understanding; these are (1) the conceptual frame-works suggested by the cultural traditions — the "biases and prejudices"⁹ we share, as Gadamer calls them, these are what Heidegger calls "*Vorsicht*"; (2) embodied perceptual habits or skills, these are what Heidegger calls "*Vorhabe*", and (3) a specific hypothesis suggested by clues in the textual material itself and by analogies with other textual material, this is what Heidegger calls "*Vorgriff*". "A person who is trying to understand a text," Gadamer says,¹⁰ "is always performing an act of projecting. He projects before himself a meaning for the text as a whole as soon as some initial meaning emerges in the text." This search for a holistic understanding is the antithesis of the assumption that basically all knowledge is derived only by combinatorics from a definite and fixed empiricist or nativist (conceptualist) repertory, or by inference from such a basis. Though circular, the hermeneutic process is not a 'vicious' circle in the logical sense, it is a 'virtuous' or 'hermeneutical circle.'¹¹ We are warned, however, that "all correct interpretation must be on guard against arbitrary fancies and limitations imposed by imperceptible habits of thought."¹² Our "first, last and constant task," to quote Heidegger,¹³ is to direct our gaze "on the things themselves," that is, on the objects, situations, goals spoken about, indicated or described.

But what are the 'things themselves'? The 'things themselves' are the subject matter about which the text speaks, and what that is depends on the kind of text that is being read. Some texts are concerned with non-perceptual objects like theoretical or philosophical notions, programs, plans and possible futures, still others are involved merely with the sound and play of words: in none of these are the 'things themselves' perceptual objects. Some texts, however, probe meanings and structures constitutive of experience; the 'things themselves' then are manifest objects accessible to a general public. It is only in current or historical Worlds — including their scientific horizons — that perceptual objects have a home. To understand a perceptual object is to be able to recognize and name it and to affirm it in a perceptual judgment.

How does one come to understand, recognize in experience and name a category of perceptual objects referred to by a text? We ask: can the essence of scientific entities be understood from a study of textual materials and illustrations alone? Clearly, the appropriate fore-structure is our understanding of the World, and its manifold of horizons; this includes developed perceptual skills embodied in our mode of interactions with our World, and a common descriptive language.

Consider the future development of science — what is now being considered in a speculative or tentative way — and its past — what was once affirmed but is no longer affirmed.

Consider such radically new and speculative entities as quarks and black holes, or archaic scientific entities like phlogistan or caloric, can these be understood simply from equations, diagrams, models, and commentaries on these? In concert with Fleck, I take the position that the essence of a quark or black hole cannot be encapsulated in literary, mathematical and illustrative materials alone. On their own, these speak only metaphorically (by conceptual models) of that which is the *real* essence, and what would be manifested (were quarks and black holes to exist), each as the invariant structure of a system of perceptual profiles made manifest through appropriate observational procedures using what I call 'readable technologies.'

Hermeneutics and the History of Science. A similar problem arises with respect to the history of science. If the archaic scientific essence is just a pseudo-essence, I presume there is no way we could recover its perceptual essence, since it had none. If the archaic scientific essence is authentic, would we then have to learn to perceive nature as archaic scientists perceived it, in order to interpret correctly what was written in the past? To the extent that the recapturing of such a perceptual experience is possible, does this experience emerge from the study of the archaic textual and illustrative materials alone?

Underlying this discussion is the question: what is science, what does it do? There are those who hold that science theory- and model-making do not have an ontological intent; that its intent is merely manipulative (Instrumentalism), or merely to construct abstract models that organize a given or fixed empirical base (Empiricism). In keeping with such philosophies, archaic scientific texts would then be interpreted without the necessity of experiencing their objects. If, however, Fleck's analysis of the perceptual use of instrumental procedures is correct, then (provided the archaic entities had authentic profiles and essences), it would be necessary to come to perceive the scientific entities in order to come to a correct understanding of the text.

Thomas Kuhn, whose view of the development of science is so close in many respects to Fleck's, spoke about the transformation that took place of his sense of the history of science when he came to understand that Aristotle in his *Physics* was not making an unsuccessful attempt to do mechanics, but was concerned with a much larger question, the character of qualitative change in general, and of local motion only to the extent that it exemplified the general qualities of change. To interpret Aristotle's *Physics* correctly, then, he holds that one must come to experience change (all, or for the most part) as charged with intentionality. Such a transformation was, in Kuhn's words, a 'hermeneutical' experience.¹⁴ According to this view, a particular set of archaic, but authentic perceptions might simply have been lost to our culture by a change of cultural interests. Kuhn's experience of the necessity of a hermeneutics of archaic texts is comparable in certain ways with the account given by Fleck (121-145), but it lacks an emphasis on the phe-

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nomenology of perception.

The role of hermeneutics in scientific observation is also reflected in the views of S. Toulmin¹⁵, Paul Feyerabend,¹⁶ N. R. Hanson¹⁷ and M. Polanyi¹⁸ who all insist that 'observational' transformations generally accompany the widespread adoption of new scientific theories; but it is often not clear as to whether 'observational' means authentically perceptible or merely detectable by indirect means.¹⁹

The importance and necessity for an aspiring scientist to be apprenticed to the experimental and theoretical life of an ongoing scientific community is stressed by Fleck, as it is stressed by others, such as Kuhn, Toulmin, Polanyi and others. Learning the "*Denkstil*," as Fleck puts it, or learning to operate within the 'disciplinary matrix,' as Kuhn calls it,²⁰ does not, however, consist solely in the ability to construct or manipulate conceptual models, but comprises also the ability to use these models in empirical procedures to exhibit the appropriate scientific structure to a trained observer. Kuhn speaks of "some non-linguistic process like ostension"²¹ in which mastering exemplary or paradigmatic studies plays a large role. This ability to 'empiricize' conceptual models is learned, not through a system of correspondence rules or reduction sentences as suggested possibly by the 'Received View',²² but, as Fleck puts it, by the scientist's becoming 'experienced' in the performance of scientific observations or, An experiment is not a piece of Nature, pure and simple, but a humanly contrived phenomenon. "In science, just as in art and life," Fleck writes, only what is true to culture is true to nature" (35). In keeping with Fleck and as I shall explain more fully below, Nature is made to 'write' a 'text' in conventional symbols for the trained scientist to 'read.' A 'reading' is direct access to meaning through a 'text', and in the case of scientific observation, the direct access is mediated by somatic and technological processes, that is, it is perceptual.

Let me call the signs, symbols, changes attended to in the experimental (or 'stylized') procedures from which the scientific facts are 'read', the "'text' " " 'written' " by the scientific object using the stylized empirical procedures; then the empirical procedures become a 'readable technology,' and the process of interpreting their meaning becomes analogous to the interpretation of a literary text.²³ These 'texts' become transparent only to the initiated, as Fleck has shown by many examples in microbiology. The same phenomenon of transparency occurs in the use of standard physical instruments, but not always. It is not present at the start of an apprentice-scientist's training, but is at the end. During episodes of scientific development dominated by pro-found theoretical change, transparency, even for an expert, can give way to deep obscurity and travail, since what is presented to perception through the available empirical procedure is incompletely understood, and the necessity for further theoretical development is painfully recognized. Fleck gives a brilliant account of this kind of groping and obscurity in immunological and serological research, which is closest to that experienced by philologists in the interpretation of archaic texts or texts from strange cultural milieus.

The role of hermeneutics in natural science is not then restricted to the study of textual and illustrative material, for these alone do not bring the reader to confront the "things themselves" about which science speaks. Such materials alone can only confront the researcher with the *model* used to understand nature — knowing what lions' are helps to understand the phrase 'Lion of Judah' but what this says of David, requires in addition the skill to apply it correctly to David; it does not describe, for example, David's appetite. The 'things themselves' in so far as they are facts, that is, *perceptual* objects, are confronted only in and through the performance of empirical procedures.

It will be noted that Fleck has comparatively little to say about a theme that fills books in the philosophy of the physical sciences, *models*.^{3a} In the discussion of models, an important distinction relevant to the question of continuity and discontinuity in theory shifts has to be made. This distinction is between an *abstract model* like a system of Newtonian point-masses, and the *use of the model descriptively* to make particular statements with realistic intent about the World. A mass-point is a constructed, abstract, imperceptible and therefore unreal entity; but the Sun-Earth system (to which this model for certain purposes can be correctly applied to yield true statements) is not a system of mass-points, but *a representation* of a mass-point model. The notion of *representation* (a particular use of the model) is an essential epistemological refinement and serves to distinguish between, say, the *Earth-represented-as-mass-point* and *mass point as an element of an abstract model*. It is often stated, following Husserl, Merleau-Ponty, Gadamer, Heidegger and others, that the sole use science makes of abstract models is to make them surrogates for the reality we perceive — "mirror images" in Mind, of reality. If this is taken as a statement about the essential nature of science, then it is a misunderstanding — though very prevalent — about the correct use of mathematical models in science. The point of the emphasis on experimental or perceptual acts in science is to insist that science is not about models (as 'mirror images' or surrogates for reality) but about reality *understood through the appropriate descriptive use of models*. Models are merely quantitative metaphors: they *enable* one to recognize certain kinds of facts given in and through perceptual experience, and they are *necessary* for the identification of those facts, since without the model/metaphor there is no way of identifying what it is one ought to perceive. Hence, differences in model construction need not imply an essential difference in the understanding of the domain of experience about which the models speaks, just as the difference between a Ford Model T and Mercedes 260S, or between a donkey and cart and a Porsche do not imply that transportation by road is an equivocal term. The continuity that is sought in the development of scientific theories is not to be judged by the syntactical congruences or non-congruences between theories-as-models, but by the greater or less inclusivity of their empirical horizons (represented by the ability to order them under the partial ordering of a lattice of *Denkstilen*). A *theory* in the latter sense, is not an abstract model, but a pre-linguistic entity logically antecedent to models (though using models in its explicit articulation), and comprises those elements that Fleck refers to as the 'mood' of the inquiry, 'proto-ideas,' 'the

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purpose of the *Denkkollektiv*,' etc.: I have paraphrased this as 'intentions,' or 'structure of intentions,' it is what connects and underlies a progressive sequence of conceptual models, where each successfully identifies the same class of referents, and each is more powerful than its predecessors in the line of development.

Progressive Development in the History of Science. According to a view first proposed by Kuhn, scientific inquiry historically falls into two patterns: 'normal science,' which is linear development within a fixed and dominant 'disciplinary matrix,' it has an internal history sufficient to account for the development, and 'revolutionary science,' which is a non-linear mode of mutually competing and mutually incompatible explanatory matrices where the selection of the winning paradigm involves predominantly external (e.g., social and political) factors.

In contrast with Kuhn's sociological view is the normative (philosophical) view of the Popperians, for them, science is always in a 'revolutionary' phase, it is the systematic effort to supplant old theories by new ones of greater explanatory power, for which project the search for anomalies is perennially crucial.

Much discussion has centered on the existence of scientific revolutions, whether they occur, and if so, how they should be described and the role they play in the scientific enterprise. Fleck had nothing to say about scientific revolutions. This seems at first sight strange. However, from the point of view of an epistemologist, scientific facts once established *by a Denkstil* as ontic possibilities remain so in principle, even if they are later lost to the human community by a change in its interests, orientations and environment. The *loss* is not perhaps significant for the philosopher; it is, however, an important empirical phenomenon about science that would naturally spark the interest of a historian or sociologist of science. Scientific revolutions as described by Kuhn are then of interest primarily to history and sociology; scientific revolutions are also of great interest to the Popperians whose epistemology, like that of the logical empiricists, rests on the historical stability of basic statements of fact. Such revolutions, however, do not spark the special interest of philosophers like Fleck for whom reality is 'horizontal,' grounded, that is, on *Denkstilen*. That science is not simply the accumulation of and systematization of factual information is generally agreed, but it is less well understood that the new scientific models and theories, as Fleck has shown, transform the content of one's perception of the World, and so transform the basic scientific facts with which the scientific community has to deal.

Fleck and Kuhn agree that conceptual models change and are replaced: what constitutes the rationality of this process? Is scientific reality then like social reality, a product of the historical-cultural process?

The rationality of theory change is something too complicated to deal with here. It requires (a) the analysis of hermeneutical changes that preserve reference, (b) a theory about the definitive abandonment of traditions of inquiry, and (c) a

theory of the synthesis of separately authentic descriptive systems that are incompatible, but nevertheless not absolutely, only relatively so. These last are systems that from their analogue in quantum mechanics I call 'complementary systems.' By 'complementarity,' I mean 'context dependent' perceptual processes. Such an account agrees better with the original insights of Bohr and Heisenberg, than with subsequent attempts in the empiricist mode to explain this peculiar aspect of quantum mechanics. The articulation of this view is to be found elsewhere in papers I have written and in my book.²⁵

Revolutionary science, whether merely in historical episodes as Kuhn claims, or as a permanent state of science as the Popperians would have it, *is hermeneutical*. An anomaly that consistently frustrates the anticipations of scientific observation brings up for reflective questioning the 'cut' that separates the subject from the objects of science; this invites a search for new descriptive models, and a new interpretation of experience embodied in new readable rechnologies.

Revolutionary science is *historical* and *dialectical*, since the persistent and significant failure of a tradition forces the scientific community to reflect on the historical roots and path of development of the tradition in an effort to find negativity that has been overlooked. This is often contained, as Fleck points out, in an existing but minor tradition, incompatible with the former and therefore considered of less significance. The purpose of this return to historical roots is to recover the global intentions that were operative prior to the entrenchment of the major tradition and that continue to underlie it. This has been illustrated by Fleck in numerous examples relating to the history of syphilis, the ethical-mystical tradition which, he says, is continually active, the etiologial-causative tradition, the therapeutic tradition, etc., all of these constitute, according to Fleck, the well-springs of the contemporary understanding of syphilis, and represent elements in the partial ordering of the dialectical lattice that synthesizes for us those past traditions. The same return to historical origins can be found illustrated in the development of physical theories, for example, in the deveopment of the atomic theory, in Einstein's reflections about relativity,²⁹ and Heisenberg's about quantum mechanics.³⁰

Reality as a whole is what belongs to Worlds and is given directly in perception; it. then shares the historicity of 'stylized' human perception. If scientific theories articulate physical reality by making its structures manifest to 'stylized' perception in and through appropriate observational procedures or 'readable .technologies,' and if scientific accounts are historical, then physical reality is like social reality, it is roughly just that part of reality that is mediated by scientific instruments or readable technologies. It is then historical and cultural, but it is not conventionalist in the sense of Duhem, Poincare, Reichenbach and Quine, for these overlook the constraints of *Vorhabe*, which are not antecedently known, or even possibly knowable.

Natural science as Non-hermeneutical? It is a well-entrenched tradition in the sociology of knowledge that goes back to Karl Mannheim that there is an

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essential difference between the natural and social sciences by reason of their subject matter, methods of goals.³¹

Hermeneutical philosophers, like Heidegger, Gadamer, Habermas, hold a very similar view. The subject matter, methods and goals of natural science are for them essentially pragmatic, ordered to the control and manipulation of people and things; its characteristic method is the construction of theoretical model systems that create a surrogate picture of nature; the components of the scientific model are radically imperceptible and do not, and cannot, have a place in any historical World. (It is this last assertion that I have contradicted.)

It is not surprising that philosophical hermeneuts of our culture as well as sociologists of science agree in their description of the phenomenon of science in the West, and in the denial of any role in its internal development for social, historical and hermeneutical factors. This view is after all the one suggested by the particular cultural history of Western societies. Empiricism in philosophy and a pragmatic bent characterized the rise of science. One finds both, for example, espoused as a public ideology by the Royal Society at its institution. Empiricist philosophy at that time was, it must be remembered, as much a political ideology as a scientific one. Non-hermeneutical empiricist science made an early ally of the Enlightenment and soon became identified as the political tool of bourgeois liberation from the 'authorities' of the *ancien regime*, and from the philosophical (mostly hermeneutical) traditions that were identified with princes, popes and divines. 'Conservative' religion and 'liberal' science were born within this sociopolitical scene.³²

For those then who, like Gadamer and the later Heidegger, have experienced science only as functioning within the historical matrix I have described, and who have not performed the kind of critique of historical prejudice so strongly recommended by themselves in their own work, it is understandable that they would accept the view that since the goal of natural science in our culture is control of natural phenomena, the content of its theories need be no more than a reconstruction of nature according to a system of models that permit the achievement of this goal.

To place a hermeneutic of perception at the core of scientific observation, as Fleck does, is to give science an ontological essence. Its current cultural/ historical profile in the West then appears just as one of its possible profiles, one historical route science can take in human culture. This distinction — between the profiles and essence of science — opens the way for the 'redemption' of science from this Babylonian captivity to one cultural path.³³

Instead of the dumb and awed silence that many feel today before the impersonal greatness of nature, a new possibility can be glimpsed, that science might come to be experienced as a creative historical dialogue between a free society and its World. Science would in this way come to be experienced as full of human choices and prejudices, of political fights and religious feeling, and the expression of human freedom. Such are the conditions for the kind of playfulness

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that is at the center of an esthetic experience, where science and art meet.³⁵

NOTES

¹ Numbers in parentheses are page numbers in the English translation of Ludwik Fleck's *Entstehung und Entwicklung einer wissenschaftlichen Tatsache: Einführung in die Lehre von Denkstil und Denkkollektiv*, Benno Schwabe, Basel, 1935. The translation is entitled, *Genesis and Development of a Scientific Fact* (transl. by Fred Bradley and Thaddeus J. Trenn), University of Chicago Press, Chicago, 1979.

² "All these thinkers trained in sociology and classics, however, no matter how productive their ideas, commit a characteristic error. They exhibit an excessive respect, bordering on pious reverence, for scientific facts" (47).

³ Referring to medical descriptions made by physicians in the past, Fleck writes, "Our physical reality did not exist for them. On the other hand, they were prepared to regard many another feature as real which no longer has meaning for us" (127).

⁴ It would not then be useful to read Fleck as if he were a Logical Empiricist *manque*. He is better compared with, say, American Pragmatists, or with S. Toulmin, N. R. Hanson, M. Wartofsky, P. Feyerabend or I. Hacking. There are many similarities between Fleck's conceptions and the hermeneutical-phenomenological approach of the present writer; cf. Heelan (1975a) and (1983).

⁵ I believe that Fleck meant the term 'psychology' here in an epistemological sense, as *intentions*, *aims*, etc., of the inquiry.

⁶ On pp. 120-121, Fleck discusses medical descriptions offered at an earlier period. It is significant that he focusses there on the conceptual model and not on the facts as they might possibly be re-experienced today.

⁷ This section depends heavily on chapter 11 of Heelan (1983). For a review of the various empiricist, hermeneutical and dialectical schools of the philosophy of science, see Radnitzky (1973).

⁸ Heidegger (1962), p. 194.

⁹ Gadamer's view of 'bias and prejudice' is that they serve a necessary role as containing the authority of a tradition, they are then inevitable, but are in need of continual criticism. Gadamer is not as emphatic about the necessity of embodied skills or *Vorhabe* as is Heidegger. See Gadamer (1975), pp. 241-253.

¹⁰ Gadamer (1975), p. 236.

¹¹ Heidegger (1962), p. 194.

¹² Gadamer (1975), p. 236.

¹³ Heidegger (1962), p. 194.

¹⁴ Kuhn (1977), Preface, pp. ix-xxiii.

¹⁵ Toulmin (1972).

¹⁶ Feyerabend (1975).

(Postprint; Cohen and Schnelle (eds.), *Cognition and Fact — Materials on Ludwik Fleck*, 287—307. Reidel 1986.)

¹⁷ Hanson (1958).

¹⁸ Polanyi (1964).

¹⁹ For a fuller discussion, see Heelan (1983), particularly chapter 13.

²⁰ See 'Reflections on my critics' by T. S. Kuhn in Lakatos and Musgrave (1970), pp. 231-278. Kuhn writes, "for [paradigm] I should now like some other phrase, perhaps 'disciplinary matrix': 'disciplinary,' because it is common to the practitioners of a specified discipline; 'matrix,' because it consists of ordered elements which require individual specification;" among the latter are "shared symbolic generalizations," "shared models, whether metaphysical, like atomism, or heuristic, like the hydrodynamic model of the electric circuit," "shared values, like the emphasis on accuracy of prediction," and particularly, "concrete problem solutions," ("problem-solution paradigms" or "exemplars") (pp. 271-272).

²¹ Kuhn, cited from Lakatos and Musgrave (eds.) (1970), p. 271.

²² Cf. Suppe (1974).

²³ Cf. Heelan (1975a), and chapter 12 of Heelan (1983).

²⁴ For an account of models and metaphors, see Black (1962) and Hesse (1963) and (1980).

²⁵ Cf. Heelan (1970), (1971) and (1983).

²⁶ Heelan (1983).

²⁷ *Ibid.*, chapter 11.

²⁸ See references.

²⁹ Cf. Holton (1973).

³⁰ Cf. Heelan (1965) and (1975b).

³¹ Mannheim (1936), pp. 116, 168; Merton (1973), p. 270. This mainline tradition of the sociology of science is being strongly challenged today, both by sociologists, cf. Bloor (1976) and Mulkay (1979), and by philosophers and historians of science, like Hesse, Kuhn, Laudan, Rorty, C. Taylor, Dreyfus to name a few.

³² For example, this is the case with Locke. "Our modern Western world has been made by scientists, merchants, statesmen, industrialists; Locke was the first philosopher to expound their view of life, to articulate their aspirations and justify their deeds," Cranston (1961), p. 3. See also, Mannheim (1936), pp. 165-9 for the role of the bourgeoisie in the development of science.

³³ Foucault (1970), Monod (1971) and Skinner (1971), to mention just a few, have argued that science has banished objective grounds for all personal and religious values. Cf. Dreyfus (1980) for the 'nihilism' of identity theories.

³⁴ This, for example, would resemble in some ways the extreme position adopted by Feyerabend, for which he coined the motto, "Anything goes!"; cf. Feyerabend (1975) and (1978). For science as a work of the imagination, see Holton (1978).

³⁵ Cf. Gadamer (1975), p. 98-99, where it is argued that human play involves players and spectators in the closed world of the game, and that the perfection of play is its transformation into the structure of a work of art; similarities with scientific model building would not be hard to express. See also Holton (1978).

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