Science & Education **3**: 1–56, 1994.
© 1994 *Kluwer Academic Publishers. Printed in the Netherlands.*

Notes on the Cultural Significance of the Sciences*

W. A. SUCHTING

229 Bulwara Road, Ultimo, NSW 2007, Australia

ABSTRACT: 'Cultural' in the title is intended to allude to the bearing of the sciences on humanity's general orientation in the world. Questions about this are distinguished from ones about the sciences' instrumental aspect, as means to ends extrinsic to them *qua* sciences, and also from ones about their intrinsic character, except to the extent that these bear on the central topic of the paper. It is argued that the sciences, ethical/moral reflection and the arts are distinct but inseparable. The sciences may be regarded as 'first among equals' substantively, insofar they are a privileged source of a certain specially important sort of factual knowledge, and, methodologically, insofar as they provide a particularly clear model for understanding a purely naturalistic approach to the world.

> *. . . Ulrich . . . loved mathematics because of the people who could not endure it. He was not so much scientifically as humanly in love with science. . . . many people for whom mathematics or natural science is a job feel it is almost an outrage if someone goes in for science for reasons like [his]. . . . [He] . . . hated . . . all those who give up half-way, the faint-hearted, the soft, those who comfort their souls with flummery about the soul and who feed it, because the intellect allegedly gives it stones instead of bread, on religious, philosophical and fictitious emotions, which are like buns soaked in milk. . . . soul is . . . easily defined negatively: it is simply what curls up and hides when there is any mention of an algebraic series.*
>
> Robert Musil, *The Man Without Qualities*, Bk. I, Chs. 11, 13, 25.

1. INTRODUCTION

1.1. The aspect of the sciences that impinges most directly on the lives of most people, to whatever extent they may be consciously aware of it, is the 'applied' or 'instrumental' one, that is, the use of scientific knowledge to alter the world in accordance with those human interests that typically pertain to 'everyday life', and in the first place to material production. But this aspect already presupposes another, namely, a purely cognitive one, the sciences considered as furnishers of knowledge as such, as 'pure', 'abstract', 'theoretical'. This may be called their 'intrinsic' character, that which constitutes their distinctive *telos*, in contrast to the 'extrinsic' aspect noted to begin with, in that the latter depends on the former, though not conversely. (Of course, the pursuit of the sciences *qua* pure also involves altering the world, in particular in experiment, but this is a means to an end and not the end itself.) However, there is a third aspect, one that is

not as easy to characterise as the other two, though it is related to both. It connects with the first insofar as it is a matter of the bearing of the sciences on human life, though the sort of bearing involved is very different, and with the second insofar as it concerns the inherent character or *telos* of the sciences. It may perhaps best be approached, even if a little circuitously, through the history of philosophy.

Kant distinguishes between two concepts of philosophy. On the one hand, there is the *Schulbegriff*, which 'has in view only the systematic unity appropriate to knowledge', the '*logical* perfection of knowledge'. On the other, there is the *Weltbegriff.* or *conceptus cosmicus*, which is concerned with 'the relation of all knowledge to the essential ends of human reason' (*Critique of Pure Reason*, A838f./B866f., and cf. *Logic*, Intro., III). Adapted to the sciences, the first conception corresponds to the latter considered as 'pure', the second to the aspect I am at the moment engaged in marking out. Then again, the first of Kant's three great 'critiques' is devoted to knowledge as such, at its highest scientific knowledge, to purely 'theoretical reason', the second to right conduct, to 'practical reason', and the third both to the idea of God's relation to the world insofar as this bears on human knowledge, and to the nature of beauty. One way of looking at the trio is, then, in terms of a project of situating knowledge as such within the totality of human life. In fact, philosophy has traditionally treated three basic themes, namely – giving them the initial capitals appropriate to their age and dignity – Truth, Goodness and Beauty. Thus Aristotle writes (*Met.*, 1025b25) that 'all thinking (*dianoia*) is either theoretical or practical or concerned with production (*poietike*)'. That is, it is either a matter of knowledge in the strict sense (*theoria*, aiming at *episteme*), for its own sake, or of human activity as such (*praxis*), a main concern of which is *ethike*, a subdivision of *politike*, the theory of the proper organisation of communal life (the life of the *polis*), or the bringing about of what does not exist just by virtue of its own nature (*poiesis*), a production that results, among other things, in works of art, things of beauty.

Further historical examples could be cited, but this may suffice as a preliminary elucidation of the third aspect of the sciences that I want to consider in this paper, what I shall call their 'cultural significance', namely, the place of the sciences within the totality which also includes, centrally, first, goodness and right conduct (the subject-matter of ethical or moral reflection) and, second, beauty, works of art (the concern of aesthetics).

1.2. With regard to both the first and second aspects, the sheer size and cost of what is often called 'Big Science' are staggering. The pervasiveness and depth, direct and indirect, of the results of the applications of the sciences on people's lives, and the foreseeable further increases in the same direction are too obvious to need illustration. The situation of pure science is hardly less obvious[1]. At one end of the *scala naturae*, there are no known phenomena that do not behave in accordance with the principles

of quantum mechanics and special relativity, and, at the other, though inquiry is by no means so advanced, cosmology has built up an impressive body of fact and theory about the origins, current state and character of the evolution of the universe. Between these extremes – to take just a few examples – knowledge of the order of bases in the human genome is within sight, thus opening up the entirely realistic perspective of a full theoretical understanding of the so far mainly only descriptively registered course of biological evolution, while the comparatively young science of neurobiology is laying bare with bewildering speed the nature and workings of nervous systems. Naturally, huge gaps in knowledge remain, and it is to be expected, if only on the basis of past experience, that virtually the whole book of what today counts as scientific knowledge will eventually be rewritten. But it is hardly less certain that at least the more fundamental present acquisitions will be preserved in one way or another, say as consequences of better theories, and will not become of merely historical interest (*histoire perimée* in Bachelard's phrase, 1951, p. 32), regarded, at best, only as stepping stones to more adequate theories, at worst simply as curiosities.

In the light of all this it may well seem surprising that, in the 'developed' world anyway, there is at present, as regards the third, 'cultural' aspect of the sciences, not only a widespread ignorance and indifference to them, but also very common attitudes of distrust shading into real hostility, even if these are often in effect veiled in more or less covert forms of scepticism and relativism[2]. This is clearly a far cry from the boundlessly positive, optimistic outlooks on the sciences characteristic of the early modern phase (Francis Bacon, Descartes and others), of the Enlightenment and much of the inspiration of what has been called 'the secularization of the European mind in the nineteenth century'[3]. The reasons for this change are many and complex. But at least part of the explanation lies, in a superficially paradoxical way, in the very advances of the applied and pure aspects of the sciences. For instance, the applications of the sciences are very often Janus-faced – technology that increases the productivity of human labour, say, may well by that very fact contribute to increasing unemployment[4] – and purely theoretical progress seems to many to involve a dangerous *hubris* in various ways (on which more later).

There can be no question of handling all the relevant issues in this paper – even all the chief issues – but I shall try to present the outlines of a constructive view of 'the cultural significance of the sciences' from which at least the general character of further developments can be inferred.

2. THE SCIENCES[5]

2.1. When the word 'science' first entered English in the fourteenth century it meant knowledge as such[6]. Somewhat later it was used to refer to

a particular body of knowledge or skill and then to a specific *kind* of knowledge or argument. Thus 'science' early exhibited a duality of meaning: substantival on the one hand, adjectival /adverbial on the other. The present dominant conception of the sciences bears the decisive stamp of the early-modern 'Scientific Revolution', of what is often called, eponymously, 'Galilean' science. This involved changes in both semantic dimensions: of views not only 'in' science, that is, about various matters of fact of different degress of generality, but also 'of' science, that is, in views about the very nature of scientific inquiry. At least in the present context the second is the more important, for the primary concern here is with the character of the sciences as such rather than with specific items of putative scientific knowledge, the latter's being susceptible of change without necessarily bringing with it changes in the former. The specific character of the 'Galilean' 'Scientific Revolution' in this regard can probably best be brought out by contrasting it with what it was a revolution *against*, namely, the Aristotelian conception of *theoria*, with its notion of *episteme* (and, by implication, the corresponding Latin *scientia*).

2.2. In the first place, the idea of *episteme* is grounded in a specific metaphysics. According to this, the world consists of individual substances, constant elements underlying change (*hypo-keimena*, Latin: *sub-stantia*). These fall into different classes determined by essences or 'forms' that are exhibited in the way in which things are qualitatively configured, 'always or for the most part' (*Met.*, 1026b28–1027a28 – also Bk V, Ch. 30, *Physics*, 196b10–14, etc.), particularly with respect to 'ends', teleologically determined final states. These universal essences or forms stand in necessary relations of inclusion and exclusion. It is a corollary that the quantitative features of things and also their relations to one another are of peripheral significance. In the second place, the idea of *episteme* involves a specific epistemology and associated methodology of inquiry. The world is presented first of all in sense-perception. But about this, as such, there can be only *doxa*, mere fallible beliefs (Latin : *opinio*). Knowledge in the strict sense, *episteme*, is a necessary system: a structure of necessary consequences of necessary axioms. Aristotle's conception of truth is often presented in the form of a 'correspondence' theory. But this is anachronistic, importing into his thought the idea of knowledge as 'representation' that only came to the fore in early-modern philosophy. Rather, *episteme* is a matter of direct, unmediated, intuitive inspection of the relevant universals and their relations. (After all, '*theoria*' is derived from the verb '*theorein*', to look at. Cf. 'theatre'.) This is the work of a special cognitive faculty (*nous*) that engages in a 'drawing out' (*epagoge*) of the universals and their relations that are obscured in ordinary perception. A corollary of this is that any actual interference with the object of knowledge must stand in the way of acquiring knowledge.

2.3. It is possible to represent the Aristotelian and Galilean conceptions

as having certain common features, for instance, a shared distinction between the unreliable beliefs based on sense-perception and genuine knowledge that is necessary. But what is meant by such views on both sides is so different as to make it dangerously misleading to construct continuities between them. A more perspicuous approach is to stress the fundamental incompatibility between them[7]. This emerges in a most fundamental way with Galileo's resituating of the place of epistemology/methodology: not only is this put in the first place, in contrast with Aristotle's grounding of it in metaphysics, but the latter is no longer assigned *any* systematic place in inquiry. Galileo had a certain very general conception of the knowledge that the sciences should aim at, namely, that of strictly universal, and thus necessary invariances that can be used to explain and predict actual states of affairs. To achieve that end he tailored an epistemology/methodology, that is justified not by a metaphysics laid down in advance of its formulation and use but solely by the success it actually has in helping to attain the end for which it was designed.

Let us now look at the matter more specifically. To start with, Galileo gives the central place not to Aristotle's individual substances, but to those items through which they were held to be accesssible, namely, qualities, properties. Here he abstracts from those that had a pivotal significance for Aristotle, namely, ones about which we are informed by the individual sense-organs: the 'secondary qualities' as they would later be called. This negative move is dictated not by some metaphysical position, for example, one to the effect that these are not 'real', but by the methodological requirement that genuine knowledge be intersubjectively invariant. (Thus this approach no more 'empties' the world of its immediately qualitative character and diversity, as has often been held by those who look at Galileo from a metaphysical rather than methodological perspective, than, say, actuarial tables that focus on people's average life-spans 'empty' the world of the hair-colour and emotions of the concrete people on whom the data is based. See here, e.g. Stebbing, 1937, esp. Pt II, and Ryle, 1954, esp. Chs V and VI.) Positively, this requirement dictates that attention be concentrated on those – soon to be dubbed the 'primary qualities' – which can be the subject-matter of such knowledge, and, in the first place, spatial and temporal properties, in effect spatial and temporal *relations*. Moreover, such can be treated quantitatively and established more or less accurately with instruments. So, once more, what was last in the Aristotelian scheme is put first. (Again, this aspect of the general approach neither presupposes nor supports any metaphysical conclusions, for example, that 'the world is ultimately mathematical' – whatever that might mean – any more than the fact that there are definite quantitative relations between the measurement-numbers assigned to the area of an ordinary table and the lengths of its sides means that the table is 'really' an arcane mathematical object. See again Stebbing and Ryle, as above.)

At this point the Galilean approach offers a replacement for the Aristotelian notion of substance as what assures constancy-in-change, namely,

the idea of an invariance in the form of the relations between particular quantitative values of properties, an invariant relation between relations, as it may be put, or, in a word, a (mathematical) *function*. But, furthermore, actual situations are always the foci of many different sorts of interactions, and are thus so complex that no conceivable general principles, at least ones of a specificity sufficient to be useful, could cover them. Therefore it is necessary to construct 'in thought' situations where abstraction is made from all but at most a few of the interactions that are always actually present and to define fundamental concepts (together with relations between them) that apply in the first place just to these 'pure cases'[8]. Actual particular situations are then handled by first theoretically 'resolving' (analysing) them into these simpler ones, and then, once more solely *within* theory, 'compounding' (synthesising) the latter into representations that more closely approximate to the real complexity[9]. The theoretical 'object' is a fully autonomous one, though the point of setting it up is to help understand the actual.

A very important corollary of all this is that theoretical principles must be *conditional*, since they pertain to purely assumed circumstances, whereas Aristotle's are *categorical*, since they pertain to what is actually the case. Now, precisely because any theoretical representation of the real will involve an abstraction from some actual features of the latter (either leaving out some altogether, that is, setting their values to zero, or assuming some constant value or range of values), theory can get a grip on the real only via an active interference with it aimed at *actually producing* a state of affairs that approximates, as far as possible, the conditions of the theoretical representation; in brief, *experiment* is necessary. So the procedure of *theoretical* construction and that of *actual* construction are *correlative*: the first can gain an anchorage in the actual only if the latter is changed in certain ways by the second, and the second can only proceed under the guidance of the 'template', as it were, provided by the first. To adapt Kant's famous words, the first without the second is empty, the second without the first is blind.

So, once more, the Aristotelian conception is reversed: as we have seen, according to it interfering with the object of knowledge is a *sufficient* condition for making knowledge *impossible*, whereas on the Galilean conception such interference is a *necessary* condition for making knowledge *possible*.

Finally, since all inquiry is mediated by both theoretical and experimental construction, there is no possibility of theory-neutral evidence (as distinct from sensory-material inputs)[10], and since all theoretical treatments of actual situations are based on various sorts of abstracting and idealising procedures, they are inevitably incomplete, so that all empirical assessments of such treatments must involve, not a two-term relation between a single theory and a set of evidence-statements, but an *n*-termed relation between *at least* two theories and a set of evidence-statements, the choice being made with respect to various, context-dependent criteria[11].

2.4. The persistence and indeed long dominance of the Aristotelian conception cannot be explained just by appeal to its comparatively late connection with Christian theology and thus with hegemonic ecclesiastical institutions. It is also in very significant measure due to the fact that it is, in many ways, a 'natural' philosophy of the 'everyday', 'commonsense' world[12]. The latter is basically the field in which human beings act in order to sustain themselves, in the first place through production. In this way it is essentially *anthropocentric*. The ordinary objects of action are humanly manageable 'individual substances', marked out in the first place by the deliverances of the unassisted sense-organs into kinds, the character of which is largely determined by their being the ends or means of action. In other words, the world tends ordinarily to be thought of teleologically, that is, as existing within contexts of human purposes. But it is also regarded teleologically in a stronger, *anthropomorphic* sense of the word: what from a purely naturalistic viewpoint has nothing to do with human beings is thought of as informed by human values and its modes of working as of the same character as intentional action[13]. These basic features of everyday thinking largely determine various others that constitute limitations, even from the point of view of needs that tend to develop within that context. What generalisations there are lack much comprehensiveness and are subject to widespread exceptions; thought tends to be holistic, syncretic and hence analogical rather than analytical, occupied with gross distinctions rather than more or less continuous variations; beliefs show a low level of systematic interconnection, and where they develop tend to do so rather haphazardly and by mere accretion rather than programmatically and by periodical thoroughgoing reorganisations; knowledge is limited both in range and detail; basic concepts, categories, are crude and quickly entangled in fundamental problems that are both drawn out and exploited by philosophers (e.g., the Eleatic 'paradoxes' of space, time and motion); explanation is usually of the unfamiliar and in terms of the familiar (the general intentional model being the prime example), rather than, as is typical in the sciences, of both the unfamiliar and the familiar, and both in terms of the more unfamiliar. The list could be extended but what has been said is sufficient to show that the founding of a genuine science always involves an 'epistemological rupture' with everyday thinking, one involving new concepts and procedures[14], even if the everyday world must always be, so long as we remain 'middle-sized drygoods' (as J. L. Austin put it), the ultimate *terminus a quo* as well as *terminus ad quem* of inquiry.

2.5. However, it is also true that some of the decisive epistemological/methodological means for overcoming these limitations, already sketched in the discussion of Galilean science above, are present embryonically precisely in the everyday domain. Since writers on everyday and scientific knowledge tend either to counterpose them sharply or to assimilate them, it may be useful to point to some aspects of their actual, often complex

relations. Thus everyday thinking exhibits a move in the direction of objectifying 'primary' qualities through more or less primitive instrumentation (for instance, measuring rods, water clocks, beam balances), and, via this, of objectifying 'secondary' qualities too (for instance, by correlating amount of heat with degree of expansion of a thermometric substance)[15]. There are also the first steps towards the formation of concepts of what is not 'manifest', notably what are often called 'dispositionals', like 'soluble'. The way this is done is worth a glance, for it bears a subtle relation to the methodology of 'pure cases' that is decisive for Galilean science.

To take a particular example, something would ordinarily be said to be 'soluble', or, more specifically, 'water-soluble', if, at a first approximation, a) it is of such a nature that b) if immersed in water it disappears and is subsequently recoverable by evaporation. But it would not be thought to count against (say) common salt's being water-soluble that, on a certain occasion, it would not dissolve in water because the water was already very salty ('supersaturated'). In general, the previous two criteria are, at least in effect, supplemented by a third that states that the satisfaction of b) is conditional upon other circumstances. This third criterion is seldom, if ever, specified very exactly; rather, it is an 'open' qualification (a so-called *ceteris paribus*, 'other things being equal' clause), supplemented as occasion warrants, that may be said to demarcate intended 'normal' conditions[16]. But this idea of what is 'normal' is intimately associated with a quite different one, which runs entirely counter to the epistemological/methodological direction of the other, though quite likely to be confused with it. This second sense is one in which 'normal' means 'usually', 'as a rule', in a purely 'frequentist'-statistical sense, so to speak. For instance, whilst in the first sense it would be perfectly correct to say that salt is water-soluble in a world where all water was supersaturated with salt, on the second it would be quite false. The first prefigures the Galilean idea of a 'pure case', whilst the stamp of the second, with its orientation to the actual, is Aristotelian [17].

2.6. It was seen above that whilst, on the one hand, the Aristotelian conception of knowledge strictly *excludes* any interference with the subject-matter of that knowledge in the course of acquiring it, and in this way sharply demarcates *theoria* against *poiesis*, 'production', on the other hand, the Galilean conception with equal strictness *includes* it. Let us now consider the Galilean view precisely *as* a process of production (of knowledge). To do this we may make use of Aristotle's own analysis of *poiesis* in terms of the four points of view for which he uses the Greek word *aition*, rendered in Latin as *causa*, and, through this, known in English as 'the four causes' (see, e.g., *Met.*, V, ii, *Physics*, II, vii). The 'formal cause' specifies the nature of the product, the 'final cause' that for the sake of which the product is brought about, the 'material cause' what the product is made from, and the 'efficient cause' the actual means by

which the latter is transformed into the product inherently characterised by its formal and final causes, which tend to coincide.

Now as regards (scientific) knowledge, its formal and final causes, specified jointly, may be said to be a system of generalities that can be used in the construction of arguments (that may include statements of particular fact) necessary for the explanation, prediction and control of matters of fact and that are assessed with respect to their success in forwarding those aims[18]. The material cause consists in matters of fact under certain descriptions, and various generalities. The efficient cause is constituted mainly by material instruments of various sorts (instruments in the proper sense differing from mere objects as such by virtue of their teleologically determined character, typically conferred on them by 'built in' theoretical principles of functioning/interpretation) and the physical and intellectual capacities of human agents. Finally, it should be noted that in general there are many processes of production of knowledge, both coexistent and successive, imbricated with one another, so that what in one process is, say, a product (for instance, a new principle of inference), may in another be a constituent of the relevant material cause. (Indeed, a product only 'proves itself' to be such in being consumed. See Suchting 1975.)

2.7. This 'production' account has a number of consequences important for the adequate understanding of the character of scientific knowledge, some of which are the following. a) Such a process is a true 'totality', aspects of which are analytically distinguishable but none separable or inherently privileged as a 'foundation', 'origin', 'centre' that determines the character of the whole. In particular, such a role is not played by the material cause *qua* matters of fact (appearing under definite modes of description) – thus excluding 'empiricism' – nor by the concepts that appear throughout, *inter alia* in the principles of inference employed – thus ruling out 'rationalism'. b) Since the mode of description of an item in a process (*qua* 'product', 'material cause', etc). is determined by its relation to other items, its context, role, function in a particular process or sort of process, and not by some 'substantial', inherent feature of it, the correct application of descriptions like *a priori*/*a posteriori*, 'necessary'/'contingent', must be context-dependent. Thus what occurs in one process as a principle of inference/interpretation (for instance, part of the rules for using a measuring instrument), and is in this sense '*a priori*'/'necessary', may well have begun cognitive life as a product of inference/interpretation and hence have been then '*a posteriori*'/'contingent'[19]. c) A product of one process may and typically does form part of the means for producing another product in a different process, a product that may well be an *improvement* on that means for producing it. (Cf. Spinoza's example – *Tract. de Intell. Emend.*, §§30–32 – of one type of hammer's helping to produce a better sort.)

What is in question here, and in the preceding point, is a procedure

that has been called 'successive definition/approximation'[20]. This further underlines the sense in which scientific inquiry is autonomous, and also the fact that such a mode of inquiry is inherently self-correcting, developmental, has built-in 'quality controls' as the inevitable 'faults' in one product lead, by *processes of the same general sort*, to improvements. d) Even if no faults show up in the short run, it belongs to the very nature of the scientific enterprise to expect them, even to seek them out, and certainly to try to find explanations for whatever has the character, at a particular time, of a 'brute fact'. Scientific inquiry is inherently *re*search: considered etymologically, a search both 'backwards' to what is taken for granted, and undertaken over and over again. This openness-in-principle is not a consequence of some metaphysical doctrine about the nature of the world (e.g., that it is 'infinitely complex'), or epistemological position on the nature of knowledge (e.g., that it is inherently fallible). Rather, it is a *rule* regulative of the 'game of science', set up by human beings, though, of course, such rules constitutive of practices may be, and indeed often have been, and are, *hypostasised* as quasi-factual philosophical claims[21].

2.8. The picture of the process of process of production of scientific knowledge so far presented is one that is abstracted from a much more complex situation[22]. In brief, *it itself is a 'pure case'*. Amongst other things, it abstracts from the institutional settings in which the processes of production of knowledge take place (e.g. publically funded institutes or privately financed 'R & D' operations), from the ways in which such knowledge circulates and is distributed (e.g. the refereed journal-system, 'classified' research), from the ways in which the goals of research may be determined by factors outside inquiry as such (e.g. environment-oriented versus military research), from the ways in which concepts, models, principles of extra-scientific provenance may feed into inquiry and be transformed by it (e.g. theological conceptions like Newton's 'absolute space' *qua* 'sensorium of God' as 'raw materials' for the production of a genuinely scientific concept)[23]. Again, it abstracts from the fact that inquiry, through its agents, always occurs within a body of norms of conduct appropriate to the inherent nature of inquiry (however far actual behaviour may sometimes depart from them)[24]. For instance, the latter's intrinsic 'openness' dictates an attitude that assesses work by reference to the ends of inquiry, that is self-critical and also appropriately tolerant of other views, that shows a 'sobriety' appropriate to the fact that the ultimate court of appeal is how the world is as it speaks in the many tongues of theory.

But at this point, where moral or ethical questions arise in the discussion of scientific inquiry itself, it is necessary to take up some general problems of ethics for their own sake.

3. ETHICS

3.1. As in the case of 'science', so in that of the English 'ethics', the word came into the language via Latin from the Greek, only more directly. (More like the history of 'science' is that of 'morals', from a Latin word used to render a Greek.) Furthermore, the history of ethical thought (on which see the excellent Macintyre, 1967 and 1981) is so far like that of the conception of science that the modern period is marked by a fundamental change in approach, mainly connected with the names of Hume and of Kant. Whether this change was, like that of the revolution in the conception of science, all to the good, remains to be seen. But the Hume/Kant shifts in standpoints have been so influential (as seen even – indeed especially – in *prima facie* contrasting positions) that discussion must almost inevitably at least start from here. As is common, problems of ethics may be looked at under two broad heads: those about value, good ('axiology') and those about what is right, obligatory, what ought or should be case or be done ('deontology').

3.2. As regards the first main area, the central question here may be put as: In what does goodness consist? Aristotle and Hume in effect agree that the first step in trying to answer this is to attempt to specify a general way of identifying some item as 'good', that is, in short, to delimit the concept 'good' (as distinct from what, if anything, this concept applies to). This is the Archimedean point where Hume applied his lever to move the world of ethics. All objects of knowledge are, he holds, either relations between 'ideas', or 'matters of fact' (sense-impressions, either isolated or in various relations to one another). 'Good' is not *itself* the name of any identifiable relation between ideas, nor of any ultimate matter of fact (something is not 'good', as it is, say, 'yellow' or 'hot'). Nor can it be *defined* in terms that refer solely to ultimate matters of fact (as, say, 'French flag' may be defined in terms of a certain pattern of red, white and blue stripes), since it is never self-contradictory simultaneously both to affirm that something is good but also to deny the application to it of any putative factual *definiens*. Hume draws the conclusion that 'good' is really just the name given to certain purely subjective sentiments and attitudes; however, by a sort of illusion, it tends to give the impression (if something more than mere word-play may be hazarded) of denoting something objective.

3.3. A standard objection is that, taken to the end, this account results in total relativism: the position that *tot homines quot sententiae* holds in matters ethical. Especially in face of this, many have held either that 'good' can after all be explicated in objective terms: say, either theistically, as for instance, 'what is in accordance with God's will', or as the name of a matter of fact that is ultimate and as such indefinable, but immediately recognizable. Now, even if, formally speaking, one or both approaches

were to be successful in avoiding Hume's conclusions, this would not *in itself* be a good ground for embracing either, since the non-subjectivity of goodness has not been independently established. But neither is in fact successful. As regards the first path, there is the problem of the relation between goodness and God's will. If it is an 'internal' relation (other than a mere semantic stipulation) then it does not seem that way to non-theists, and, if it is not , then the basic Humean argument is once more in play. Another problem is, of course, that the very thesis of the existence of God is not an unproblematic one. In brief, this *prima facie* objectivist, anti-relativist approach is *in effect* just as subjectivist and relativist as what it opposes, insofar as it provides no generally accepted way of resolving differences. No matter how strong the faith of those who have it, this is irrelevant to those committed to scientific values of critical argument unconstrained by ultimate framework beliefs. But a similar problem faces the second path. For this offers no basis for resolving differences between people about answers to questions regarding the nature of what is good. So in both cases we find *the purest dogmatism in theory combined with the purest relativism in practice*. But that questions about what is good are genuinely discussible seems to be an essential part of the way the concept actually *functions*: this is not to prejudge the question as to whether this actual functioning involves some sort of basic illusion but simply to point out that any possible doctrine of the nature of goodness should account at least for the appearance.

3.4. Now note – what may not be obvious – that the *general pattern* of the Humean argument about 'good', just briefly rehearsed, also applies to concepts about matters of fact. Though this could be shown to be the case even for Hume's ultimates, namely, the concepts of the objects of the basic sense-modalities, it will suffice for present purposes to make the point about concepts like the dispositionals already considered. Here too it may be argued that 'soluble', say, does not name a 'relation of ideas', is not a sense-impression, and is not definable in terms of any set of concepts referring exclusively to ultimate sorts of sense-impressions. Now we have already seen how 'soluble' is in fact specified, namely, as that property of something, whatever it turns out to be, that is (causally) responsible for the fact that if what is soluble is interfered with in a certain way (naturally or intentionally) then it reacts in a definite way, 'other things being equal'. In other words, 'soluble' implies that what has this property is in a certain state (which may be one of a disjunction of states) of which, in certain circumstances, a certain conditional is true. Thus 'soluble' is *univocal* whilst in principle denoting a *variety* of sorts of actual states of affairs: the specification of its meaning does not involve any *specific* matter of fact, but nor does it involve any terms *not* denoting matters of fact either.

Let us now return to the main road of the discussion. What may have seemed to be merely a digression turns out to have been rather a detour,

for if the Humean approach to dispositionals can be countered by that already sketched, and if the Humean approach in ethics is of the same general sort as the former, then an alternative similar to the latter may be employed here. More specifically, suppose 'good' is considered (at a first approximation anyway) as that about some state of affairs which, 'other things being equal', is apt for the realisation of some intended state of affairs. That is, to bring the expression more into line verbally with the treatment of dispositionals, let us say (at least as a first approximation) that something is 'good' if it is such that if the state of affairs thus denoted obtains, then (in the circumstances) another, intended one does. Thus 'good' is here defined in teleological terms and, to this extent, is a reprise of Aristotle's approach. As in many cases where a term is specified relationally, the relation may be telescoped into one of the terms of the relation, so that what pertains to the item by virtue of standing in a certain sort of relation may be thought of as inherently possessed by it; this shows how it could come about that 'good' can be thought of as an *intrinsic* property[25]. 'Good' is here univocal though applicable to different sorts of actual states of affairs, does not involve reference to anything but matters of fact and is therefore susceptible of genuine critical discussion.

3.5. Now it will be immediately objected that 'good' as characterised so far is not specifically *ethical*: in this sense a knife or agricultural technique or chess player may properly be said to be 'good'. This is true, but in itself shows only the *insufficiency* of the account as it has been developed to this point. Moreover, it can be seen as a positively welcome consequence, insofar as it reflects the at least verbal continuity in English (and many other languages) between 'ethical' and 'non-ethical' uses of 'good'. So the problem at this stage is to mark off a *specifically* ethical or moral sense of 'good' from the *purely* instrumental one, and, within the sphere of human qualities and actions themselves, those which may be judged 'good' only as a means to something else (being otherwise, in themselves, morally indifferent) and those that are good in themselves. (See Aristotle, *Nic. Eth.*, 1096b 14–15, and cf. Max Weber's distinction, 1947, I, 2, between what is *zweckrationell* and what is *wertrationell* – what, on the one hand, it is rational to do only as a means towards realising what, on the other hand, it is rational to try to bring about just for its own sake.) In fact all this may recall the ambiguity in 'desirable', pointed out numberless times *à propos* utilitarianism, namely, that between what is just *de facto* desirable, what is simply in fact an object of preference, and what is desirable *de jure*, that is, what has a properly ethical claim to be desired.

3.6. Now these objections have a point, or 'allude' to something; but the problem is, in the first place, to see just what it is. To start with, it is doubtful if there in fact is a *purely* instrumental or functional sense of 'good' of the sort indicated, since an element of moral evaluation would seem to enter into most if not all applications of 'good'. Thus a certain

sort of virus may be a highly preferred weapon of biological warfare, but most people would consider it perverse to call it 'good', rather than, say, 'effective' or 'efficient' as a means to an end. So some element of moral approval of the end to which something is a means would seem to enter into the description of the latter as 'good'. What is in question here is perhaps best designated by the word most appropriately used to render the Greek – in particular Aristotelian – word *arete*, namely, 'excellence'. Ability and will to kill other human beings in certain circumstances is common to the murderer and the Homeric warrior, but only the latter is possessed of *arete*. At this point the claim about the ambiguity of 'desirable' arises. However, there is no sharp distinction between the two senses in question. On the one hand, the morally desirable is not *just* what is in fact desired at some time; on the other hand, from a naturalistic viewpoint anyway, the morally desirable is by no means completely independent of what is in fact desired. There is a 'slippage' here which cannot be arrested in any simple way. Aristotle writes that 'the good (*tagathon*) is that at which all things aim' (*Nic. Eth.*, I, i, 1). His account avoids the dichotomy between what is factually and what is ethically the case by assuming that *all* existents, in particular human beings, are characterised by distinctive essences and strive to conform fully to them. (This is a view with numberless variants. For example, Hegel's account of *Sollen*, the ethical 'ought', depends on one of them.) But a naturalistic view cannot assume such essences, not (if it does not wish to be just another metaphysics) because it denies their existence, but simply because assuming them *cuts no real ice*, does not help in deciding between the *de facto* multiplicity of conceptions of what things are really like, in particular as regards what being good consists in. Even what may appear to be unified, homogeneous moral universes always turn out to be, when examined a little more closely, quite diverse. (Consider, for instance, any great world-religion.) The vacuity of Aristotle's own answer, namely, 'happiness' or 'well-being' (*Nic. Eth.*, I, iv, 2) – as *eudaimonia* has been variously rendered – is indicative. Going beyond this always results in what is, in the final analysis, simply a description of *de facto* modes of evaluation, however these are presented in a duplicate form as 'essences', 'natures' that, as a result of standing the whole situation precisely upside down, are conceived as determining what in fact determine them. (Cf. here what Marx and Engels early called the 'camera oscura' effect of ideology – 1976 p. 36 and cf. also pp. 23f., 54, 92, 99, 420, 460.)

3.7. Now all this suggests that from a non-metaphysical viewpoint the solution of the problem consists (to recall Wittgenstein's familiar early words) in the vanishing of the problem. Conceptions of good are relative to what the later Wittgenstein called 'forms of life'. From this point of view such conceptions have two broad roles. On the one hand, they describe, codify in more or less general terms, certain basic aspects of how conduct in fact proceeds in various human communities, and, on the

other hand, they function prescriptively, normatively, regulatively[26]. (A reasonably exact analogy is provided by the dictionary and grammar of a language. Cf. too the remarks already made about the character of so-called 'laws of nature'.) The distinction involved in the above objection between desirable *qua* 'merely' desired and desired *qua* ethically or morally desirable is a matter, speaking very roughly, of the depth of 'entrenchment' of a principle of conduct in a form of life. (Compare the idea that 'a priori' and 'necessary', and their contrasts, allude, analogously, to different degrees of 'entrenchment' in theories about what is factually the case.) From this point of view, 'good' may be said to be 'objective' in the sense of being generally *intersubjectively* valid for a form of life, independent of each person living that form, though not independent of all, as would have to be the case if it were objective *qua* 'absolute' (whatever that might mean)[27]. 'Good' is normative as regulating conduct in a way analogous to that in which 'pure cases' in a scientific theory are regulative of representations of real situations.

3.8. Now such a position may be labelled a form of 'relativism'. This term has traditionally been in bad odour in most quarters, even if now it tends to be flaunted in many. Though it is seldom if ever desirable in serious discussion to let much, if anything, hang on a word, still, if a label is required, then the view might be called 'pluralism'. *This* description is very positively regarded in wide circles. It has, amongst other things, an overtone of tolerance, of 'peaceful coexistence' of types of conduct that are different and indeed ultimately irreducibly so. Certainly the *existence* of such differences has always been the usual situation (see the surveys in, e.g., Brinton 1959; Groethuysen 1969). 'Every stage of development', writes Nietzsche (*Daybreak*, §108), 'has as its aim a special sort of happiness, incomparable, neither higher nor lower than others, simply its own'. This is applicable in a wider than merely 'diachronic' sense of 'stage of development'. An example is the contrast between, on the one hand, what may be called an ethic of everyday life, an orientation to peaceful production and reproduction, the family and other personal relationships, and, on the other, what may be called a 'warrior' ethic, meaning by this not necessarily anything martial in the ordinary sense, but an orientation towards personal achievement, renown, and so forth. (Cf. here Taylor 1989.) 'Pluralism' probably also carries (at least at the present time) an implication that coexistence of different systems of values has, apart from the 'negative liberty' it vouchsafes to people to live according to them, also the more positive value of enhancing human life through the opportunity it affords to learn from diversity. (The analogy with the sciences here is the crucial importance of 'theoretical pluralism', emphasised especially by Feyerabend – see especially 1975 and 1981 – for a more adequate approach to the understanding of the real.)

All this having been said, it must be added that there is, as history sufficiently attests, a permanent real possibility of *conflict* between such

divergent ethical/moral standpoints. But, in the first place , actual conflicts here are seldom if ever total. This is more or less assured by the fact that, at the most general level, there is a common 'human condition': human beings have to survive and, if possible to flourish, in a world that, in certain crucial respects anyway, is the same for all. In any case conflicts can often be resolved, either by argument or by getting people to see, by various means (initiation of people into new experiences, for instance – cf. here Feyerabend 1967) the 'point of view' of others: 'At the end of reasons comes *persuasion*' (Wittgenstein 1969, §612). (This is not inconsistent with the fact that ethical reflection is always from *within* some ethical standpoint, just as reflection on what is the most adequate view of what the facts in general are is always from within some theoretical standpoint.) Nevertheless, it is also true that there have occurred in the past, and will certainly also occur in the future (if humanity survives) conflicts between value-systems of such depth and extent that no arbitration is practically possible; such 'incommensurable' value-systems may be represented by different groups, by different individuals, or, in the most poignant case, be situated within one and the same individual. Such is the stuff of genuine tragedy. The most fundamental cases of such conflicts are aspects of transitions between world-historic epochs in which the whole situation of great parts of humanity, and sometimes of humanity as a whole, is radically reconstructed, as vast earth-movements alter the geology and topography of the earth[28]. The latter are consequences of the constitution of nature, and the former of the way historical change takes place in general: so we must ultimately contemplate them, in the words of Spinoza, 'not to mock, lament, or execrate, but to understand' (*Tract. polit.*, I, §4).

3.9. We come now to the second of the two major questions posed at the end of 3. 1 above, namely, that of right, obligation, ought/should. In a purely formal sense, the problem of good, or moral value, discussed so far, might be considered one of *description*, that before us now one about *conduct*, action, behaviour. And many ethical thinkers have in fact thought in terms of such a dichotomy. But doing so immediately offers a foothold for the sort of Humean argument already rehearsed. For, if 'good' ultimately simply describes what is the case, then there arises the problem of how to make the link with right conduct, what obligation consists in, what ought or should be done, and Hume's contention that there is no logical inference from 'is' to 'ought' appears once more: a factual state of affairs remains factual even if the fact is an irreducible, autonomous ethical evaluation. It is no good intercalating a 'bridge law', so to speak, between 'is (good)' and 'ought (to be done)', because then this link must be in turn be justified, and so on indefinitely. This problem is only avoidable if there is an 'internal' relation between 'good' and 'right (etc.)' Such is in fact assured by a teleological account of 'good' of the sort exemplified by that presented so far. From such a standpoint there is, *so far*, no more a *general* problem about the relation between what is morally good and

what morally ought to be done than about, say, the relation between what is the best agricultural technique in certain circumstances for realising a certain agricultural end and what technique I ought to adopt, assuming that I am in those circumstances and wish to realise that end.

3.10. But various considerations suggest that this is by no means the end of the matter, and exploring just a couple of these may serve to fill out somewhat the above very schematic account. To start with, consider those familiar lines from Ovid: *Video meliora proboque, /deteriora sequor* (*Met.*, VII, 20–21) – 'I recognise and appprove the better; I follow the worse'. They obviously refer to a situation that is not idiosyncratic to this poet but is rather a classic expression of a very common human one. But how can this be possible if there is a tight linkage between evaluation and action? I suggest that at the root of the problem is a divergence between, on the one hand, a course of action enjoined by a recognition of what, under one description anyway, is the good, and, on the other, a personal *inclination*, which, in the circumstances, proves the stronger impulse to action. (What is involved in Ovid's lines might be something else. In particular, I think that moral thought has hardly recognised, far less investigated, what Poe wrote about in his wonderfully perceptive essay 'The Imp of the Perverse'. But this is not the place to go into that matter, and if what I have identified in Ovid's lines was not the issue, then it might well have been, so common is the situation.) This serves at least to bring out something that the discussion so far has ignored, namely, the special role of 'deontological' language in situations involving moral *conflict*. More specifically, the language of right, obligation, and so on, is typically used to mark off what is morally *preferable* from some alternative course of action[29]. This may occur not only in a situation of conflict between, on the one hand, what is enjoined by moral reasoning, and, on the other, what 'the old Adam' pushes towards, but in other situations as well. For instance, a given situation may be the source of moral reasonings having contrary conclusions as to what is to be done, in which case deontological language may be used rhetorically (in the sense of persuasively) in favour of one conclusion rather than another, or to mark the actual choice of one over another. (There is an analogy here with the situation of *belief* in the case of alternative truth-claims, possibly as resulting from ordinary factual inferences.)

3.11. Consider now an at least *prima facie* somewhat different sort of situation, illustrated by the case adduced by Sartre (in *Existentialism is a Humanism*) of the young man who finds that he must choose between, on the one hand, leaving home and his mother to join the Resistance, and, on the other, staying to look after her. (A more contemporary example: Should Moslem authorities in Bosnia-Herzegovina allow the UN to evacuate their non-combatants from contested territory belonging to them, and thus in *effect*, assist Serb 'ethnic cleansing', or make them stay

to face unspeakable suffering and frequently death, in order to assert their rights to the land, draw world attention to their plight, and so on, without any guarantee that this policy is going to be effective?) Here we seem to have a conflict not between a (recognised) obligation and an inclination or immediate impulse, but between two obligations. How could this be so if 'good' is, contextually anyway, univocally descriptive and also implies a certain obligatory course of action in the circumstances?

To start with, a person may well fall under different modes of moral description that are not *themselves* incompatible, whose *consequences* as regards what ought to be done are *severally* self-consistent and susceptible of being acted upon, but which are incompatible when taken *collectively*[30]. Such is the case of the young man in Sartre's example. He is both 'son' and 'patriotic citizen living in a state of foreign occupation'. Each (when filled out, and together, of course, with relevant principles of ethical reasoning) entails a comparatively unproblematic obligation to act in a certain way[31], but the associated courses of action cannot both be undertaken at the same time. Let us compare this with a purely scientific context. Here two things may fall under different, simultaneously applicable descriptions that do not have consequent behaviours that 'interfere' with one another- say, 'is red' and 'has a mass of 5 gms'. They may also fall under ones which do or can have 'interfering' consequences, such as 'subject to a central gravitational force' and 'subject to an electromagnetic force in a direction normal to that of the gravitational force'. But whilst a body cannot move in two different directions at the same time, the tendencies, so to speak, to move thus can be 'compounded' by some sort of principle of 'addition' (e.g. parallelogram of forces). However, the incompatible courses of action open to the young man in question cannot by any stretch of the analogy be similarly combined. (Even in quantum mechanics it is not that two actions – measurements of two sorts of conjugate parameters – cannot be simultaneously carried out, but only that doing so involves an interference between them, so that the aims of both cannot be realised with with arbitrary accuracy; moreover, there is a strict general form of the amount of interference involved, namely, the indeterminacy relation.) So the moral case seems to be ultimately dissimilar, in the respect in question, to any known physical case.

Now it might be suggested that in the type of case being considered there must be a sort of higher-order ethical principle that establishes a hierarchy of priority in obligations, one that is not by any means always apparent but that can be found if only it is sought for thoroughly enough. However, what can possibly justify such a belief, assuming, at least, that we stick to the general naturalistic viewpoint that, *ultimately* anyway, human practices are the basis of ethical principles and not conversely? The most that could be hoped for along these lines is that, if certain general sorts of moral dilemmas were sufficiently widespread, certain overarching ethical principles might end up emerging, not as what was there all along, though unrecognised, but as codifications of *de facto*

arbitraments: as in mathematics (cf. Wittgenstein 1978, I, §167) what we do here is often better described as inventing rather than discovering (as often comes out with special clarity in the case of legal judgements). But such is the complexity of the moral world that there is no reason whatever to believe that its structures can ever be adequately captured in the form of general ethical principles.

The situation here may be compared with that of language. Actual languages always involve three basic elements: a user, a means of communication and a recipient, potential or actual, of the communication[32]. The problem of dealing with this situation is, in a way , analogous to the 'three-body problem' in mechanics, though it is more intractable, for in the linguistic case not only do the effects of pair-wise interactions themselves become causes feeding back into the original situation, but new elements constantly enter. So it is not realistically conceivable that any grammar plus dictionary plus whatever else could ever capture the complexity of a living language. (Of a dead one not only is much of the data of such an inquiry in principle unavailable, but there seems a sense in which even if, *per impossible*, we knew about every utterance that had ever been made in that language, there would still be an indefinitely large amount more to know, namely, the further utterances which it could have been used to make.)

Certainly, as we have seen above, ethical principles enter into scientific practices broadly conceived, and, conversely, ethical reflection must look to the sciences, both formally, as regards models of concept-formation and methodology, and substantively, as regards the purely naturalistic explanation of ethical phenomena and as a resource in determining, say, practically realisable ends. Still, for the reasons indicated above, among others, ethical reflection is necessarily more 'casuistic' than reasoning in the sciences, and is often more like 'knowing how' than 'knowing that'. In this respect (as in so many others) Aristotle was right to insist on the specificity of the sort of reasoning (*phronesis*) (*Nic. Eth.*, 1140a24, 1141b23) typical of the sphere (*praxis*) in which action is the constituting *telos*, rather than, as in the sciences, only a means to another *telos*, namely, the acquisition of knowledge for its own sake. In this bias towards the individual case rather than the general rule ethics resembles the arts.

4. THE ARTS[33]

4.1. As in the case of 'science' and 'ethics', 'art' makes contact with Greek through Latin, *ars* being the equivalent of *tekhne*, in this way connecting with the third member of Aristotle's trinity of fundamental human activities, *tekhne* being associated with *poiesis*. This, referring as it does to what is produced, that is, what does not occur 'by nature' (though it also has an extended use with regard to nature itself), brings together what later would not be naturally assimilated (e.g. medicine and sculpture) and

separates what later would be naturally assimilated (e.g. sculpture and music). In fact the formation of what has been called 'the modern system of the arts' (Kristeller 1951–52), which took place during the period of the Scientific Revolution, involved a reconceptualisation of 'the arts' hardly less thoroughgoing than that which occurred in regard to the sciences. If the idea of production entered the latter (as has been argued in **2** above) it tended to leave the former, to the gain of the first and the loss of the second. In fact I want to hold on to the connection of the arts with production and indeed consider the theme using the general schema of Aristotle's 'four causes' already employed in elucidating the nature of the sciences.

4.2. Considering the arts from the point of view of its 'material' and its 'efficient' 'cause' does not, at least within the limits of the present inquiry, present any serious problems. The first includes such items as colours, pieces of three-dimensional material like expanses of canvas and blocks of stone, and traditional musical and verbal forms[34], whilst the second embraces human beings using a variety of 'tools' from brushes and chisels and welding equipment to musical instruments. Difficulties begin when we try to identify the 'formal' and the 'final' 'cause'. The relevant questions here are not ultimately separable, but may be distinguished, up to a point anyway, for analytical purposes.

4.3. Let us first consider the problem of the 'formal cause'. One way to get a foothold on the problem is by posing certain questions about the relations between the arts and the sciences. To start with the question of similarity, it is important to keep in mind that a work of art, like a scientific theory, is the *result* of work, is *a* work, an 'ontologically' *autonomous 'object'*. Just as the treatment of the motion of a projectile (say) with the means afforded by the science of mechanics is a distinctive item in the 'furniture of the world', connected with what it treats in more or less complex ways, so a landscape painting, say, is first of all a certain configuration of colours with a significance of its own[35]. If, as Spinoza reminds us (*Tract. de Intell. Emend.*, §33), the idea of a circle does not have a centre and circumference, it is also true that we should not expect a work of art to have all the properties of a non-aesthetic object. That this, which should be almost a triviality, needs to be said, is shown by such things as literary critics' discussing characters in novels as though they were real people, persistent comments on the 'artificiality' of opera, and so on. But let us turn to the question of the distinctiveness of the arts *vis-à-vis* the sciences.

A central feature here would seem to be the following. The sciences strive to attain a 'view from nowhere' (to borrow Thomas Nagel's expression). They consist of systems of *concepts* and *general relations* between concepts. This is true even where they are 'about' sense-perceptible matters: it is a question of the basic *way* in which the sciences deal with

their subject-matters and is as true of the sciences concerned with human beings as of those concerned with nature. In the final analysis, both the *terminus a quo* and the *terminus ad quem* of the sciences is the world as presented through sense-perception; this follows simply from the fact that this is the ultimate, naturally determined, causally mediated 'interface' between human beings and their environment, natural, interpersonal, social. But the sciences as such move in the medium of generality. The sciences 'mean' in at least two ways. First, they employ the normal 'representative function' of language: certain types of marks or sounds are semantically associated, ultimately by some practical procedures carried on in the 'everyday' world, with certain meanings. Second – and this amounts to a criterion of the degree of development of a science – meanings become specified more and more in terms of relations between signs themselves. (For instance, 'point' in geometry starts semantic life in the ordinary world of very small dots and the like but ends up in the world of purely 'implicit' definitions.) This means also that a scientific theory is itself non-particular: 'Newton's mechanics', in a given mode of presentation anyway (Newton's, Lagrange's, Hertz's or whatever) is, however actually set out (as regards terminology, etc.), one and the same.

By contrast, the arts never leave the world of sense-perception, they always have a human 'horizon'. This is true even if it is 'about' quite abstract matters (e.g. 'philosophical' poetry like that of Lucretius, Dante, Goethe or Leopardi, say). The point may be put by saying that the arts as such live and move and have their being in the world of *images* (where this includes not only visual but also, for instance, auditory ones). This means too that works of art are always particular: a musical work, say, only exists in the full sense in a specific performance, even if such performances bear 'family resemblances' to one another by virtue (among other things) of their being all based on the same score, the most perfect copy of a picture is still a copy, and so on. But works of art nevertheless *mean*, *communicate*. How can they do that if they do not move in the field of *concepts*, as the sciences do?

I suggest that the answer lies in the phenomenon of *expression*, of the 'expressive function'. This goes back to the both phylo- and ontogenetically most primitive stratum of 'meaning'. In the context of expression, meaning and its concrete vehicle are immediately unified: paradigmatic are *gestures*. In the course of development the physical vehicle and its meaning are distinguished and the former becomes a 'representation' of the latter. As indicated above, the sciences tend in the direction of making that vehicle irrelevant in the sense of being functionally interchangeable with any other (whereas language in the sphere of representation always has nuances inseparable from a particular type of physical vehicle). So it may be said that whilst the representative function is common to both the arts and to the sciences (the most abstract sciences must interpret at least some of its signs in ordinary language), the arts look back in the direction of purely expressive meaning whereas the sciences look forward in the

direction of purely conceptual meaning. (In this sense music and purely 'implicit' definition involve a *coincidentia oppositorum*.) To sum up the matter in the briefest of formulas: the sciences strive towards the condition of pure 'saying', the arts towards pure 'showing'[36].

4.4. Let us now tackle the question of the arts' 'final cause'. I have suggested that the basis of the distinctiveness of the arts in comparison with the sciences resides in its use of the expressive rather than the purely conceptual function. Now 'expression' almost irresistibly suggests emotion, feeling, the 'affects' (to use a traditional and inclusive term). (This is vouched for by the very etymology of the term 'aesthetic'.) Doubtless there is a connection between the two. Whether this is of the essence of the matter remains to be seen, but let us at least start here. Of what sort is the relation between artistic expressiveness and the affects? Certainly a work of art does not 'express' emotion in the way in which, say, an imprecation in everyday life expresses anger. To make just the most obvious point, art involves representation, whilst the imprecation is more like a *symptom*, that is , a *sign*, in the way in which inflammation of the body may be a sign of infection. But consider now the affects in the context of art-as-representation. The *telos* of a work of art is not an *arousal* of actual affects, either for their own sake (e.g. thrillers) or for the sake of some other end (e.g. the 'mobilisation' of affects by a National Anthem), though, of course, properly aesthetic configurations may do both of these things (e.g. many of Poe's tales are thrilling and *Fidelio*, say, is 'uplifting'). Ultimately, this claim cannot be supported more firmly than by reference to that basic aspect of the phenomenology of aesthetic experience which can be at best gestured at by the use of terms like 'distance', 'transparency', 'lightness' , and self-contradictory descriptions like 'fear that is not painful', 'anger that does not tend to move to action', and so on. It may be taken to be what Kant was pointing to in his talk of the 'disinterestedness' of the aesthetic effect, and what Brecht was wanting to preserve with his theory of the *Verfremdungseffekt*, the subverting of tendencies for members of the audience (in the broadest sense) of the work emotionally to *identify* with the emotions portrayed in the latter, or to have actual emotions aroused[37].

4.5. This rejection of a certain view of the place of affects in the aesthetic sphere involves at least the suggestion of a positive answer to the question of how they are in fact situated there. To start with, a work of art may result in the illumination of what was before obscure, known only through its effects. At work here is one of the most fundamental of all human interactions with the world, that is, the cognitive illumination of a situation by *naming* it[38]. Furthermore, a work of art may involve not just a naming of affects in the most primitive sense, but an *exploration* of what has been named. Again, a work of work of art may not only name and explore in its categorical dimension what is affectively thus and so, but, moreover,

by abstracting from *de facto* modifying circumstances, present it as (to borrow an earlier term) a 'pure case': as the consummate shape of what is generally met with in only trammelled form[39].

So far I have been identifying the affects as the central subject-matter, so to speak, of works of art. This fits some classes of the latter better than others, for instance, music, lyric poetry and much portraiture more closely than novel and drama. In these the main point may well be the depiction and analysis of human/social relations and institutions. Affects will generally be part of this subject-matter, but not necessarily the focus of the work, and sometimes be present only in the constitutive horizon of the work of art, namely, human 'concern', affective 'engagement' with what is depicted. Here it is still a matter of understanding, but what is up for understanding, so to speak, is something more comprehensive and 'objective' than affects. (For instance, Balzac's novels both broaden and deepen our understanding of how a certain sort of society 'works', and the same is true of, say, Ibsen.) This is in no way inconsistent with the idea that the arts work one and all in the mode of expressiveness. *Othello*, say, does not *tell* us about trust, jealousy, and so on: it *shows* us such matters. (In this case it is interesting to compare Shakespeare's play with Verdi's great opera of the same name, based as closely as it is on the play.) Nor is any of this inconsistent with the occurrence of purely general, discursive passages in such works (think, for example, of *War and Peace*, *Moby Dick*, Brecht's *Galileo*), for, where such are in artistic place, they are themselves part of the aesthetic design of the work, part of the 'profiles' created, part of the process of 'showing'. What has just been said might be summed up by saying that, at least from one point of view, the *telos* of the arts is 'revelation', 'dis-clos-ure', 'dis-cover-y': both the making of what is unfamiliar more familiar and conversely, as in the case of the sciences, the bringing to light of the complex in the apparently simple and of unifying traits in what seems irreducibly diverse[40]. But this, focussing as it does on 'what is the case', in the temporal modes of past and present, is connected, potentially at least, with what may be called the 'anticipatory' or 'utopian' function, in the temporal mode of the future: in giving us an opportunity for understanding better what is/has been the case, a work of art may give us *at the same time* an opportunity to see possibilities for what *might* be the case. (An aspect of this is what has sometimes been spoken of as the 'critical' function of art.)[41]

4.6. What has been said so far may serve to point up the poverty of the idea that the arts aim at 'beauty', already obvious enough from a mere consideration of what there could possibly be in common, in this regard, between, say, classical Greek sculpture, typical Raphael madonnas, Rembrandt's *The Anatomy Lecture of Dr Jan Deyman*, Cézanne landscapes, *King Lear*, Goethe's lyric poetry, a Mozart serenade, the *Hammerklavier* sonata, and so on. (Simmel 1985, p. 104, remarks that the idea of 'beauty' is really rooted in the 'classical' form-ideal. Thus its promotion to the

position of a – indeed *the* – fundamental concept of aesthetics may be seen as a typical philosophical generalisation of what is legitimate at best in a particular context.) Indeed it is not only useless but misleading, suggesting as it does that there is some one thing that the arts strive to capture or create, when in fact what the word may be assumed to be vaguely gesturing at (and in this way as it were roughly marking the site of a problem – like 'truth' with regard to the sciences and 'good' and 'right' to ethics) is so very diverse in character. Poussin's comment about painting that *la fin est la délectation* (Raphael 1989, p. 21) is nearer the mark, but the disparateness of the sources of this 'delight' has to be emphasised. One is the pleasure that accompanies *relief* from the oppressiveness of what is felt only obscurely[42]. A second is an aspect of the pleasure that is afforded human beings (probably also at least some other living things too) by *exploration*: here not the actual exploration of drawers, boxes, forests, or whatever, but the 'virtual' exploration of the nature of affects, of motivation, of human relationships, and so on. A third must be related to the delight vouchsafed in extra-aesthetic contexts by the 'free play' of shapes and forces (their interconnection and their working according to unimpeded inner necessities), in the finely turned human body and the exercise of its powers, in various natural shapes: in the aesthetic sphere there are such things as as the unity of intricate ornament and the exhibition of consummate and consummated emotions and destinies[43]. A fourth, closely related to this, is the deep satisfaction that may accompany the contemplation of the aesthetic prefiguring of new possibilities of living. I suggest that this is at least part of the meaning of Stendhal's really enigmatic *mot* according to which beauty is *la promesse du bonheur*. Beauty is here said to be not happiness itself but the *promise* of happiness ('promise' in the sense of an indication of a future achievement) or, a happiness that is aroused by a promise of future happiness. Nietzsche, who liked this saying so much, himself wrote the deep words: 'what is perfect teaches hope' (*Thus Spoke Zarathustra*, IV, 'Of the Higher Man', §15).

4.7. At different points in the preceding pages I have given some brief indications about the way in which the sciences and ethics are imbricated (end of **2** and **3**). At this point it is necessary to say a few words about this matter with regard to the arts in relation to both the sciences and ethics.

As to the first point, the sciences enter the aesthetic sphere in at least two ways: with regard to what may be called the means of aesthetic production (such things as new sorts of pigments, principles for the improvement of existing sorts of musical instruments or even for the construction of new sorts), and with regard to the supply of thematic material (for instance, the embryonic atomism of antiquity *vis-à-vis* Lucretius's *De rerum natura*). Conversely, the arts enter the sphere of the sciences in at least two ways. One is exemplifed by the manner in which the new

approach to nature in general characteristic of the Scientific Revolution was prefigured by the 'naturalistic' revolution in the arts, and by the way in which the development of perspective, especially in the visual arts, anticipated advances in mathematics (particularly projective geometry)[44]. For another thing, features of the aesthetic approach to the world and of works of art are inherent in the sciences. Thus imagination plays a basic role in the development of existing theories, the creation of quite new ones, in the working-out of new types of instrumentation and sorts of experiment, and *délectation* is afforded by scientific theories and their applications, especially crucial ones (scientists often talk of a 'beautiful' theory, result, etc.)[45]

As regards the arts in relation to ethics, ethics may supply themes to the arts, either in the way in which a work of art may, in effect at least, criticise ethical theories (consider, for instance, Brecht's *The Good Woman of Szechuan*), or in the way in which ethical outlooks on the world may inform artistic representations (much of Tolstoy's fiction is a case in point). Conversely, works of art may enter the sphere of ethics, by, for instance, presenting material for specifically ethical reflection (perhaps even assisting the resolution of ethical problems), whilst something akin to aesthetic *délectation* may be afforded by personalities and actions in their ethical aspects.

4.8. But there is another aspect of the relations betwen the sciences, ethics and the arts which must be looked at, however briefly. To begin with, consider some of the main ways in which the sciences are cognitively preeminent. First of all, they offer a way of grasping the real in optimally 'objective', context-free, precise terms (this is seen most clearly in the case of metrical description). Furthermore, the knowledge they vouchsafe is general, hence at least potentially both comprehensive and unified. Again, scientific knowledge is highly systematic, so that the bearing of one part on another can, in principle anyway, be pinpointed with great precision. Moreover, the scientific way of knowing is (as pointed out earlier) inherently dynamic and self-correcting. Finally (for present purposes anyway), it is highly cumulative as regards both methods and achievements (whether the cumulativeness is simply aggregative or consists in the fact that a theory that replaces another will typically conserve its results by virtue of being able to generate them by its own means).

The arts seem unable to compete with the sciences in these regards. Though there is a substantial degree of truth in this, it should be importantly qualified in ways that cannot be gone into at this point. Rather, I want to focus on just one – but central – point. By virtue of the fact the sciences work with concepts, generalities, and aim at optimally context-free precision, they must approach the irreducible particularity of the real step by step. Now it is precisely characteristic of the expressive images constituting works of art that they not only can be, but typically are, what, in the context of his inquiry into specifically dream-images, Freud called

'over-determined', that is, each has, especially taken in relation to others, at one and the same time a number of different and indeed sometimes quite inconsistent 'meanings'[46]. Thus it is precisely because the arts are, from the scientific point of view, poor in resources for general specifications of the real that a work of art can capture complexities *directly*, rather than, as the sciences have to do, by patient superposition of descriptions. To borrow words that Mephistopheles uses in another connection (*Faust*, I, 1923–7), a true work of art is like a machine for making cloth, where at just one stroke many threads are woven:

> *Wo* ein *Tritt tausend Fäden regt*, . . .
> Ein *Schlag* tausend *Verbindungen schlägt.*

Thus, in a superficially paradoxical fashion, the *ambiguity* of images is an incomparable means for a *precise* depiction of what is the case, insofar as the latter, *qua* particular, belongs to many different contexts at once[47]. To venture some word-play, the arts inhabit (in the sense explained) the realm of 'pre-science', but nevertheless possess their own sort of prescience. In fact it is precisely a *criterion* of a significant work of art that its images should be inexhaustible in significance, and that it should thus forever fall through the meshes of general descriptions. (Applied to the bulk of what is commonly called 'poetry', such a 'tuning fork' shows that most of it is mere specially rhythmical and perhaps rhyming prose.) This circumstance gives rise to so many different though, at their best, really complementary, interpretations of one and the same work. Of attempts to determine which is 'correct', uniquely 'right', one can only say what Milton did of the philosophical deliberations of the Fallen Angels: 'Vain wisdom all, and false philosophy!' If we now consider ethics in this connection, we can see that it occupies a place between the sciences and the arts: like the first insofar as general principles play some part in it, like the second insofar as these only go a short way in providing solutions to the real, concrete problems that it faces.

5. CONSIDERATIONS ON THE SCIENCES, ETHICS AND THE ARTS AS A WHOLE

5.1. At various places in the preceding pages I have said something about the relations of the sciences, ethics and the arts pairwise. It is now time to make some synoptic remarks about them and specifically about the general perspective within which they have been viewed, something that may best be done in terms of a contrast with a certain traditional but very different one that is pervasive, remaining essentially the same through endless variants. It can be stated briefly as follows. 1) The most basic elements of this framework are subjects and objects. 2) The sciences, ethics and the arts are conceived in terms of their roles in establishing or ascertaining certain entities that exist in the context of this subject-object

couple. Thus science is basically concerned with truth that is conceived either as a matter of an objective, fixed order of things that is intuited (e.g. Aristotle) or registered in mental copies of some sort (representationalism), or as a state of the subject (e.g. subjective idealist and various 'pragmatic' accounts), or as a blend of the two (e.g. doctrines of Kantian stamp). Along similar sorts of lines, ethics is concerned with the good and the right, that are either a matter of how things objectively are, or a matter of purely subjective sentiments, or a sort of combination of the two (e.g. 'projection' accounts), and art is concerned with beauty which is either a matter of the objective order of things (e.g. Thomist accounts), or just 'in the eye of the beholder', or, again, a mixture (e.g. theories of *Einfühlung*). 3) The entities that are the subject-matters of science, ethics and art, and hence the latter as their 'organs', are either simply juxtaposed or arranged in an order of value (e.g. for Plato the good is the privileged item, for the Romantics beauty, for positivists truth).

5.2. The 'problematic' of this paper is opposed to that just sketched in each of the above three respects. 1) What is basic in the case of the sciences, ethics and the arts are different sorts of *practices*, regular types of transformative activities, which are not so much 'interactions' between 'subjects' and 'objects' as ones in which 'subjective' and 'objective' aspects (or 'moments' to use an Hegelian expression) can be distinguished for purposes of analysis. (See here Althusser, esp. 1969. Cf. Bourdieu 1977.) In the case of the sciences, on the one hand, the agent of the subjective aspect (the scientist) makes demands (as it were) on the objective aspect by means of an apparatus of theory and instrumentation, and in doing so changes that objective aspect, whilst, on the other hand, the fixed character of that 'order of things' constrains the possibilities of those demands being satisfied, and, in exercising those constraints, in effect suggests new demands. In the case of ethics, conceptions of more or less general goals of action are tested for viability in the world as it exists independently of that action, and in the process the goals are changed (e.g. formation of new conceptions of the good and right) and so is the world (e.g. new types of individual and social conduct created). In the case of the arts, attempts by aesthetic means to reveal the character of what determinately exists independently of those attempts typically change the character both of the subjective aspect, and, through actions that this enables, the character of the objective aspect. Each, whilst having an irreducible objective aspect, is 'self-based' in the sense that each comes to terms with that objective character in its own, immanently determined way. 2) From this point of view the ideas of 'truth', 'good/right', 'beauty' basically represent reifications of the regulative principles constituting different sorts of practices, or functionally different aspects of the same practice, principles that are less misleadingly regarded in adjectival or adverbial rather than in substantive terms. At best they are markers, surveyors' pegs, buoys, gestures towards problems (cf. 4.6 above). 3) It follows that the sciences,

ethics and the arts should be considered neither as simply juxtaposed nor as arranged in a hierarchy of value. They are not simply juxtaposed, because, speaking at a certain level of abstraction, all of them have a common regulative *telos*. This *telos* may be specified in various ways. Most generally all can be described as ways in which human beings seek to orient themselves in the world in which they find themselves, to find out what is the case in order to be able rationally both to adapt to what is unchangeable and to change what is changeable in order to bring things 'nearer to the Heart's Desire'. In the service of this striving stands humanity's two fundamental powers, namely, reason and imagination, that ideally work in tandem, the one to ascertain what is the case, the other to envision what is not yet the case but which might be so[48]. A way of putting one manner in which the triad of human activities does this is suggested by some lines in Goethe's great poem 'Eins und Alles': there exists, the work conveys, a vital activity that eternally makes over what has come to be, but which, as ossified, has become hostile to us:

> *Und umzuschaffen das Geschaffne,*
> *Damit sich's nicht zum Starren waffe,*
> *Wirkt ewiges lebendiges Tun.*

It is crucial to break up the apparently rigid, opaque structures of what is the case at a time, the 'false concrete' (cf. Kosik 1976) at first in thought and then in action. From this point of view the three are all, to borrow the title of Sartre's novel-trilogy, *chemins de la liberté* ('freedom-roads'), or means by which humanity may put behind it its period of 'immaturity (*Unmündigkeit*)', the transition by reference to which Kant saw the answer to the question posed in his short but crucial essay of 1783, 'What is Enlightenment?', whose 'motto' he says is the Horatian phrase (*Epist.*,I,ii,40) *Sapere aude*! which he renders as 'Have the courage to use your *own* understanding'. Each member of the triad has its own unique and indispensable role in this process. If the sciences can be said to be in any sense *primus inter pares* they are so only insofar as their focus is on the common objective constraints upon humanity imposed by the ultimate nature of things and because they offer a uniquely clear model for understanding the others. But any attempt unconditionally to privilege any one of them results in either scientism, or moralism or aestheticism, each of which subverts rational thought and practice.

6. THE CLAIMS OF RELIGION?

6.1. Experience suggests that the purely naturalistic picture sketched so far, in which human beings are thought of in purely immanent terms, seems almost bound to appear incomplete to many, not just or even principally because of incompletenesses of detail, but because of what is felt to be an *essential* deficit, an intrinsic incapacity to answer some quite

fundamental questions. Indeed, claims that the naturalistic view is both necessary and sufficient, at least in principle, appear to a great many people to exhibit a sort of *hubris*, with all that this implies. It is not easy to capture, both comprehensively and precisely, what is at issue here, but the major claims would seem to be of two general kinds. Firstly, even assuming that the sciences are capable, in principle anyway, of giving satisfactory explanations of why certain particular aspects of the world are as they are (in general by showing how one state of things is a condition of another), neither the sciences nor, for that matter, any part of the purely naturalistic account, can even in principle answer the question as to 'why there should be a world at all' (Leibniz, *De rerum originatione radicali*, 1697), can throw any light on 'the wonder of all wonders: that what is *is*' (Heidegger, *Was ist Metaphysik*? Postscript to 1934 ed.). Secondly, the naturalistic account may be able to cope with questions about the meaning, point, significance of particular human actions in terms of particular goals, and the latter in terms of others, but it cannot, even in principle, tell us the meaning of life as a whole, the purpose of human existence as such, and therefore cannot provide either ultimate principles of right conduct or what may be called 'consolation' for the evil and suffering that seem to be inseparable from 'the human condition'.

6.2. That the great, paradigmatic religions seem to offer answers to these questions, and indeed at bottom wonderfully simple and unified answers, is surely the ultimate basis of their perennial appeal. The general schema of such answers is as follows[49]. Firstly, there is a distinction between what may be called a 'true' and an 'apparent' world. Secondly, the former is centred in a God, whilst the latter is the secular world, the world considered just as it seems naturalistically to be. Thirdly, God created the world. Fourthly, this is seen as offering at one stroke answers to both the fundamental questions posed in the preceding paragraph. As regards the first, it explains why there is something rather than nothing in what may be called the causal sense, namely, because God *created* it, and also in the sense that requires an answer in terms of intentional behaviour, namely, because *God* created it. As regards the second, the meaning of life as such is seen as at least implicit in God's overall plan of creation, which also involves ultimate principles of right conduct, and grounds of consolation, insofar as reference to that plan allows us to see where evil and suffering fit into the total scheme of things and hence their ultimate significance[50].

6.3. The history of ideas is filled with arguments that are intended to demonstrate the 'internal' weakness, even incoherence, not only of these answers, but, more fundamentally, of the questions that provoke them. Thus it is objected that the theistic account cannot even in principle answer the first question (insofar as it is conceded, for the sake of argument, to be a genuine question) because it immediately leads to the problem of

explaining the fact of God's existence and of His intention to create the world. If it is replied that both God's intentions and His existence are part of His nature, the response is that there cannot be a *concept* of something whose connotation includes the existence of a referent for it. And so on. As regards the second question, it may be objected that if God lays down certain principles of right conduct because these are right in themselves, then it is not the fact that God thus prescribes them that grounds their rightness, and so there is a surd in the theistic account; or, if it is just the fact of his laying them down that accounts for their being right, then this is either merely tautologous or simply another contingent residue in that account. And so on. Such debates never reach any definite conclusion, something that frequently maddens the critics whose arguments seem to them to be so transparently probative[51].

6.4. At the root of this situation are a number of considerations. One is that the theistic account involves not only a set of substantive, metaphysical claims, but also what may be called an epistemological principle, namely, the absolute primacy of *faith* (no matter what secondary place may be allowed for theological *argument*): this is in effect an ultimate source of eristic *closure*, sealing off religious claims *ab initio* from the sorts of attacks exemplified above, and so the debates are, to use a Kantian expression, really 'mock combats (*Spiegelgefechte*)', even if this only becomes apparent after some time. Another is that the naturalistically minded critic typically fails to see that the existence of evil and suffering – the *lacrimae rerum* in Virgil's great phrase – does not, in the final analysis, offer a *problem* for theists, but is a part of an *answer*, to the question, namely, *why they are theists in the first place*, that is, in order to be able to see a *significance* in what seems to non-believers simply the grim, brute *fact* of evil and suffering. That theists so often regard this significance as just part of the great mystery of God's governance of the world may exasperate critics beyond measure, but is entirely in order *within* the terms of the theistic *Weltanschauung* itself.

6.5. The term '*Weltanschauung*' is used here advisedly, for the term signifies, in Adorno's words (1973, p. 118), a conception 'of the essence and interrelation of things, of the world, of man, matched to the *subjective need for ... ultimate answers*' (emphasis added). It is not for nothing that religious belief, where not simply inherited, as it were, is experienced as a 'conversion', a radical, 'Gestalt'-like switch of viewpoint. Argument may lead up to it, as gradual lowering of the temperature of water may lead to its freezing, but in both cases the change of state is instantaneous. The *ultimate* religious attitude or *Weltgefühl* is, as Rudolf Otto has rightly put it (e.g. in the preface to Schleiermacher 1958), that of *dependence*: of the *derivativeness* of the ordinary ('apparent') world as a whole, and of human life in particular, from something outside it, the sentiment of 'creatureliness'. But if there can be a conversion *to* such a world-view, so

there can be one *from* it. Again this may be prepared for by argument, as well as by other factors, but it finally takes the form of the attitude that the world and human life is sufficient unto itself. The solution to the problem is seen in the vanishing of the problem. On a naturalistic view, life does not need anything transcendent to give it what 'meaning' it has, and, indeed, *within* this standpoint the idea of a source of the significance of life lying *outside* life *simply does not make sense*, for reasons already alluded to. Its significance must lie in its own elements and their relation to one another its details are significant just in themselves and their relations to one another (cf. Hegel, *Enc. Philos. Sc.*, [*Logic*] §237 Z). In the resonant words of Apollinaire ('Cors de Chasse' in *Alcools*):

Notre histoire est noble et tragique
Commme le masque d' un tyran
Nul drame hazardeux ou magique
Aucun détail indifférent
Ne rend notre amour pathétique.

If the religious world-view offers cognitive and moral certainties it does so at the price of total *closure*; if the naturalistic view of the world can offer only uncertainties in these respects, it does so with the bonus, in principle anyway, of the satisfactions afforded by openness of cognitive horizons and self-determination of conduct. If the religious world-view offers comforts, naturalism offers, as consolation worthy of human dignity, works of art, there, as Nietzsche wrote, 'so that the bow does not break'[52].

6.6. It cannot be denied that a purely naturalistic view of the world is not a natural one. People may well be everywhere in chains, in Rousseau's famous words. But his companion claim, that they are born free, is false. From the point of view of the species, human beings came to be in a complex, frightening world, the prey first of purely natural forces and then of estranged social ones. Moreover, every individual human being always at least begins life in the spirit of Housman's simple, uncanny lines (*Last Poems*, XII):

I, a stranger and afraid
In a world I never made.

Human emancipation is a *task*, and a terrifying one. No wonder that few have even posed the question of a purely and simply immanent view of the world, without transcendent illusions, free both of the overarching pessimism and the global optimism that are just opposite choices within an *ultimately* identical world-view, that is, one that assigns valuations to life as such, as a whole and consequently from some imaginary point *outside* it. Leopardi is one of that few. In one of his greatest poems, and indeed one of the greatest 'philosophical' poems in world-literature, 'La ginestra, o il fiore del deserto' ('Broom, or The Desert Flower'), he begins by apostrophising the flower, growing quite alone on the arid slopes of

Vesuvius [53] scattering its fragrant, solitary flowers, at home in the wastes, and ends by turning to it again: though it will ultimately succumb to the subterranean fire, bowing its head neither stubbornly nor with supplication, it is still wiser than mankind in not fancying itself above mortality:

Ma più saggia, ma tanto
Meno inferma dell' uom, quanto le frali
Tue stirpi non credesti
O dal fato o da te fatte immortali.

7. CONCLUSION

All periods in history have been times of change, but it is at least very doubtful whether ever in recorded history has humanity experienced the breadth and depth of the recent, present and foreseeably continuing transformations. It is understandable that in such dark times many voices, emerging from 'empty cisterns and exhausted wells', urge the abandonment of reason with its necessarily slow, tentative procedures, in favour of quickly apprehendable, global solutions, 'a fat word replacing a spindly question-mark' (Nietzsche, *On the Genealogy of Morals*, III, §16). But almost two centuries ago Goethe had Mephistopheles say, Faust having just left the room after concluding the fatal pact, that people only have to despise reason and science, man's highest power, to give themselves over to illusion and magic, in order to fall totally under his control:

Verachte nur Vernunft und Wissenschaft,
Des Menschen allerhöchste Kraft,
Lass nur in Blend- und Zauberwerken
Dich von dem Lügengeist bestärken,
So hat ich dich schon unbedingt -

At about the same time Goya was producing a powerful series of etchings and aquatints called *Caprichos*. Plate 43 (Perez Sanchez and Sayre 1989, pp. 110ff.) depicts the artist sitting at a table, head on his hands, asleep. In the background, amongst other apparitions, crouches a black cat, traditionally allied through its colour with the Prince of Darkness, staring from the print with single-minded intensity of purpose. To the left and right of it are four owls of the ill-auguered horned kind (*buho*), the natural habitat of which is darkness. One of them has taken up Goya's chalk holder in its claw, and is looking toward the artist as if it were urging him to depict them in the flattering guise of wise owls. Goya's title is: *The sleep* [or: *dream – sueño*] *of reason produces monsters*[54]. In the Prado manuscript the print is accompanied by the following lines (possibly from the pen of Goya's friend, Moratin): 'Imagination forsaken by Reason begets impossible monsters: united with her she is the mother of the arts and the source of their wonders.'

8. 'CONCLUDING UNSCIENTIFIC POSTSCRIPT'

'Soft you; a word or two before you go.' At the end of the paper, looking over what I have written, I sense here and there what might be interpreted as, and perhaps is, a tone of optimism, even triumphalism, about the prospects for the deepening and widening of the cultural effects of the sciences, including, in the first rank, a naturalistically conceived ethics. But it would be a betrayal of the realistic spirit of naturalism itself to let this stand, at least without the gravest qualifications. Recent research has found that *homo sapiens* shares 98.4% of its genes with pygmy chimpanzees, and this physical continuity is reflected in a propensity for xenophobic killing of other human groups and destruction of the environment. The powers made possible by the remaining 1. 6% of genes, have, amongst other things, heightened the former to genocides and the latter to the point where the continued existence of the species, at least in a form worthy of its history at its best, is in serious question. *Homo sapiens* may be said to be unique in its delight in torture and addiction to toxic substances. It is also, of course, unique in its culture, and here, in the first place, in the possession of the marvel of language. (On the preceding see the excellent Diamond 1991, bound to be misunderstood by both conservatives and 'progressives'.) The latter has made possible, amongst other things, the creation of new sorts of toxins such as racisms and nationalisms (but cf. earlier species- and territorial 'imperatives') and others that are unique, in the first place, religions and those metaphysical beliefs with an essentially similar character, narcotics that induce fantasies which both console present suffering and help guarantee its continuance. Given the terrible burden that specifically human life inflicts on the instincts (as Freud explains in many places, especially *Civilisation and its Discontents*), and, on top of this, the pervasive miseries inflicted on the mass of people by historically endemic class-exploitation, together with the failures of all attempts so far to construct any form of social organisation that might countervail, wholly or partly, the effects of the first of these sources of distress, or do away with the second, it may seem, and possibly is, largely frivolous to think that human beings, in any great numbers anyway, will, in any realistically foreseeable future, renounce illusions that make life tolerable in favour of a purely naturalistic view of the world that can offer, at best, only limited prospects of unconditional happiness[55].

NOTES

* The word 'Notes' here is meant to indicate, not that the paper presents only more or less random reflections, but rather that it is very condensed, and also that, though it is meant to be basically self-contained, the footnotes are more than usually important. The compression

is the result both of a desire to set out a fairly complex argument in such a way that it can be surveyed as far as possible in a single sweep, and, also within the scope of that intent, of restrictions of space. I have supplemented the basic presentation with notes that give further indications on certain points and direct attention (in a necessarily extremely selective way) to relevant literature that, among other things, contains developments that cannot be pursued here.

[1] See, respectively, e.g., Galison and Helvy (1992) and Smart (1989).

[2] On the matter of ignorance, cf. Roger Penrose (1991, p. 18): 'James Clerk Maxwell . . . is now generally accepted as the greatest theoretical physicist of the period between Newton and Einstein, even if, to the public at large, his name seems to be almost unknown. Perhaps it says something about our cultural values that, in informed society, people may never have heard of a scientist such as Maxwell when even a British schoolboy would be considered grossly uneducated if he had never heard of Dickens.' This is, of course, a contemporary variation on the theme of C. P. Snow's *The Two Cultures and the Scientific Revolution* (1959), which was significant not so much on its own account as giving voice to a widely felt sentiment. On the matter of distrust, etc., Steven Rose has recently commented (1992, p. 8): 'In the run-up to the second millenium, there is no doubt that the claims of the critics [*sc.* of science] have found the greatest popular resonance, as shown by the startling popularity of books and articles offering alternatives to orthodox modern science . . . ' For examples of what may be called broadly 'cultural criticism' of science, all published in the period 1991–92, see, e.g., Appleyard (1992) – on which see the swingeing review by Hacking (1992) – Midgley (1992), Schwartz (1992), Sorrell (1991). On the more general philosophical side, see, in the anglophone literature, e.g., Feyerabend , esp. (1975), (1987), and Rorty (1989). (For a critique centred on the former's 1975 see Curthoys and Suchting 1977 and Feyerabend's reply reprinted in his 1978, pp. 154ff.) Much recent French thought has been along these lines, e.g. that of the very influential Jacques Derrida. Of course, opposition in principle to 'Newtonian' science is not new. See, e.g., that of William Blake (on which Bronowski 1954, pp. 143ff.) and Goethe (see the sympathetic presentation in Cassirer 1921). There has been what might be called a distant relation to science in certain trends in the Marxist tradition, as in Lukács (at least in his *History and Class Consciousness* period), and the Frankfurt School later. For current defences of science, at least much of it somewhat mediocre, see , e.g., Passmore (1978), Grove (1989) and Wolpert (1992).

[3] The words quoted are the title of Chadwick (1975). For the Baconian-Cartesian attitude see, e.g., Böhme *et al.* (1977, esp. pp. 15ff) and on the Enlightenment Gay (1966/1969).

[4] Sometimes technology as such, as a 'life-form', is held responsible. See, e.g., Spengler (1926–28, Vol. II, Ch. 5, Sec. II, and 1932), the title essay in Heidegger (1977), and Gehlen (1980).

[5] I use the plural here deliberately in order to indicate, minimally, that I am not assuming the existence of some generic item, 'science', of which the particular sciences are species, marked out by certain differentiating traits. This is the most common approach, various views about this putative science as such being then formulated either from essentialist or nominalist points of view. That is, 'science' may be defined in terms of some allegedly permanent ontological and/or epistemological truths (which can vary all the way from an extreme Platonism through phenomenology to a radical empiricism) or by an in principle free stipulation, which may nevertheless be influenced by what those people called 'scientists' at a particular time consider their work to consist in. Each approach has many drawbacks that cannot be gone into here (the problems basically involve general ones of philosophical methodology) beyond the following brief remarks.

On the one hand, essentialism, whose self-image is to be above history, is in general, without knowing it, the reflection of historically and systematically determinate stages in the development of inquiry (cf. Collingwood 1940) and thus transmogrifies what is both in fact and in principle conditional into what is allegedly eternal, thus depriving itself of the possibility of a productive discussion of general features of types of *ongoing* investigations. On the other hand, nominalism, *if taken strictly*, must produce basically arbitrary definitions, which, as such, preclude constructive dialogue with other conceptions, and, if anchored in pure

descriptions of how 'science' is used at a time, is, *qua* a form of historicism, just as incapable of genuine criticism of what is simply the case at a time as its apparent opposite, essentialism.

The alternative conception assumed in the present paper *cuts across this entire approach*. A word acquires its meaning (if it is other than, say, a mere terminological stipulation, like the name of a newly discovered star or an abbreviation for a longer expression) from its connection with certain paradigms. This is an historical matter. The word is in general applied, at different speeds, to new, non-paradigmatic cases, with more or less subtle, by no means always clearly formulated changes in criteria of application. Thus the language largely consists of words which are applied not according to some set of strictly necessary and sufficient semantic conditions (the chimera of scholastic philosophers from antiquity to the present day) but rather according to a usually very complex structure of what Wittgenstein called 'family resemblances'. As Nietzsche said, 'only the ahistorical can be defined' (*On the Genealogy of Morals*, II, §13), and added elsewhere that philosophers are in principle ahistorical creatures (*op. cit.*, I, §2, *Twilight of the Idols*, '"Reason" in Philosophy', §1, *Human, All Too Human*, Vol. I, **1**, §2). For our time, physics has been, for various historical reasons, some but not all rooted in the sorts of knowledge that this discipline has produced, the *paradigm* 'science'. Boundless confusion has been caused by misinterpreting this as meaning that it is the *only* 'science'. This generates all manner of pseudo-questions, in particular as to whether this or that sort of inquiry is 'really' a science *qua* conforming totally to the conditions allegedly defining this *particular* science, when in fact there are no permanent necessary and sufficient conditions *even for this branch of inquiry*, as is shown by the simple observation that determinism was for long, but is no longer, held to be *constitutive* of a specifically physical theory. Rather, the question as to whether some sort of inquiry and its results is to be called a 'science' is partly 'objective', namely, its similarities to the paradigm science of physics, partly 'subjective', namely, whether there are 'sufficient' similarities. For instance, certain sorts of inquiries into the individual human and social orders may be shown to be like physics in certain respects and not in others, for instance, as regards possibility of use of experiment of the sort available to physics. But, on the one hand, say, astronomy has, historically, also lacked this access, and, on the other hand, the development of techniques may narrow or make largely irrelevant this gap, for example, by the use of computer simulation. For further considerations on this question see Suchting (1992, esp. pp. 29f.). There are illuminating remarks on this whole matter, *à propos* the particular case of causation, in Miller (1987, Ch. 2, esp. pp. 73ff.).

Finally, it may be remarked that many other problems arise from use of the essentialism/nominalism couple that do not arise on the basis of the approach recommended here. For instance, the controversy raised by Lakatos's 'History of Science and its Rational Reconstructions' (1978, **1**, pp. 102ff.) involving the alleged 'hermeneutic circle' of constituting 'science' as a subject of history when reference to precisely the latter is required to indicate what it is that is being constituted, is easily resolved by the reflection that 'science' at a time is understood with reference to certain paradigms (purely historical, descriptive point) but can and does change both its 'extension' and its 'intension' as a result, in large part, of the 'track record' of certain modes of inquiry as regards their *objectively demonstrated* capacity to achieve the goals they set *for themselves*, thus generating new semantic *norms*. The rats' nests of philosophical issues occasioned by 'non-Western' and 'counter-hegemonic' conceptions of science present in much debate about 'multiculturalism' can also be cleaned out with this broom: though constraints of space forbid the operation here, how it can be done should be clear enough from what has been said.

[6] For a convenient summary of information on this point see Williams (1983, pp. 276ff.).

[7] The literature on the Scientific Revolution is overwhelming in extent and, once one passes from the narrowest descriptive-historical treatments to questions involving a real theoretical comprehension of the issues, ultimately inseparable from fundamental philosophy of science. In the following I shall list only what I can recall as having been of special importance to me in both respects, the division between the two subject-areas being, as indicated, only rough and ready. The literature listed is thus also relevant to later parts of the main text, and further references in the latter are relevant to present themes. Such works with a

significant historical orientation include: Blumenberg (1983), Böhme, van den Daele, Krohn (1977), Canguilhem (1970), Cassirer (1922), Damerow and Lefèvre (1981), Heidegger (1969) and 'The Age of the World-View' in (1977), Lefèvre (1978), McMullin (1985), Mittelstrass (1970, 1972), Moscovici (1977), Pitt (1992), Strong (1936). Works with a primarily or exclusively systematic orientation, but rooted (according to the present interpretation) in the breakthrough represented by the Scientific Revolution and the scientific traditions finding their proximate origins there include: Ackermann (1985), Althusser, esp. (1969, 1976), Althusser and Balibar (1970) (the preceding three works have an absolutely primary place in my thinking), Bachelard (1986, 1938, 1949, 1951, 1953) – for excellent commentaries on which see Lecourt (1975, 1974) and Tiles (1984) – Balser, Molinas, Sneed (1987), Baltas (1988), Bridgman (1927, 1937, 1952), Cartwright (1983, 1989), Cassirer (1953, 1953–59, esp. Vol. 3, 1956), Dewey (1948, 1929, 1938), Dingler (1928, 1938, 1969) – and, *à propos*, Böhme (1976), Butts and Brown (1989), Holzkamp (1968), Tetens (1987), Duhem (1954, Pt II, esp. Chs IV and VI), Gooding (1990), von Greiff (1976), Hacking (1983, 1992a), Laymon (1985), Le Grand (1990), Lewin (1927), Nowak (1980), Pickering (1992, Pt I), Raphael (1974), Stachel (1976). The especially recent tendency to make Galileo the crucial figure of the 'Scientific Revolution' is dangerously one-sided: his immense achievement required completion, by amongst other things, that causal-dynamical element, that introduction of *forces* as explanatory items, which characterises *all* the founding scientific breakthroughs that we know of historically. Thus Newton is also of absolutely central importance, even if, as Mittelstrass and others have shown, the scientific-philosophical AIDS represented by empiricism/positivism is also found in his work.

[8] Toulmin's notion of 'ideals of natural order' in his (1961) might be seen as referring, in part at least, to the fundamental 'pure cases' of a science or branch of science. But it is at least misleading to assimilate this sense to, say, Aristotle's distinction between 'natural' and 'enforced' motion, if only because this is established in advance of scientific inquiry, not just heuristically but metaphysically, and therefore immune to influence by the results of that inquiry. Cf. also the distinction between 'framework principles' and causal explanation in Ellis (1990, pp. 23ff.).

[9] It is worth remarking, primarily because of widespread misunderstanding of the point, that the 'resolutive-compositive method' is neutral as between theories; in particular it is not inherently 'reductive'. The crux is the basic unit of analysis chosen and this is not prescribed by the method itself in advance of the mode of inquiry that uses it. As always, what counts as a 'simple' is a contextual matter.

[10] The distinction between the causal and epistemic 'foundations' of knowledge is a central part of the argument in Rorty (1979), who argues that a major part of modern, Cartesian/post-Cartesian epistemology rests on a confusion between the two. For a similar point, made independently of Rorty, see Suchting (1986, p. 36), who brings this distinction into connection with that between the theoretical or discursive 'object' and the real object, between a mode of description and that to which the description applies. These confusions underlie, in particular, the theory of 'internal realism' in Putnam (1990). It is true that we can never step 'outside' of discourse whilst we are in the context of knowledge *qua* knowledge, even if this is basically just the trivial point that, since knowledge that something is the case must be able to be formulated in statements that something is the case, we cannot state something without stating it. (Cf. Wittgenstein's remark, 1974, p. 244, that you cannot get 'behind' rules because there is *no* 'behind'. I take this to be what may be called a categorial point, not an ontological one. In this sense one cannot get 'behind' certain 'rules of evidence' in a court of law because anything that *counts* as 'admissible evidence' can do so only by virtue of its conforming to *some* acknowledged rules of this sort. But this does not mean that the people giving the evidence do not depend, ultimately, on, amongst other things, ordinary sense-perception). Discourse is always within a causal context which regulates the assertion, acceptance and rejection of statements. The currently fashionable 'hermeneutic' idea that everything is a text, that we can never get 'behind' texts, besides rendering the idea of a 'text' entirely vacuous, is basically just a tarting up in modish linguistic dress of Berkeley's principle, which he presented in plain, honest clothing, that 'to be is to

be perceived'; this now becomes 'to be is to be a text'. This idea that we are always 'within' language is superficially the opposite of the idea underlying the alleged problem of finding how language 'hooks on to the world' as Putnam , *op. cit.*, for one puts it. But language is *always already* applied within various practices ('language games') that have both linguistic and extra-linguistic components: language is not first set up and only then fitted on to its subject-matter (cf. Wittgenstein 1974, p. 89) as a ready-made suit is donned by the person who wears it. For a very good discussion of some of these issues see Doyal and Harris (1986, Ch. 7). It is another aspect of this whole question that, to use Ziman's terminology, theory may 'depict' reality without 'mirroring' it (see Ziman 1978, p. 37, and Ch. 4, esp. §4. 3).

[11] The idea that the assessment of theories is a matter not of a lonely confrontation between one theory and 'the facts' but involves a comparison between theories goes back at least as far as the later Popper – see, e.g., (1963), but was finely developed by Lakatos, e.g. (1978, **1**, esp. Ch. 1). See also Miller (1987, Ch. 4).

[12] See Wieland (1970). On the character of the 'commonsense' world see, *inter alia*, Dewey (1938, Ch. IV), Gehlen (1988), Heidegger (1962), Heller (1978), Holzkamp (1968), Husserl (1970), Lefebvre (1947), Lukács (1963 Ch. 1).

[13] As an example, take the case of space in the commonsense world. Here it is experienced as *finite*, determined by the limits of our actions. It is *non-isotropic*, its directionality (right/left, up/down, etc). determined by the orientation of the human body and human actions. It is *non-homogeneous*, as shown by phenomena like the differences between haptic and visual 'spaces' (e.g. differences in assessments of the size of a tooth-cavity made on the basis of information furnished by the tip of the tongue or the eye). It is *discontinuous*, as a result of features of the sense-organs (e.g. the 'blind spot' in the eye). It is of *uncertain dimensionality*: visual space may be sometimes, in effect bi- or tri-dimensional, and auditory 'space' is multidimensional (e.g., the many different sounds generated by the various instruments in an orchestra occupy the 'same space'). It is of *uncertain structure*, as is seen in the way in which physically parallel railway lines, for instance, apparently meet as they recede into the distance. The list of such anthropocentric features could be continued. But it may also be seen that everyday space tends to have anthropomorphic traits. Thus left/right, up/down, East/West, near/far, inside/outside, closed/open, square/circular, straight/curved, and so on have 'value' accents, 'expressive' (cf. below 4. 3) significance. Moreover, these are variable. For instance, 'closed' may be intimate and 'positive', but also claustrophobic and terrifying, as in so many of Poe's stories. For more on this whole matter, see, e.g., Bachelard (1969), Carnap (1922), Cassirer (1969), Clark (1992). For the case of time, similar in many essential respects, see Dux (1989), Bakhtin (1981, pp. 206ff.).

[14] The phrase 'epistemological rupture' is Bachelard's – see esp. his (1949 , pp. 104ff. and 1953, pp. 207ff.). The background to it is developed at greatest length in his (1938). It was taken up by Althusser. See the synoptic treatment in Balibar (1978). This state of affairs may be taken to be at least an essential part of what Wolpert (1992) is alluding to in speaking of the 'unnaturalness' of science.

[15] On the process of empirical concept-formation see, e.g., Carnap (1926) and Hempel (1952).

[16] It might be objected that this account of concepts like 'soluble' in terms of (qualified) conditionals, that is, a construal in a purely *relational* manner, might well be satisfactory for properties such as this but not for ones of which we can have direct, non-relational knowledge, like 'red' or 'sour', the so-called 'secondary' qualities. However, I would give precisely the same account of these, *mutatis mutandis*. (Popper was one of the first to regard *all* empirical-descriptive concepts as dispositional. See, e.g., his 1963, pp. 118f., etc.) The question is too complex to discuss adequately here, but the key points are the following. Something is 'red', say, if and only if it is such that, *if*, under certain conditions, it is acted upon in a certain way (e.g. illuminated with light of certain frequencies), *then* it reacts in a certain way (e.g. reflects certain frequencies and not others). Of course, in general (again under certain conditions) this will also cause a certain state ('experience') in an appropriately sentient organism, such that this state is a *reliable indicator* of the presence of the property 'red'. But this fact must be carefully distinguished from the question of the *meaning* or

semantics of 'red'. The one is a matter of private sensory states, the other of intersubjective (objective, public) knowledge. (Cf. here Armstrong 1968, pp. 273ff., esp. 275–7.) It must also be carefully borne in mind that this account does not hold that properties are *identical with* relations, but that they are only *identifiable in terms of* relations. 'That which' they are, intrinsically, can be spelled out only in terms of how they are related to other 'that whichs'. (On the idea of 'topic-neutral' concepts see Ryle 1960, Ch. VIII.) By the way, this resolves, in principle at least, the traditional conundrums about 'internal' vs 'external' relations: the *specification* of the *concept* of some item essentially involves reference to relations to other items, and so relation is in *this* sense 'internal', but the intrinsic character of the item itself is *not* identical with these relations, and so relations between *instances* of the concept in question are 'external'. Historically, the idea of the primacy of relation over 'substance' goes back at least to Kant, and was developed by various Kantians, e.g. Cassirer (1953, 1953–59, Vol. 3, etc), and others (e.g. Poincaré 1958 [1905], pp. 135ff.). It probably entered the mainstream of twentieth century philosophy via Russell (1916, p. 61 and cf. 1948, pp. 267ff.). So Schlick (1974 [1918], p. 31 – and cf. 1979, I, pp. 141ff., II, 99ff., 285ff., 1987, 69ff., 139ff.), Carnap (1967 [1928], §§10–16), etc. . Also Eddington (1939, Ch. IX), Vygotsky (1962).

[17] E.g. Scriven (1959, pp. 464ff.) seems to run together the two senses of 'normal' , with the emphasis on the second.

[18] I construe what are usually called the 'laws of nature' among the 'generalities' involved not as *statements*, that is, roughly, as expressions that assert, truly or falsely, that something is the case, but as *rules* for inferring certain statements, ultimately singular ones, from one another. As regards the history of such a conception, I trace it at least as far back as J. S. Mill's *System of Logic* (1st ed., 1843) where (II, iii, 4), in the context of his criticism of the customary account of the syllogism, he distinguishes between inferring 'from' and inferring 'according to'. (He never makes use of this idea again in the book, though I believe that it would have helped him deal successfully with a great many of the problems that remained unresolved for him. It is just one example of the plethora of insights that lie like gems in the heaps of dross that have caused the book to be almost universally neglected nowadays.) Thoughts along similar lines may also be found in e.g. Peirce, 'What is a Leading Principle?' (reprinted in Peirce 1940), in Schlick, 'Causality in Contemporary Physics' (in 1979, Vol. II, *inter al.* reporting Wittgenstein's views, in which connection cf. also his later distinction, 1974, p. 297, between inferences being 'based on' and 'developed from' a principle), in Ramsey (1931), Watson (1938), Ryle (1949 and 1950), and in Toulmin (1953 and 1958). Zilsel (1942) argued that the concept of a 'law of nature' in the contemporary (empirical, non-normative, categorical) sense was not older than Descartes and Newton – in particular, Galileo did not have it. Ruby (1986) shows at most that the historical situation was a little more complex but not that Zilsel was wrong in his basic claims.

As the 'rule' view of laws is very much a minority one, a few remarks in defence of it may be added, especially as these will help to bring out more clearly the fundamental orientation to the sciences represented in this paper, namely, the consideration of them from the point of view of the *process of production* of knowledge, that is, of *inquiry*, rather than of the 'finished' *product*. 'Statemental' views of 'laws of nature' are of broadly two sorts. One holds that the latter affirm a necessary (therefore universal) relation 'in being' (*de re*) between universals, the other that they state simply a contingent 'constant conjunction' between aspects of particulars, the universality of the concomitance giving rise to the false idea that it is necessary. The first sort of doctrine suffers from many problems, including the obscurity of the idea of *de re* modality. But the key weakness is not one whose identification requires any subtle *metaphysical* argument, but merely the fact, manifest to purely *methodological* reflection, that it is, from a strictly cognitive viewpoint, an utterly *idle* doctrine, for the 'laws of nature' that allegedly embody this modality can only be *identified* by the ordinary scientific means, whatever they happen to be, that mark out certain expressions as 'laws of nature'. The second sort of doctrine is open to many objections too, but again the decisive one is involved in the very simple fact, verifiable *by reference to the sciences themselves*, that no known law is exact (see, e.g., Feynman 1992, p. 33). (This couple is just one instance of

the metaphysical problematic that posits two sorts of 'being', one adequate for domestic use, as it were, namely, the 'contingent', and the other of industrial strength, namely the 'necessary'. In this sense, both general views of laws, though apparently diametrically *opposed*, occupy the *same* conceptual 'space': it is just that they embrace different options available there.) Now the 'rule' view has the fundamental advantage that it does not generate the *question*: What makes a 'law of nature' true? and therefore need not be concerned about an answer to it, with all the problems that this entails, as seen in the case of statemental views. (Assessment of competing rules of inference is made by reference to whatever – contextually determinate – criteria are normally used for marking out laws considered as statements.) Furthermore, it has at least one other not insignificant advantage. As a matter of descriptive fact the assertions of physics (to take the clearest case) include, at a first approximation: first, singular statements of measurement, second, specific laws (e.g. of gravitation), and third, 'great general principles' that 'sweep across the variety' of the latter, ones which all these seem to follow (Feynman 1992, p. 59) like principles of conservation and symmetry. (On the taxonomy of physical assertions see also the excellent discussion in Cassirer 1956, Pt II.) Now, as has been pointed out in the controversies round Popper's demarcation-criterion, these have the formal (logical) property of being strictly unfalsifiable, for they affirm of *all* instances of F that they have a certain relation to *something else* that is G (e.g. of all every energy-system that if it registers an increase/decrease there must be some other such system that shows a decrease/increase) and the negation of an existential statement is a strictly universal statement that cannot in principle be exhaustively verified.

One proposal for dealing with this has been to regard these as having the character not of categorical statements but of rules or 'maxims' *regulating* inquiry: that is, that enjoin the search for what instantiates the existential statement. (This way out is suggested by the interpretation of the 'law of causality' as such a maxim, roughly, one that directs inquiry to search for explanatory conditions, necessary and sufficient in the circumstances, for every state of affairs.) But, on the statemental view, this is a basically *ad hoc* move that destroys the unity of character of general principles, whilst it is an *integral* part of a general 'rule' view of the latter. (Some rules are more specific than others.) In brief, there *are* 'laws', but they belong to the context of inquiry (rules of procedure, either intra- or extra-discursive), whilst there are statements about nature (and other subject-matters) but they are not 'laws'.

[19] See Lenzen (1931, 1937–38, 1938, 1939) and Pap's splendid (1946).

[20] See the references in the preceding note. Evolutionary improvements of this sort, that is, the 'leap-frogging' of results and principles of inquiry, affect not just particular concepts and theories but the most general categories. The matter may be studied very clearly with respect to the idea of physical determination, in particular, causality. See the material in, e.g., Collingwood (1940, Chs XXIX–XXXIV) and Kuhn (1977, Ch. 2). To take a non-physical case, not considered in such literature, Darwin's idea of natural selection, worked out for the solution of the *particular* problem of the origin and development of biological species, becomes, when formulated more abstractly, a completely new conception of determination, that is of something's coming about by virtue of the action of an 'environment' on a pool of options (as distinct from, say, purely 'linear' causality), and hence a new *heuristic principle of inquiry*, as, for instance, in the theory of neuronal group selection (Edelman 1987).

[21] The most obvious case of this is the (mis)interpretation of the rule that enjoins the search for determining conditions of states of affairs as a categorial truth of metaphysics (see, e.g., Popper 1972, 78, and cf. 1982a, esp. Ch. IV): the 'necessity' that attaches to a principle insofar as it constitutes or contributes to constituting a mode of activity is misrecognised as a 'necessity' characterising a state of affairs – a genuine *metabasis eis allo genos* (Aristotle, *On the Heavens*, 268b1). More generally, what is true of theoretical, intra-discursive 'objects' is (mis)interpreted as true of the real itself. (Cf. Wittgenstein's remark, 1967, §458, that metaphysics obliterates the distinction – contextual certainly, but still real – between factual and conceptual investigations.) This may occur at different levels of generality. Thus the principle of unity of a series, that is, its generating *relation*, may be thought of as a certain sort of *thing*, a 'universal' (the opposing position *within the very same conceptual framework* is nominalism that conceives a 'universal' as a mere *flatus vocis*), or a distinction between

different types of measurement-concepts ('fundamental' and 'derived') as a matter of two fundamentally different sorts of *properties* ('primary' and 'secondary'), or a particular *condition* of measurement as something *conditioning* measurement (cf. here the stimulating interpretation of Newton's absolute space, time and motion in Toulmin 1959). Needless to say, such slippages generate all manner of insoluble philosophical problems. Thus philosophers can never be without work to do, since their subject itself generates its own problems – as indeed Berkeley remarked, *The Principles of Human Knowledge*, Intro., IV – even if this is not the whole truth of the matter regarding this type of discourse. In particular, it should not be overlooked that the converse movement may occur, that is, that a philosophical doctrine about the world may be reinterpreted in a fruitful scientific way. Cf. here Agassi (1964), Holton (1988), Koyré (1955), Popper (1982, pp. 31ff., 160ff.).

[22] At this point the Aristotelian analysis of production in terms of the 'four causes' shows some of its limitations in principle in comparison with Marx's conceptual framework that explicitly includes the larger matrix encompassing circulation, distribution and consumption. However, I have used the Aristotelian conceptual set-up rather than Marx's mainly in order to tie together more closely and persuasively the elements of the *historical* situation. For a Marxist analysis of 'theoretical production', building on that of Althusser, see Suchting (1986, pp. 22ff.) and, for the case of physics in particular, Baltas (forthcoming). Laitko (1979) treats (ultimately unsatisfactorily) the problem posed by Marx's difficult concept of the 'general [*allgemeinen*] labour of the human spirit' (*Capital*, III, Ch. 5, V). The 'production' approach is also applicable to mathematics. See the materials in Kitcher (1984), Lakatos (1976, and parts of 1978, **2**), and some of the papers in Pickering (1992).

[23] On the question of the social-institutional setting within which the sciences produce, circulate-distribute and consume knowledge there is now an enormous literature, detailed references to which may be found in Pickering (1992). Older works like Aronowitz (1988), and Ravetz (1971) are still well worth consulting. On the way in which various ideological representations may figure as 'material cause'/raw materials in the process of production of knowledge, see, e.g., Fleck (1979), Freudenthal (1986), Hallyn (1990), Lefèvre (1978). The whole 'internalist' vs 'externalist' controversy may be left to rest in peace if the following considerations are taken into account. Firstly, whatever the character of the materials from which an item of putative knowledge is produced, it is *ultimately* the character of the real object, as revealed in testing, that pronounces on the adequacy of the result, so that 'relativism' of *origins* (valuable knowledge of which has been produced by some work in the 'sociology of knowledge') does not entail relativism of *result*. (This does not presuppose or entail a sharp dualism of 'context of discovery' vs 'context of justification', though this point cannot be gone into here.) See here, *inter alia*, Baltas (1987), Chalmers (1990), Freudenthal (1988). Secondly, as principally Bakhtin and Vološinov have shown, the production of what the former calls 'utterances', that is, concrete, context-determined statements, is *fundamentally* 'dialogical', that is, it assumes and is intrinsically partly determined by the linguistic framework of a specific interlocutor or sort of interlocutor, actual or 'ideal', so that the basic dualism without which the 'internal'/'external' distinction cannot even be made is undermined *ab initio*.

The whole field of 'sociology of knowledge' is in general a very depressing one theoretically, bedevilled as it is by fundamental confusions. There is in particular a very basic lack of clarity about the way in which, though certain 'ideological' representations may figure as 'material cause'/ raw materials in the process by which a science attempts to produce knowledge it is ultimately the character of the world that determines the *objective* adequacy of the result, so that the admission of institutional, ideological and other such factors as part of the process of production of knowledge in no way results in an epistemological relativism.

[24] On the 'ideological' matrix of scientific inquiry see in the first place the title work in Althusser (1990). Nietzsche is full of penetrating remarks on the scientific cast of mind – e.g. *Human, All Too Human*, Vol. I, **1**, §3, *Daybreak*, §270, *On the Genealogy of Morals*, Essay 3, §25, *Will to Power*, §469 (Kaufmann ed.).

[25] This is a further case of the reification/fetishisation, instances of which have already been identified in respect of the sciences.

[26] It is an essential part of the *ideological function* of a moral code to bring about, in as 'natural', spontaneous fashion as possible, a fundamental uniformity of behaviour, a sort of ethical *Gleichschaltung*, in a social group. This is not in itself a 'bad thing': all groups need certain reasonably stable sorts of behaviour in order to produce and to reproduce themselves. Of course, such principles work against the *de facto* diversity of impulses to behaviour, many of them in conflict with one another, but then it is an essential part of the very function of ideology to elide the appearance of conflict (cf. Marx and Engels 1976, 78, 287, 469). Even Nietzsche, one of the deepest critics of moral/ethical discourse, puts forward an essentially universalist ethic.

[27] On the idea of 'social objectivity' see Marx, *Capital*, Vol. I, Ch. 1, §4.

[28] Cf. Hegel's magisterial account of Sophocles' *Antigone* in the *Phenomenology of Spirit*, Ch. VIA, and the final pages, on tragedy, of his *Aesthetics*. As regards more recent treatments, see esp. Else (1965), von Fritz (1962 – esp. the first paper), Hauser (1951, II, p. 589 and 1965, pp. 131ff.), Lukács (1981, pp. 25f., 39ff., 45ff.), Raphael (1975, pp. 244ff.), Thomson (1955). It may be remarked here that, in the final analysis, the roots of moral changes, fundamental ones anyway, lie in changes in social practices that are seldom if ever given a clear formulation (even in terms that, as is usually the case, at least partly misidentify them) till after they have proceeded for some time. 'In the beginning was the act!' – Faust's words are as applicable here as elsewhere. This is not to say that philosophers and others may not *project* new ('Utopian') moralities, but these in general remain mere figments of the imagination unless they find a vehicle in real changes whose expressions and 'justifications' they may become.

[29] I have not taken up a notion that belongs to the area of right/ought, namely, that of 'conscience', and in particular a theme that belongs at least to the 'phenomenology' of conscience, namely, what is often referred to as the 'bite' , 'gnawing', 'sting' of conscience. This is as distinct from the mere contemplation, as it might be called, of right/ought, as *belief* that something is the case is, as Hume recognised (*Enquiry Concerning Human Understanding*, Sect. V, Pt II), distinct from the simple entertaining of a statement as true. I do not think that ethics as such, as ordinarily understood anyway, can cast the slightest light on this question, for it falls into the domain of *causality*. This is too large a topic to consider here, even in outline, and I shall have to confine myself to saying that I believe that the decisive clue to the solution of the problem lies in Freud's doctrine of the super-ego as the expression of internalised constraints, imposed by familial-social *training*, 'bringing up', on the 'anarchic' impulses of the id (the two fundamental drives of hunger and libidinal tension). Among Freud's very many treatments of these themes, see esp. the following: **VII**:231, **XI**:24, **XIII**:67–71, **XIV**:93–97, 279–88, **XVI**:429, **XVIII**:74f., 109f., **XIX**:34–8, 52–54, 57f., 166–70, **XX**: 128n, 223.

With their typical tendency to reverse the terms in a cause–effect relation philosophers spontaneously tend to take abstract ethical obligation as the *rational* ground of the feeling of conscience, rather than the latter (the result of inculcation) as the *causal* ground of belief in the existence of the former. It may be added, pursuant to one of the basic strategies of this paper, namely, to argue continuities between the three areas taken up, that this is similar to Wittgenstein's explanation of what he calls – 1978, I, §121, and cf. 1953, I, §437 – 'the hardness of the logical must', namely, in terms of training – see e.g. 1978, I, §4, 118 and II, §30). – Furthermore, it is in the context of all this that it is possible to explain quite naturally the fact, often noted, that deontological questions have little role in Aristotle's ethics.

The explanation can suitably begin with reflection on the meanings and relations of the Greek we translate as 'ethics'. The Greek '$\check{\varepsilon}\theta$os (*ethos*)' means a custom, habit, and '$\mathring{\eta}\theta$os (*ēthos*)' means disposition or character, whilst adjectival forms *etheios/ethaios* have the significance of 'honoured' and *ethikos* is coordinate with *dianoetikos* (roughly, 'intellectual') as a form of *arete*, 'excellence'. (On the foregoing cf. Aristotle, *Nic. Eth.*, beginning of Bk. II.) So the point of Aristotle's 'ethics' may be said to be the laying down of principles for the 'production' of a certain sort of disposition or character such that certain forms of behaviour are customary, habitual, more or less spontaneous. To the extent that this suc-

ceeds, conflicts between inclination and morally excellent conduct, that is, situations where deontological notions have a purchase, simply do not occur. It is from this point of view that the magnitude of the difference, which amounts to an unbridgeable gulf, between Aristotelian and various other central later moralities can begin to be grasped. Christianity, for instance, by defaming the 'natural' character of human beings in terms of their allegedly divine aspect, anchored in the transcendent, makes a coincidence between ordinary inclination and the morally good *impossible in principle*, thus delivering a creature crippled by guilt into the hands of the priests. Hume's ethical thought, in intent anti–religious, in fact stands thoroughly within the Christian framework, to the extent that he radically separates factual and axiological questions: in effect he secularises that framework, and, no longer having any Christian values, has to fall back on individual sentiment, eked out by assumed social feelings. (The situation here is analogous to that in his philosophy of causality where he subscribes unconditionally to the traditional – in particular Aristotelian – view that knowledge in the strict sense must be certain, but denies cognitive access to the real essences that would vouchsafe certainties about relations between matters of fact, and so ends in scepticism. But that is another story.)

Kant completes the revolution against Aristotle, for his approach to ethics is the precise *opposite* of the latter's, insofar as he holds that it is a *necessary condition* for something to be a properly ethical action that there *be* a conflict between inclination and the good/right. However weird this may sound to anyone whose intuitions have not been corrupted by religion and much traditional philosophy, considered more closely it is an absolutely consistent move for any non-naturalistic ethics that *contrasts* inclination and the good/right and is in fact *symptomatic* of this sort of ethical project. But at the same time, looked at more constructively, it *cautions* against any simple-minded immediate identification of fact and value: for a naturalistic 'ethics' a contrast between the two is, considered regulatively, one to-be-overcome.

[30] This touches upon the complex question of the relation of 'ought' and 'can'. It seems almost self-evident that I cannot properly be said to be under an obligation to do something unless I am able to do it should I so decide. But a little reflection serves to cloud this intuitive obviousness. One is the apparent fact of conflicting 'oughts'. Another is the difficulty of deciding, in particular cases, when it is appropriate to say that someone 'can' do something. It is clear that someone can return a stolen library book, and that no one person can stop a world war. But in what sense, if any, 'could' Don José have given himself up after the fight with his captain at the tavern rather than take to the hills with Carmen and the smugglers? A passing remark by Wittgenstein (1986, pp. 37f). opens up another line of thought: that a statement of obligation may serve to pose the *task* or *project* of *becoming* able to do what it enjoins. This links up once more (cf. end of 3. 7 above)with the comparison between ethical concepts and principles with 'pure cases' in the sciences which function *regulatively*, enjoining and guiding attempts to analyse the real in terms of them. (I take this opportunity of referring to Will (1988) that came to my notice only after finishing this paper. This excellent book makes a concept of 'norm' central to thought about both the sciences and human conduct.)

[31] This marks the site of a possible consideration of Aristotle's intriguing but in many ways obscure idea of a 'practical syllogism', which is like that of an ordinary syllogism except that the conclusion is not a statement but an action. See *On the Soul*, 434a16–21, *On the Movement of Animals*, 701a7–701b1, and cf. *Nic. Eth.*, 1147a24–b6.

[32] On this account of language and the criticism of the idea of a formal theory of language based on it see Vološinov (1973, esp. Pt II) and Bakhtin (1981, 1984, 1986) whose thinking on this theme, scattered in various places, and in some respects incomplete, is deftly drawn together in Morson and Emerson (1990, esp. Chs 1 and 4).

[33] The use of the plural here is based on the same sort of considerations as its use in 'the sciences', on which see note 5 above.

[34] An excellent example of this is Homer's formulation of new expressions on the model of particular words and of the metrical patterns of old formulaic expressions, on which see

Parry (1971, p. 266). Cf. also, say, Beethoven's use of traditional forms as raw materials for his work – Dahlhaus (1988, p. 222).

[35] Raphael insisted from first to last on the autonomy and internal necessity of a genuine work of art – see, e.g. (1989, pp. 35, 118, 120, 148, 179, 180, 190f., 1968, pp. 194ff.). The strict internal necessity of a Beethoven symphony has often been commented on – cf. e.g., Adorno (1986, pp. 211f., 220f., 241) – and Mahler is reported to have said that to write a symphony is 'with all available technical means to construct a world' (cited in Adorno 1986, p. 230). This state of affairs is also, I think, what Rilke was gesturing towards in the wonderful lines 5–7 of the third of the *Sonnets to Orpheus*: 'Gesang, wie du ihn lehrst, ist nicht Begehr, /nicht Werbung um ein endlich noch Erreichtes;/Gesang ist Dasein.'

[36] For the distinction between the expressive, representative and purely conceptual functions my basic indebtedness is to Cassirer, esp. (1953–59) – but see also the later, less exhaustive presentations in (1961 and 1944). Langer (1953) is much indebted to Cassirer with regard to her expressivist theory of art. On art as the language of expression see earlier Spengler (1926–28, Vol. I, Ch. 3, Sec. II, Vol. II, Ch. 2, Sec. II) and in connection with Rembrandt, Simmel (1985). On the cognitive significance of expression (as distinct from verbal protocols) for psychoanalytic practice see Reich (1973, esp. Pts I and II). Nietzsche speaks finely of how Wagner 'thinks in visible and sensible processes [*fühlbaren Vorgängen*] not in concepts' and of how the *Ring* is 'a gigantic system of thought without the conceptual form of thought'. (See 9 of 'Richard Wagner in Bayreuth' in the *Unzeitgemäße Betrachtungen*.) Cf. with this Wagner himself (1893, pp. 325ff., esp. pp. 329f.). In this regard it is significant that writers on art frequently speak of the 'physiognomic' character of certain states of affairs – e.g. Adorno (1986, pp. 194, 201, etc). Wittgenstein interestingly speaks at one place of meaning as 'physiognomy' (1953, I, §568). The fundamental significance of gesture has long been recognised. See, for instance, the passage in Montaigne (*Essays*, II:12), where he says, *inter alia*: 'There is no movement that does not speak both a language intelligible without instruction, and a public language . . . ' (Frame trans). (One may recall the story that it was Sraffa's showing Wittgenstein an obscene Neapolitan gesture and asking him what it could be said – propositionally – to mean that was one of the factors that turned Wittgenstein away from his previous account of language.) On gesture see, *inter alia*, Bramly (1991, pp. 190, 191, 395f.), Brecht (1974, esp. pp. 42, 86, 104f., 115–17, 198–20), Bremmer and Roodenburg (1992), Gadamer (1986, pp. 65, 79–81), McNeill (1992), Pearson (1992). – The poet reflects in Broch's *The Death of Virgil*: '. . . human life . . . could comprehend itself only through images, the images were not to be banished, they had been with us since the herd-beginning, they were anterior to and mightier than our thinking . . .' (English tr., p. 76). Let the last word be with Goethe's imperative: 'Bilde Künstler, rede nicht . . . '

[37] Kant, *Critique of Judgement*, §§2, 5. Schiller in effect took up this line of thought, as he did so much else in Kant. See, e.g., his superb characterisation of 'the mood in which a genuine work of art should release us' as a 'lofty equanimity and freedom of the spirit, combined with power and vigour' (1967, Letter 22, §3, p. 153), and his great poem 'Das Ideal und das Leben', especially the stanza beginning 'Aber dringt bis in der Schönheit Sphäre', and concluding: 'Alle Zweifel, alle Kämpfe schweigen / In des Sieges hoher Sicherheit; / Ausgestossen hat es jeden Zeugen / Menschlicher Bedürftigkeit.' See also, essentially along Kantian lines, though in a different context, Schopenhauer, *Die Welt als Wille und Vorstellung*, Vol. I, esp. §§34ff., Vol. II, Ch. XXX. From a completely different direction, Brecht (1974, esp. pp. 94–96, 143–5, 191–5) and also some of his poems, especially the 'theatre' poems, e.g., Suhrkamp *Gesammelte Werke* (1967), **9**, pp. 775ff. (*Poems*, Methuen ed., pp. 340ff., 424ff.).

[38] On the fundamental significance of naming, see, e.g., Blumenberg (1985, Pt I, Ch. II). Cf. once more Schiller (1967, Letter 25, §3, p. 185): 'From being the slave of nature, which he remains as long as he merely feels it, man becomes its lawgiver from the moment he begins to think it. That which hitherto merely dominated him as *force*, now stands before his eyes as *object*.' Also the well-known lines at the end of Goethe's *Tasso* (those beginning, 'Die Träne hat uns die Natur verliehen, '). The liberating power of aesthetic naming is a fundamental theme in Collingwood's fine (1938).

[39] The consummatory significance of art is a basic topic in Dewey's great (1932). On the comparison with the idea of a 'pure case' in the sciences see the following astonishing passage from Georges Poulet which is all the more significant insofar as there is no indication whatever that he had such a connection in mind: the work of art 'creates a cloister in whose shelter reality can be isolated, contemplated and represented, without running the risk of melting into the universal multiplicity of phenomena' (cited Solomon 1988, p. 25).

[40] There has been much discussion, especially since Heidegger's essay on 'The Nature of a Work of Art', on the sense in which the latter can reveal 'truth', little of which I have found of much value, which is only to be expected in view of the use of the weasel-word 'truth'. Nowhere is Wittgenstein's advice more helpful: 'Say what you choose, so long as it does not prevent you from seeing how things stand.' (1958, I, §79, p. 37e) (He adds parenthetically: 'And when you see this there is a good deal you will not say.' Cf. also his following remark (1977, p. 119 – cf. also p. 75): 'Nowadays people believe that the sciences are there to teach them something, poets and musicians etc. to give them enjoyment. *That the latter have something to teach them never enters their heads.*'

[41] This is a matter of great complexity. Schiller was once more in the forefront of thinking here with his idea (see esp. his essay 'On Naive and Sentimental Poetry') of art's role in representing a lost human wholeness and dignity as real, before us, and hence both an object both of joy and an ideal goal as something to be recaptured. Solomon (1988, esp. pp. x, 10ff., 214) has finely caught this union of the archaic and the utopian in Beethoven. Mahler is reported (Adorno, 1986, p. 165) to have said: 'Music must always contain a yearning, a yearning for what is beyond the things of this world'. The Utopian function of art was a constant theme of the Frankfurt School of Marxism. See, e.g., Marcuse (1978). Also Raphael (1945, esp. pp. 1f., 50). The elements of a subtle attempt to delineate how a critique may be 'shown' rather than 'said' is adumbrated in Althusser (1971), developed in Macherey (1978), Hadjinicolaou (1978). Sprinker (1987, esp. Ch. 10) is useful here. A related idea is that of Jameson's 'double hermeneutic' (see, e.g., his 1981), applied to classical Greek literature in Rose (1992).

[42] This would be the place, 'had we but world enough and time', for a discussion of the still unresolved problem of the Aristotelian notion of 'catharsis' as the end of tragedy. See *Poetics*, 1449b27–28.

[43] Once more Schiller is a pioneer here – see (1967, esp. Letters 14 and 15). Also, more recently, Gadamer (1975, esp. Pt I, and Pt II 1, and 1986, pp. 22–5, 127–30).

[44] See here the materials assembled in Ellenius (1985), and on the early modern period in particular, Edgerton (1991), Frey (1929), Kemp (1984), Shirley and Hoeniger (1985), White (1946).

[45] The aesthetic dimension of science is a common theme in Nietzsche. See, e.g., *Daybreak*, §§427, §450, *The Gay Science*, §293. More recently Curtin (1980 and 1982), Chandraskhar (1987) and Hallyn (1990).

[46] See Freud (1966ff., esp. **II**: §262f., §289, **IV**: §283, **V**: §569, **XV**: §173, 228–33). Cf. here the excellent paper on the significance of psychoanalysis for art in Hauser (1959, pp. 101ff.).

[47] For the phenomenon of ambiguity in poetry see the classic Empson (1930), in visual arts see, e.g. Gombrich (1972), and in music see the splendid examples from Beethoven in Dahlhaus (1988, pp. 42ff., 129ff., 165ff., 211f., 275ff.).

[48] On imagination in general see the magisterial work on the 'anticipatory consciousness', Bloch (1986) which, however, in its vast expanse of three volumes, simply leaves science out of account. Cf. however, Nicolson (1956). All this ties up with the excellent pages on language as 'the main instrument of man's refusal to accept the world as it is', and indeed of the 'creativity of falsehood' in Steiner 1992, Ch. 3, esp. pp. 228ff.. (The citations are from pp. 228 and 230 respectively.)

[49] 'Religion' is a 'family resemblance' concept in Wittgenstein's sense, that is, it is applied in accordance with different 'clusters' of conditions from a set only some of which may be generally necessary. Thus, say, Christianity and Buddhism are not both religions *qua* sharing a single set of conditions that are severally necessary and jointly sufficient. But the following characterisation may serve as a sort of 'profile' of at least paradigmatic religions. It may be

compared with Freud's concept of religion. See esp. *The Future of an Illusion*, and *Civilization and Its Discontents*, both in Freud (1966ff., **XXI**).

[50] Unfortunately, constraints of space prevent a tracing out of the 'genealogy' of that historically specific form of thinking called 'philosophy'. But in the crudest of terms the story is this. Primitive, 'mythical' thought (these adjectives used here both phylo- and ontogenetically) thinks the world and acts upon it as a locus of events related as intention and intended action, that is, teleologically. However, it makes, in effect, a distinction between, on the one hand, relatively stable, regular modes of this operating and, on the other, sorts of situations requiring regular human interventions in the forms of prayer, ritual and so on. For reasons that cannot be explored here, the first became a basis for a secularising, deanthropomorphising process, in which an attempt was made to think relations between events in purely naturalistic terms, without the intermediary of another, teleologically directing factor.

This is the fundamental character of that first flowering of early Greek, especially Ionian thinking, generally referred to as 'pre-Socratic philosophy'. But this very *description* encapsulates a *thoroughgoing falsification* of the history of ideas in at least two interconnected ways. To start with, the early Greek thinkers in question were called (in the first place by Socrates himself) *physiologoi*, that is, roughly, those who sought an explanation (*logos*) of the natural character (*physis*) of things, and specifically natural principles of change (*physis* is derived from the verb *phyo*, 'to grow'). The *philosophoi*, that is lovers (*philoi*) of wisdom (*sophia*), belonged to an entirely different current of thought, founded by Pythagoras and Parmenides, that sought, in effect, to recuperate the essential 'other-worldly', teleological character of primitive thought. The two *fundamentally opposed* directions had a first major confrontation in fifth century BC Athens with the attack by Socrates/Plato on the *physiologoi*, whose thought was now crystallised in the purely materialist systems of Atomism (Leucippus and Democritus) and supplemented by the extension of naturalistic thought to human matters by the Sophists. So – and this is the second aspect of the falsification indicated above – to call early Greek thinking 'pre-Socratic' is to suggest a specially privileged place for Socrates (and, by implication, Plato), as though the others were merely precursors of the really serious Greek thinking that began at this time. (The extent and depth of Socrates-worship – and 'the cult of Plato' as it has been called, Stove 1991 – is almost unbelievable. He has become a sort of Jesus for otherwise secularly inclined philosophers, the arrogant, priggish *Apology* regarded with the admiring wonderment others accord the Sermon on the Mount, and the story of his last hours, related in the *Crito*, a sort of Crucifixion-story.) From this point on the two 'lines' may be traced as fairly separate traditions.

Despite all the differences between Plato and Aristotle the latter carried on the work of the former in essential ways, like that of offering a metaphysical 'foundation' for the sciences and a teleological view of the world. Christianity took up elements of Platonic thought ('Platonism for the people' as Nietzsche called it in the Preface to *Beyond Good and Evil*) but, at its philosophical high-point, in Thomism, mainly appropriated Aristotle. Atomism carried on a basically marginal existence, developed in various ways by Epicurus and rendered in Lucretius's marvellous poem, through various thinkers, till it was recuperated (in connection with the craftsman tradition – on which see Zilsel 1942a, 1976) by Galileo, amongst other Renaissance thinkers, in the second great showdown between the traditions of the *physiologoi* and the *philosophoi*. The outcome was, of course, this time a victory for the first, though the second regrouped, the history of 'modern' (that is, post-Cartesian) philosophy being, from one fundamental point of view, an attempt to carry on the old philosophical project by different means.

I have said something in more detail on these matters in (Suchting 1991, esp. pp. 157ff.). For the rest I must restrict myself to some especially pertinent references to the vast literature. On 'mythical' thinking and the emergence of a materialist world-view see, *inter alia*: Blumenberg (1987), Cassirer (1953–59, esp. Vol. 2, and 1925), Cornford (1952 and 1957), Dux (1982, 1989), Frankfurt *et al.* (1949), Heinimann (1945), Hübner (1978), Lukács (1963, esp. Ch. 1), Nestle (1941), Pohlenz (1953), Thomson (1955), Winspear (1974). Against the Socrates-Plato 'cult' see in a primarily metaphysical-epistemological regard Mittelstrass

(1962), Stove (1991), with Strong (1936) on the anti-scientific role of later Platonism, and with emphasis on the political dimension Popper (1966) (despite weaknesses still an attack the basic soundness of which is attested by the basic feebleness of the replies by affronted Plato-cultists), Stone (1988), Wood (1978). On the history of modern philosophy as part of a defensive strategy against modern natural science see, *inter al.*, Dewey (1929 and 1948), Dux (1976). On the history and criticism of teleological thinking in philosophy Hartmann (1951), Theiler (1965). So far as I can see, no one has as yet produced even the beginnings of a satisfactory study of Nietzsche's penetrating remarks on the relations, both historical and systematic, between religion and philosophy *as such*. See, *inter al.*, *The Gay Science*, §151, *On the Genealogy of Morals*, Essay 2, §7, *The Anti-Christ*, §§10–12, *Ecce Homo*, 'Daybreak', §2, *Will to Power* (Kaufmann ed.), §140. (It should not be overlooked, however, to what extent these ideas were anticipated by the disgracefully neglected Ludwig Feuerbach.)

[51] On the history of atheism see, *inter alia*, Ley (1966–71) and Hunter and Wootton (1992). It is very important to be as clear as possible about the character of this criticism of *questions* here. (On the distinction between criticism of answers and criticisms of the questions that generate them see Marx and Engels 1976, p. 28.) For instance, with regard to the expression: 'Why is there something rather than nothing?' what is being rejected are not various *answers* so much as what the latter all necessarily assume, namely, that a genuine question has been posed. One way of putting the crucial point is to say that a genuine question presupposes *some* idea of how it might be answered. (Cf. here Wittgenstein 1967, §§695–697, and 1974, pp. 377, 379, 380, and also Bachelard 1949, pp. 55ff..)

Now it is crucial to see that this is not, as some might immediately think, one or another form of 'positivism', 'verificationism', or whatever. On the contrary, it is simply a feature or consequence of the ordinary, and, in more developed form, scientific sense of the notion of a question, it is a matter of 'logical grammar'. However it is later extended and even corrected, the procedure of posing questions has its roots in everyday life. The basic point of posing a question is to ask for information, whether this be about what is the case (What is the time? What is the speed of light?), about how to do something (e.g. riding a bicycle), or a combination of the two (e.g. successful growing of a certain sort of vegetable). The question is idle, that is, is merely a form of words, is not really a question, if there is not at least some idea present, however vague, as to how that information might be found. This is true even of questions that turn out not to have answers, because what is sought for does not exist (e.g. the question of 'squaring the circle' or the velocity of the earth relative to 'the aether'). In other words, questions in their paradigmatic form are always posed within *contexts* of the sort indicated.

Now what philosophers tend to do is to take questions that have a good sense *within* certain contexts, and, perhaps by way of a series of intermediate cases, remove the contextualising conditions, so ending up by posing questions that have the *form* of legitimate questions but no longer *function* as such. Thus people may and constantly do properly ask why some *particular* state of affairs exists, or why it has these features and not others, why some general feature of the world is as it is, and so on, all of which questions are answerable, in principle anyway, by reference to some other particular or general feature of the world. But the question of why what is the case *as such* is as it is is unanswerable in this way because, by virtue of the terms of the 'question', there can be no reference to anything beyond that about which the 'question' is being asked.

Put another way, it is as though someone were to ask what an object ordinarily describable as a brick was for, and, on being given a list (constructing buildings, separating planks used for shelving, keeping papers from blowing away, etc), rejected such answers on the ground that he wanted to know what it was used for 'as such', 'in general'. So we get what Wittgenstein called in general a 'thumb-catching of the intellect' (1978, IV, §6). It is true that an expression like 'Why is there something rather than nothing?' may seem to some to be not just a genuine question but one of a specially 'deep' sort, perhaps veritably vertiginously deep, giving rise to the sort of dizzy feelings often experienced in looking down from a great height. But even in the exact sciences certain expressions that have looked like

genuine ones, even to extremely clever people, can be shown to be only pseudo-questions since 'answers' to them lead to logical impasses (e.g. the heterological paradoxes). In fact the feeling of quasi-mystical depth is a mental state induced by lack of logical oxygen, the sense of ineffableness a consequence not of the immense profundity of any possible answer but of the vacuousness of the 'question'.

[52] End of §4 of 'Richard Wagner in Bayreuth' in the *Unzeitgemäße Betrachtungen*, and cf. *The Gay Science*, §107. Nietzsche remarks elsewhere (*Human, All Too Human*, Vol. I, §150) that art typically arises when the grip of religion relaxes. On this point see also Raphael (1921, pp. 41f). on art's incompatibility in principle with the other-worldly, and Bramly (1991, p. 90). This might seem at first sight inconsistent with, say, ecclesiastical patronage of art. But where this does not stem from the private, secular tastes of ecclesiastics it is in general a matter of art's being used for extra-aesthetic purposes, for instance, as a *means* for the propaganda of religious attitudes and doctrines. On this see, e.g., Hauser 1951, esp. I, pp. 136ff., 190, 379ff..

[53] It is tempting to conjecture, knowing his high regard for Leopardi's work, that Nietzsche had this poem in mind when, in *The Gay Science*, §283, he enjoined: 'Build your homes on the slopes of Vesuvius!'.

[54] Compare the striking passage, which does not seem to have been noted in the present regard, in Montaigne's *Essays* (I:8). He writes that in retiring, to let his mind 'entertain itself in full idleness and stay and settle itself', he found that in such circumstances it 'gives birth to . . . many chimeras and fantastic monsters, one after another, without order or purpose . . . ' (D. M. Frame translation)

[55] At least two elucidations are necessary here. (1) Some naturalistic – or, as I would prefer to say were the word not so almost hopelessly compromised, materialist – thinkers have taken the more optimistic view that the disappearance or at least very great decrease in the extent and depth of belief by human beings in a transcendent order of things would have the effect of bringing about, amongst other desirable changes, a new sense of human solidarity flowing from the sense that only we ourselves are responsible for our weal and woe. See, for instance, Leopardi, *op. cit.*, esp. lines 111–157, and the words given by Jens Peter Jacobsen to the eponymous main figure of his novel *Niels Lyhne*, especially at the end of Chapters IX and Ch. XIII.

My own sentiments, for what they are worth – and in matters like this it is largely a matter of what Hegel calls 'swapping assurances' – are rather those of Lynhe's friend Dr Hjerrild:' . . . atheism is exceedingly modest in its claims, for its object is really nothing more or less than to disillusion mankind. The belief in a God who guides and judges is man's last great illusion, and when this is gone – what then? He will be wiser; but richer, happier? I do not see it.' (Ch. IX) Atheism is at most a *presupposition* of a generally more satisfactory life for human beings. (2) A second point is more important, being absolutely crucial for a right understanding of the position I am putting forward here. *I am not in any sense whatever setting out a doctrine of 'genetic determinism'* according to which the course of human history is wholly or for the most part determined by human genetic make-up, so that the future course of that history can be more or less reliably inferred from a knowledge of that make-up and/or extrapolated from the course of history so far.

More positively, I believe that Freud was, broadly, right about the *ultimate* causal sources of the dynamics of history, namely, the drives towards self-preservation of the individual and the species, but consider as (at least contextually) much more important what I take to be Marx's fundamental insight that may be put in the present context by saying that the operation of these drives is mediated, *and their forms of expression transformed*, by different types of 'modes of production' in the inclusive sense of distinctive ways of *producing* means of human subsistence and of *reproducing* those ways, both through the basic productive mechanisms themselves and, more importantly, through equally distinctive forms of 'superstructure'. It is a consequence of this that the numerically tiny proportion of specifically human genes can be the biological basis for causal forces that *countervail the realisation* of the tendencies rooted in the numerically vastly greater proportion of genes that human beings share with pre-human orders of beings. The extent to which this will actually happen

cannot be foreseen. I am simply affirming that history up till now does not provide much ground for any great degree of optimism, though this should be supplemented by the remark that political action (in the broadest sense of the word) should be guided by the *regulative maxim* that a happier state of things for human beings can be attained. Here, as in so many other places, the slogan should be Gramsci's: Optimism of the heart, pessimism of the head! I might add that, as regards the relation of Freudian psychoanalysis to historical materialism, I find the position of Wilhelm Reich in his *Dialectical Materialism and Psychoanalysis* (1929, 2nd ed., 1934 – available in Reich 1972, pp. 3–74) the closest to my own. (Contrast the attitude to Freud's views in Vološinov 1987.) My understanding of Marx's historical materialism is presented in outline in Suchting (1983).

REFERENCES

Ackermann, R. J.: 1985, *Data, Instruments and Theory. A Dialectical Approach to Understanding Science*, Princeton University Press, Princeton.

Adorno, T.: 1973, *Philosophische Terminologie*, Bd 1, Suhrkamp, Frankfurt/M..

Adorno, T.: 1986, *Mahler. Eine musikalische Physiognomik*, in *Die musikalischen Monographien*, Suhrkamp, Frankfurt/M..

Agassi, J.: 1964, 'The Nature of Scientific Problems and their Roots in Philosophy', in M. Bunge (ed.), *The Critical Approach to Science and Philosophy*, Free Press, Glencoe, 189–211.

Althusser, L.: 1969, *For Marx*, Allen Lane, The Penguin Press, London.

Althusser, L.: 1971, *Lenin and Philosophy and Other Essays*, New Left Books, London.

Althusser, L.: 1976, *Essays in Self-Criticism*, NLB, London.

Althusser, L.: 1990, *Philosophy and the Spontaneous Philosophy of the Scientists*, Verso, London and New York.

Althusser, L. and Balibar, E.: 1970, *Reading Capital*, New Left Books, London.

Appleyard, B.: 1992, *Understanding the Present. Science and the Soul of Modern Man*, Picador, London.

Armstrong, D. M.: 1968, *A Materialist Theory of the Mind*, Routledge and Kegan Paul, London.

Aronowitz, S.: 1988, *Science and Power. Discourse and Ideology in Modern Society*, University of Minneapolis Press, Minneapolis.

Bachelard, G: 1986, *The New Scientific Spirit*, Beacon Press, Boston.

Bachelard, G.: 1938, *La Formation de l'esprit scientifique*, Vrin, Paris.

Bachelard, G.: 1949, *Le Rationalisme appliqué*, P. U. F., Paris.

Bachelard, G.: 1951, *L'Activité rationaliste de la physique contemporaine*, P. U. F., Paris.

Bachelard, G.: 1953, *Le Matérialisme rationnel*, P. U. F., Paris.

Bachelard, G.: 1969, *The Poetics of Space*, Boston, Beacon Press.

Bakhtin, M. M.: 1981, *The Dialogic Imagination: Four Essays*, University of Texas Press, Austin.

Bakhtin, M. M.: 1984, *Problems of Dostoevsky's Poetics*, University of Minnesota Press, Minneapolis.

Bakhtin, M. M.: 1986, *Speech Genres and Other Late Essays*, University of Texas Press, Austin.

Balibar, E.: 1978, 'From Bachelard to Althusser: the Concept of "Epistemological Break"', *Economy and Society* **7**, 207–237.

Balser, W., Molines, C. U., Sneed, J. D.: 1987, *An Architectonic for Science*, D. Reidel, Dordrecht.

Baltas, A.: 1987, 'Ideological "Assumptions" in Physics: Social Determinations of Internal Structures', in A. Fine and P. Machamer (eds.) '*Philosophy of Science Association* 1986, Philosophy of Science Association, East Lansing, Michigan.

Baltas, A.: 1988, 'On the Structure of Physics as a Science', in D. Batens and J. P. van Bendegam (eds.), *Theory and Experiment*, D. Reidel, Dordrecht, 207–225.
Baltas, A.: Forthcoming, 'Physics as a Mode of Production', *Science in Context*.
Bloch, E.: 1986, *Principle of Hope*, 3 vols, Blackwell, Oxford.
Blumenberg, H.: 1983, *The Legitimacy of the Modern Age*, MIT Press, Cambridge, Mass..
Blumenberg, H.: 1985, *Work on Myth*, MIT Press, Cambridge, Mass..
Blumenberg, H.: 1987, *Das Lachen der Thakerin. Eine Urgeschichte der Theorie*, Suhrkamp, Frankfurt/M..
Böhme, G. (ed.): 1976, *Protophysik. Für und wider eine konstruktive Wissenschaftstheorie der Physik*, Suhrkamp, Frankfurt/M..
Böhme, G., van den Daele, W. and Krohn, W.: 1977, *Experimentelle Philosophie. Ursprünge autonomer Wissenschaftsentwicklung*, Suhrkamp, Frankfurt/M..
Bourdieu, P.: 1977, *Outline of a Theory of Practice*, Cambridge University Press, Cambridge.
Bramly, S.: 1991, *Leonardo. Discovering the Life of Leonardo da Vinci*, Edward Burlingame Books, New York.
Brecht, B.: 1974, *On Theatre. The Development of an Aesthetic* (ed. and tr. J. Willett), Methuen, London.
Bremmer, J. and Roodenburg, H. (eds.): 1992, *A Cultural History of Gesture: From Antiquity to the Present*, Polity Press, Oxford.
Bridgman, P. G.:1927, *The Logic of Modern Physics*, Longmans, New York.
Bridgman, P. G.: 1937, *The Nature of Physical Theory*, Princeton University Press, Princeton.
Bridgman, P. G.: 1952, *The Nature of Some of Our Physical Concepts*, Philosophical Library, New York.
Brinton, C.: 1959, *A History of Western Morals*, Harcourt Brace, New York.
Bronowski, J.: 1954, *William Blake* 1727–1827. *A Man Without a Mask* (2nd ed.), Pelican.
Butts, R. E. and Brown, J. (eds.): 1989, *Construction and Science. Essays in Recent German Philosophy*, Academic Publishers, Dordrecht/Boston/Lancaster.
Canguilhem, G.: 1970, 'Galilée: La Signification de l'oeuvre et la leçon de l'homme' in *Etudes d'Histoire et de philosophie des sciences* (2nd ed.), Vrin, Paris, 37–50.
Carnap, R.: 1922, *Der Raum. Ein Beitrag zur Wissenschaftslehre, Kant-Studien*, Ergänzungshefte **56**, Verlag von Reuther & Reichard, Berlin.
Carnap, R.: 1926, *Physikalische Begriffsbildung*, G. Braun, Karlsruhe.
Carnap, R.: 1967, *The Logical Construction of the World*, Routledge and Kegan Paul, London.
Cartwright, N.: 1983, *How the Laws of Physics Lie*, Clarendon Press, Oxford.
Cartwright, N.: 1989, *Nature's Capacities and their Measurement*, Clarendon Press, Oxford.
Cassirer, E.: 1922, *Das Erkenntnisproblem in der Philosophie und Wissenschaft der neueren Zeit*, Vols I and II (3rd ed.), B. Cassirer, Berlin.
Cassirer, E.: 1953, *Substance and Function and Einstein's Theory of Relativity*, Dover, New York.
Cassirer, E.: 1921, 'Goethe und die mathematische Physik. Eine erkenntnistheoretische Studie', in *Idee und Gestalt*, B. Cassirer, Berlin, 29–76.
Cassirer, E.: 1953–1959, *Philosophy of Symbolic Forms*, 3 vols, Yale University Press, New Haven & London.
Cassirer, E.: 1925, 'Die Philosophie der Griechen von den Anfängen bis Platon', in M. Dessoir (ed.), *Lehrbuch der Philosophie*, Vol. I, *Die Geschichte der Philosophie*, Ullstein, Berlin, 1–139.
Cassirer, E.: 1969, 'Mythic, Aesthetic and Theoretical Space' (1931), *Man and World* **2**, 3–17.
Cassirer, E.: 1956, *Determinism and Indeterminism in Modern Physics. Historical and Systematic Studies of the Problem of Causality*, Yale University Press, New Haven and London.
Cassirer, E.: 1961, *The Logic of the Humanities*, Yale University Press, New Haven and London.

Cassirer, E.: 1944, *An Essay on Man. An Introduction to a Philosophy of Human Culture*, Yale University Press, New Haven and London.
Chadwick, O.: 1975, *The Secularization of the European Mind in the Nineteenth Century*, Cambridge University Press, Cambridge.
Chalmers, A.: 1990, *Science and Its Fabrication*, Open University Press, Buckingham.
Chandrasekhar, S.:1987, *Truth and Beauty: Aesthetics and Motivations in Science*, University of Chicago Press, Chicago.
Clark, G.: 1992, *Space, Time and Man: A Prehistorian's View*, Cambridge University Press, Cambridge.
Collingwood, R. G.: 1938, *The Principles of Art*, Clarendon Press, Oxford.
Collingwood, R. G.: 1940, *An Essay on Metaphysics*, Clarendon Press, Oxford.
Cornford, F.: 1957, *From Religion to Philosophy. A Study in the Origins of Western Speculation*, Harper, New York.
Cornford, F.: 1952, *Principium Sapientiae*, Cambridge University Press, Cambridge.
Curtin, D. W.: 1980, *The Aesthetic Dimension of Science*, Philosophical Library, New York.
Curtain, D. W. (ed.):1982, *The Aesthetic Dimension of Science*, Philosophical Library, New York.
Curthoys, J. and Suchting, W.: 1977, 'Feyerabend's Discourse Against Method: A Marxist Critique', *Inquiry* **20**, 243–397.
Dahlhaus, C.: 1988, *Ludwig van Beethoven und seine Zeit* (2nd ed.), Laaber-Verlag, Laaber.
Damerow, P. and Lefèvre, W. (eds.): 1981, *Rechenstein, Experiment, Sprache*, Klett-Cotta, Stuttgart.
Dewey, J.: 1948, *Reconstruction in Philosophy* (2nd ed.), Boston:Beacon Press.
Dewey, J.: 1929, *The Quest for Certainty*, Minton, Balch, New York.
Dewey, J.: 1932, *Art as Experience*, G. Putnam, New York.
Dewey, J.: 1938, *Logic, the Theory of Inquiry*, Holt, Rinehart and Winston, New York.
Diamond, J.: 1991, *The Rise and Fall of the Third Chimpanzee*, Radius, London.
Dingler, H.: 1928, *Das Experiment. Sein Wesen und seine Geschichte*, Ernst Rinehardt, Munich.
Dingler, H.: 1938, *Die Methode der Physik*, Ernst Rinehardt, Munich.
Dingler, H.: 1969, *Die Ergreifung des Wirklichen Kapitel I–IV*, Suhrkamp, Frankfurt/M..
Doyal, L. and Harris, H.: 1986, *Empiricism, Explanation and Rationality. An Introduction to the Philosophy of the Social Sciences*, Routledge and Kegan Paul, London.
Duhem, P.: 1954, *The Aim and Structure of Physical Theory*, Princeton University Press, Princeton.
Dux, G.: 1976, *Strukturwandel der Legitimation*, Freiburg/Munich, Karl Alber.
Dux, G.: 1982, *Die Logik der Weltbilder. Sinnstrukturen im Wandel der Geschichte*, Suhrkamp, Frankfurt/M..
Dux, G.: 1989, *Die Zeit in der Geschichte. Ihre Entwicklungslogik vom Mythos zur Weltzeit*, Suhrkamp, Frankfurt/M..
Eddington, A. S.: 1939, *The Philosophy of Physical Science*, Cambridge University Press, Cambridge.
Edelman, G. M.: 1987, *Neural Darwinism. The Theory of Neuronal Group Selection*, Basic Books, New York.
Edgerton, S. Y., Jr: 1991, *The Heritage of Giotto's Geometry. Art and Science on the Eve of the Scientific Revolution*, Cornell University Press, Ithaca and London.
Ellenius, A. (ed.): 1985, *The Natural Sciences and the Arts: Aspects of Interaction from the Renaissance to the Twentieth Century*, Almqvist & Wiksell, Uppsala.
Ellis, B.: 1990, *Truth and Objectivity*, Blackwell, Oxford.
Else, G. F.: 1965, *The Origin and Early Form of Greek Tragedy*, Cambridge University Press, Cambridge.
Empson, W.: 1930, *Seven Types of Ambiguity*, Hogarth Press, London.
Feyerabend, P. K.: 1967, 'The Theatre as an Instrument for the Criticism of Ideologies: Notes on Ionesco', *Inquiry* **10**, 298–312.

Feyerabend, P. K.: 1975, *Against Method. Outline of an Anarchist Theory of Knowledge*, NLB, London.
Feyerabend, P. K.: 1978, *Science in a Free Society*, NLB, London.
Feyerabend, P. K.: 1981, *Philosophical Papers*, 2 vols, Cambridge University Press, Cambridge.
Feyerabend, P. K.: 1987, *Farewell to Reason*, Verso, London and New York.
Feynman, R. P.: 1992, *The Character of Physical Law*, Penguin.
Fleck, L.: 1979, *The Genesis and Development of a Scientific Fact* (1935), Chicago University Press, Chicago.
Frankfurt, H. *et al.*: 1949, *Before Philosophy. The Intellectual Adventure of Ancient Man*. Pelican.
Freud, S.: 1966 ff., *The Standard Edition of the Complete Psychological Works*, J. Strachey et al. (eds.), The Hogarth Press and the Institute of Psychoanalysis.
Freudenthal, G.: 1986, *Atom and Individual in the Age of Newton*, D. Reidel, Dordrecht.
Freudenthal, G.: 1988, 'Towards a Social History of Newtonian Mechanics. Boris Hessen and Henryk Grossmann Revisited', in I. Hronszky, M. Feher, B. Dajka (eds.), *Scientific Knowledge Socialized*, Kluwer Academic Publishers, Dordrecht, 193–211.
Frey, D.: 1929, *Gotik und Renaissance als Grundlagen der modernen Weltanschauung*, B. Filser, Augsburg.
Fritz, K. von: 1962, *Antike und Moderne Tragödie. Neun Abhandlungen*, W. de Gruyter, Berlin.
Gadamer, H.-G.: 1975, *Truth and Method* , Sheed and Ward, London.
Gadamer, H.-G.: 1986, *The Relevance of the Beautiful and Other Essays*, Cambridge University Press, Cambridge.
Galison, P. and Helvy, B. (eds.): 1992, *Big Science: The Growth of Large-Scale Research*, Stanford University Press, Stanford.
Gay, P.: 1966, 1969, *The Enlightenment: An Interpretation*, A. A. Knopf, New York.
Gehlen, A.: 1980, *Man in the Age of Technology*, Columbia University Press, New York.
Gehlen, A.: 1988, *Man. His Nature and Place in the World* (1972), Columbia University Press, New York.
Gombrich, E. K.: 1972, 'The Visual Image', *Scientific American* **227**(3), 82–96.
Gooding, D.: 1990, *Experiment and the Making of Meaning*, Kluwer Academic Publishers, Dordrecht/Boston/London.
Greiff, B. von: 1976, *Gesellschaftsform und Erkenntnisform. Zum Zusammenhang von wissenschaftlicher Erfahrung und gesellschaftlicher Entwicklung*, Campus Verlag, Frankfurt/M..
Groethuysen, B.: 1969, *Philosophische Anthropologie*, R. Oldenbourg, Munich.
Grove, J. W.: 1989, *In Defence of Science: Science, Technology, and Politics in Modern Society*, University of Toronto Press, Toronto.
Hacking, I.: 1983 , *Representing and Intervening. Introductory Topics in the Philosophy of Natural Science*, Cambridge University Press, Cambridge.
Hacking, I.: 1992, 'His Father The Engineer', *London Review of Books*, 28 May.
Hacking, I.: 1992a, 'Experimentation and Instrumentation in Natural Science', in W. H. Newton-Smith and Jiang Tianji (eds.), *Popper in China*, Routledge, London and New York, 21–36.
Hadjinicolaou, N.: 1978, *Art History and Class Struggle*, Pluto Press, London.
Hallyn, J.: 1990, *The Poetic Structure of the World: Copernicus and Kepler*, Zone Books, New York.
Hartmann, N.: 1951, *Teleologisches Denken*, W. de Gruyter, Berlin.
Hauser, A.: 1951, *The Social History of Art*, Routledge & Kegan Paul, London.
Hauser, A.: 1959, *The Philosophy of Art History*, Routledge & Kegan Paul, London.
Hauser, A.: 1965, *Mannerism. The Crisis of the Renaissance and the Origin of Modern Art*, Routledge & Kegan Paul, London.
Heidegger, M.: 1962, *Being and Time*, J. Macquarrie and E. Robinson (tr.), Blackwell, Oxford.

Heidegger, M.:1969, *What is a Thing*?, Henry Regnery, Chicago.
Heidegger, M.: 1977, *The Question Concerning Technology and Other Essays*, Harper, New York.
Heinimann, F.: 1945, *Nomos und Physis. Herkunft und Bedeutung einer Antithese im Griechischen Denken des 5. Jahrhunderts*, F. Reinhardt, Basel.
Heller, A.: 1978, *Das Alltagsleben. Versuch einer Erklärung der individuellen Reproduktion*, Suhrkamp, Frankfurt/M..
Hempel, C. G.: 1952, *Fundamentals of Concept Formation in Empirical Science* (*International Encyclopaedia of Unified Science*, **7**(2)), University of Chicago Press, Chicago.
Holton, G.: 1988, *Thematic Origins of Scientific Thought: Kepler to Einstein* (rev. ed.), Harvard University Press, Cambridge, Mass..
Holzkamp, K.: 1968, *Wissenschaft als Handlung*, W. de Gruyter, Berlin & New York.
Holzkamp, K.: 1986, *Sinnliche Erkenntnis. Historischer Ursprung und gesellschaftliche Ursprung der Wahrnehmung* (5th ed.), Athenaum, Frankfurt/M..
Hübner, K.: 1978, 'Mythische und wissenschaftliche Denkform', *Tijdschrift voor Filosofie* **40**, 637–658.
Hunter, M. and Wootton, D. (eds.): 1992, *Atheism from the Reformation to the Enlightenment*, Clarendon Press, Oxford.
Husserl, E.: 1970, *The Crisis of the European Sciences and Transcendental Phenomenology. An Introduction to Phenomenological Philosophy*, Northwestern University Press, Evanston, Ill.
Jameson, F.: 1981, *The Political Unconscious*, Cornell University Press, Ithaca.
Kemp, M.: 1984, 'Geometrical Perspective from Brunelleschi to Desargues: A Pictorial Means or an Intellectual End?' *Proceedings of the British Academy* **70**, 89–132.
Kosik, K.: 1976, *Dialectics of the Concrete. A Study on Problems of Man and World*, D. Reidel, Dordrecht/Boston.
Koyré, A.:1955, 'The Influence of Philosophic Trends on the Formulation of Scientific Theories', *Scientific Monthly*, February, 107–111.
Kitcher, P.: 1984, *The Nature of Mathematical Knowledge*, Oxford University Press, London & New York.
Kristeller, P. O.: 1951–1952, 'The Modern System of the Arts: A Study in the History of Aesthetics', (I) (II), *Journal of the History of Ideas* **12**, 496–527, **13**, 17–46.
Kuhn, T. S.: 1977, *The Essential Tension. Selected Studies in Scientific Tradition and Change*, University of Chicago Press, Chicago.
Laitko, H.: 1979, *Wissenschaft als allgemeine Arbeit. Zur begrifflicher Grundlegung der Wissenschaftswissenschaft*, Akademie-Verlag, Berlin.
Lakatos, I.: 1976, *Proofs and Refutations. The Logic of Mathematical Discovery*, Cambridge University Press, Cambridge.
Lakatos, I.: 1978, *Philosophical Papers*, 2 vols, J. Worrall and G. Currie (eds.), 8–101, Cambridge University Press, Cambridge.
Langer, S. K.: 1953, *Feeling and Form. A Theory of Art Developed from 'Philosophy in a New Key'*, Routledge and Kegan Paul, London.
Laymon, R.: 1985, 'Idealization and the Testing of Theories by Experimentation', in P. Achinstein and O. Hannaway (eds.), *Observation, Experiment, and Hypothesis in Modern Physical Science*, MIT Press, Cambridge, Mass., 147–173.
Lecourt, D.: 1975, *Marxism and Epistemology. Bachelard, Canguilhem, Foucault*, New Left Books, London.
Lecourt, D.: 1974, *Bachelard ou le jour et la nuit* (*Un essai du matérialisme dialectique*), Bernard Grasset, Paris.
Lefebvre, H.: 1947, *Critique de la vie quotidienne*, Grasset, Paris.
Lefèvre, W.: 1978, *Naturtheorie und Produktionsweise. Probleme einer materialistischen Wissenschaftsgeschichtsschreibung. Eine Studie zur Genese der neuzeitlichen Naturwissenschaft*, Luchterhand, Darmstadt & Neuwied.
Le Grand, H. E.: 1990, *Experimental Inquiries. Historical, Philosophical and Social Studies of Experimentation in Science*, Kluwer Academic Publishers, Dordrecht/Boston/London.

Lenoir, T.: 1988, 'Practice, Reason, Context in the Dialogue between Theory and Experiment', *Science in Context* **2**, 3–22.
Lenzen , V. F.: 1931, *The Nature of Physical Theory*, Wiley, New York.
Lenzen, V. F.: 1937–1938, 'Experience and Convention', *Erkenntnis* **7**, 257–267.
Lenzen, V. F.: 1938, *Procedures of Empirical Science* (*International Encyclopaedia of Unified Science* **1**(5)), University of Chicago Press, Chicago.
Lenzen, V. F.: 1939, 'Reason in Science', *University of California Publications in Philosophy*, **21**, 77–96.
Lewin, K.: 1927, *Gesetz und Experiment in der Psychologie*, Weltkreis-Verlag, Berlin/Schlachtensee.
Lewin, K.: 1935, 'The Conflict between Aristotelian and Galilean Modes of Thought in Contemporary Psychology', in K. Lewin, *A Dynamic Theory of Personality*, McGraw-Hill, New York, 1–42.
Ley, H.: 1966–1971, *Geschichte der Aufklärung und des Atheismus*, VEB Deutscher Verlag der Wissenschaften, Berlin.
Lindsay, J.: 1974, *Blast Power and Ballistics. Concepts of Force and Energy in the Ancient World*, Frederick Muller, London.
Lukács, G.: 1963, *Aesthetik*, Teil I, 1. Halbband, Luchterhand, Neuwied/Berlin.
Lukács, G.: 1981, *Entwicklungsgeschichte des modernen Dramas*, Luchterhand, Darmstadt/Neuwied.
MacIntyre, A.: 1967, *A Short History of Ethics*, Routledge and Kegan Paul, London.
MacIntyre, A.: 1981, *After Virtue. A Study in Moral Theory*, Duckworth, London.
McMullin, E.: 1985, 'Galilean Idealization', *Studies in History and Philosophy of Science* **1**, 247–275.
McNeill, D.:1992, *Hand and Mind. What Gestures Reveal About Thought*, University of Chicago Press, Chicago.
Macherey, P.: 1978, *A Theory of Literary Production*, Routledge and Kegan Paul, London.
Marcuse, H.: 1978, *The Aesthetic Dimension. Towards a Critique of Marxist Aesthetics*, Beacon Press, Boston.
Marx, K. and Engels, F.: 1976, *The German Ideology*, Vol. 5 in Marx/Engels, *Collected Works*, Lawrence and Wishart, London.
Midgley, M.: 1992, *Science as Salvation. A Modern Myth and Its Meaning*, Routledge, London.
Miller, R. W.: 1987, *Fact and Method. Explanation, Confirmation and Reality in the Natural and the Social Sciences*, Princeton University Press, Princeton.
Mittelstrass, J.: 1962, *Die Rettung der Phänomene. Ursprung und Geschichte eines antiken Forschungsprinzips*, W. de Gruyter, Berlin and New York.
Mittelstrass, J.: 1970, *Neuzeit und Aufklärung. Studien zur Entstehung der neuzeitlichen Wissenschaft und Philosophie*, W. de Gruyter, Berlin & New York.
Mittelstrass, J.: 1972, 'The Galilean Revolution. The Historical Fate of a Methodological Insight', *Studies in History and Philosophy of Science* **2**, 297–328.
Morson, G. S. and Emerson, C.: 1990, *Mikhail Bakhtin. Creation of a Prosaics*, Stanford University Press, Stanford.
Moscovici, S.: 1977, *Essai sur l' histoire humaine de la nature* (2nd ed.), Flammarion, Paris.
Nestle, W.: 1941, *Vom Mythos zum Logos*, A. Kroner, Stuttgart.
Nicolson, M.: 1956, *Science and Imagination*, Cornell University Press, Ithaca, New York.
Nowak, L.:1980, *The Structure of Idealization*, D. Reidel, Dordrecht.
Pap, A.: 1946, *The A Priori in Physical Theory*, King's Crown Press, New York.
Parry, M.: 1971, *The Making of Homeric Verse: The Collected Papers of Milman Parry*, Clarendon Press, Oxford.
Passmore, J. A.: 1978, *Science and Its Critics*, Duckworth, London.
Pearson, R. E.: 1992, *Eloquent Gestures. The Transformation of Performance Style in the Griffith Biograph Films*, University of California Press, Los Angeles.
Peirce, C. S.: 1940, *Philosophical Writings*, J. Buchler (ed.), Routledge & Kegan Paul, London.

Penrose, R.: 1991, Review of Vol. 1 of *The Scientific Papers and Letters of James Clerk Maxwell*, *London Review of Books*, 26 September.
Perez Sanchez, A. E. and Sayre, E. A. (eds.): 1989, *Goya and the Spirit of Enlightenment*, Little Brown, Boston.
Pickering, A. (ed.): 1992, *Science as Practice and Culture*, University of Chicago Press, Chicago.
Pitt, J. C.: 1992, *Galileo, Human Knowledge, and the Book of Nature. Method Replaces Metaphysics*, Kluwer, Dordrecht/Boston.
Pohlenz, M.: 1953, 'Nomos und Physis', *Hermes* **81**, 418–438.
Poincaré, H.: 1968, *The Value of Science*, Dover, New York.
Popper, K. R.:1972, *The Logic of Scientific Discovery* (3rd ed.), Hutchinson, London.
Popper, K. R.: 1966, *The Open Society and its Enemies*, Vol. I *The Spell of Plato* (5th ed.), Routledge, London.
Popper, K. R.: 1963, *Conjectures and Refutations*, Routledge and Kegan Paul, London.
Popper, K. R.: 1982, *Quantum Theory and the Schism in Physics*, Hutchinson, London.
Popper, K. R.: 1982a, *The Open Universe. An Argument for Indeterminism*, Hutchinson, London.
Putnam, H.: 1990, *Realism With a Human Face*, Harvard University Press, Cambridge, Mass..
Ramsey, F. P.: 1931, 'General Propositions and Causality' in *The Foundations of Mathematics and Other Essays*, Routledge and Kegan Paul, London.
Raphael, M.: 1989, *Von Monet zu Picasso. Grundzüge einer Aesthetik und Entwicklung der modernen Malerei* (2nd ed.), Suhrkamp, Frankfurt/M..
Raphael, M.: 1921, *Idee und Gestalt. Ein Führer zum Wesen der Kunst*, Delphin-Verlag, Munich.
Raphael, M.: 1968, *The Demands of Art*, Princeton University Press, Princeton.
Raphael, M.: 1945, *Prehistoric Cave Paintings*, Pantheon Books, New York.
Raphael, M.: 1974, *Theorie des geistigen Schaffens auf marxistischer Grundlage*, S. Fischer, Frankfurt/M.
Raphael, M.: 1975, *Arbeiter, Kunst und Künstler. Beiträge zu einer marxistischen Kunstwissenschaft*, S. Fischer, Frankfurt/M..
Ravetz, J. R.: 1971, *Scientific Knowledge and Its Social Problems*, Clarendon Press, Oxford.
Reich, W.: 1973, *Character Analysis*, Vision Press, New York.
Reich, W.: 1972, *Sex-Pol. Essays 1929–1934*, L. Baxandall (ed.),Vintage Books, New York.
Rorty, R.: 1979, *Philosophy and the Mirror of Nature*, Princeton University Press, Princeton.
Rorty, R.: 1989, *Contingency, Irony, and Solidarity*, Cambridge University Press, Cambridge.
Rose, P. W.: 1992, *Sons of the Gods, Children of Earth. Ideology and Literary Form in Ancient Greece*, Cornell University Press, Ithaca and London.
Rose, S.:1992, Review of Schwartz (1992), Midgley (1992), Wolpert (1992), *Times Literary Supplement*, December 4.
Ruby, J. E.: 1986, 'The Origins of Scientific "Law" ', *Journal of the History of Ideas* **47**, 341–359.
Russell, B.: 1916, *Introduction to Mathematical Philosophy*, Allen & Unwin, London.
Russell, B.: 1948, *Human Knowledge. Its Scope and Limits*, Allen & Unwin, London.
Ryle, G.: 1949, *The Concept of Mind*, Hutchinson, London.
Ryle, G.: 1950, ' "If", "So" and "Because" ', in M. Black (ed.), *Essays in Philosophical Analysis*, Cornell University Press, Itahaca.
Ryle, G.: 1954, *Dilemmas*, Cambridge University Press, Cambridge.
Schiller, F.: 1967, *On the Aesthetic Education of Man* (Tr. E. M. Wilkinson and L. A. Willoughby), Clarendon Press, Oxford.
Scriven, M.: 1959, 'Truisms as the Grounds for Historical Explanations', in P. Gardiner (ed.), *Theories of History*, Free Press, New York, 443–475.
Shirley, J. and Hoeniger, D. (eds.): 1985, *Science and the Arts in the Renaissance*, Folger Books, Washington, D. C..

Schleiermacher, F.: 1958 *On Religion. Speeches to Its Cultured Despisers*, Harper, New York.
Schlick, M.: 1974, *General Theory of Knowledge*, Springer, Vienna.
Schlick, M.: 1979, *Philosophical Papers*, 2 vols, D. Reidel, Dordrecht/Boston.
Schlick, M.: 1987, *The Problems of Philosophy in Their Interconnection*, D. Reidel, Dordrecht/Boston.
Schwartz, J.: 1992, *The Creative Moment. How Science Made Itself Alien to Modern Culture*, Jonathan Cape, London.
Simmel, G.: 1985, *Rembrandt. Eine kunstphilosophischer Versuch* (1916), Matthes & Seitz, Munich.
Smart, J. J. C.: 1989, *Our Place in the Universe. A Metaphysical Discussion*, Blackwell, Oxford.
Solomon, M.: 1988, *Beethoven Essays*, Harvard University Press, Cambridge, Mass..
Sorell, T.: 1991, *Scientism: Philosophy and the Infatuation with Science*, London, Routledge.
Spengler, O.: 1926–1928, *The Decline of the West*, 2 vols, Knopf, New York.
Spengler, O.: 1932, *Man and Technics. A Contribution to a Philosophy of Life*, Allen and Unwin, London.
Sprinker, M.: 1987, *Imaginary Relations. Aesthetics and Ideology in the Theory of Historical Materialism*, Verso, London.
Stachel, J.:1974, 'A Note on the Concept of Scientific Practice', R. S. Cohen *et al.* (eds.), *Boston Studies in the Philosophy of Science*, **15**, Reidel, Dordrecht, pp. 417–433.
Stebbing, L. S.:1937, *Philosophy and the Physicists*, Methuen, London.
Steiner, G.: 1992, *After Babel. Aspects of Language and Translation* (2nd ed.), Oxford University Press, Oxford.
Stone, I. F.: 1988, *The Trial of Socrates*, Little Brown, Boston.
Stove, D.:1991, *The Cult of Plato and Other Philosophical Follies*, Blackwell, Oxford.
Strong, E. W.: 1936, *Procedures and Metaphysics. A Study in the Philosophy of Mathematical-Physical Science in the Sixteenth and Seventeenth Centuries*, University of California Press, Berkeley.
Suchting, W.: 1975, 'Marx on the Dialectics of Production and Consumption in the Introduction to the *Grundrisse*', *Social Praxis* 3, 291–313.
Suchting, W.: 1983, *Marx. An Introduction*, Wheatsheaf Books, Brighton.
Suchting, W.: 1986, *Marx and Philosophy. Three Studies*, Macmillan, London.
Suchting, W.: 1991, 'On Some Unsettled Questions Touching the Character of Marxism, especially as Philosophy', *Graduate Faculty Philosophy Journal*, New School for Social Research, **14**(1), 139–207.
Suchting, W.: 1992, 'Reflections on Roy Bhaskar's "Critical Realism" ', *Radical Philosophy* **61**.
Taylor, C.: 1989, *Sources of the Self. The Making of the Modern Identity*, Cambridge University Press, Cambridge.
Tetens, H.: 1987, *Experimentelle Erfahrung. Eine wissenschaftstheoretische Studie über die Rolle des Experiments in der Begriffs- und Theorie-Bildung der Physik*, F. Meiner, Hamburg.
Theiler, W.: 1965, *Zur Geschichte der teleologischer Naturbetrachtung bis auf Aristoteles* (2nd ed.), W. de Gruyter, Berlin and New York.
Thomson, G.: 1946, *Aeschylus and Athens. A Study in the Social Origins of Drama* (2nd ed.), Lawrence and Wishart, London.
Thomson, G.:1955, *The First Philosophers*, Lawrence and Wishart, London.
Tiles, M.: 1984, *Bachelard: Science and Objectivity*, Cambridge University Press, Cambridge.
Toulmin, S. E.: 1953, *Philosophy of Science. An Introduction*, Hutchinson, London.
Toulmin, S. E.: 1958, *The Uses of Argument*, Cambridge University Press, Cambridge.
Toulmin, S. E.: 1959, 'Criticism in the History of Science: Newton on Absolute Space, Time, and Motion', *Philosophical Review* **68**, 1–29, 203–227.
Toulmin, S. E.: 1961, *Foresight and Understanding. An Enquiry into the Aims of Science*, Indiana University Press, Bloomington, Indiana.

Toulmin, S. E.: 1972, *Human Understanding*, Clarendon Press, Oxford.
Vološinov, V. N.: 1973, *Marxism and the Philosophy of Language*, Seminar Press, New York & London.
Vološinov, V. N.: 1987, *Freudianism. A Critical Sketch*, Indiana University Press, Bloomington and Indianapolis.
Vygotsky, L. S.: 1962, *Thought and Language*, MIT Press, Cambridge, Mass..
Vygotsky, L. S.: *The Psychology of Art*, MIT Press, Cambridge, Mass..
Wagner, R.: 1893, *Opera and Drama*, Vol. II of *Prose Works* (tr. W. A. Ellis), Routledge and Kegan Paul, London.
Watson, W. H.: 1938, *On Understanding Physics*, Cambridge University Press, Cambridge.
Weber, M.: 1947, *The Theory of Social and Economic Organization*, The Free Press, New York.
White, L., Jr.: 1946, 'Natural Science and Naturalistic Art in the Middle Ages', *American Historical Review* **52**, 421–435.
Wieland, W.: 1970, *Die Aristotelische Physik* (2nd ed.), Vandenhoeck & Ruprecht, Gottingen.
Will, F. L.: 1988, *Beyond Deductivism. Ampliative Aspects of Philosophical Reflection*, Routledge, London.
Williams, R.: 1983, *Keywords. A Vocabulary of Culture and Society*, Fontana, London.
Winspear, A. D.: 1974, *The Genesis of Plato's Thought* (3rd ed.), Harvest House, Montreal.
Wittgenstein, L.: 1953, *Philosophical Investigations*, Blackwell, Oxford.
Wittgenstein, L.: 1967, *Zettel*, Blackwell, Oxford.
Wittgenstein, L.: 1969, *On Certainty*, Blackwell, Oxford.
Wittgenstein, L.: 1974, *Philosophical Grammar*, Blackwell, Oxford.
Wittgenstein, L.: 1977, *Vermischte Bemerkungen*, Suhrkamp, Frankfurt/M..
Wittgenstein, L.: 1978, *Remarks on the Foundations of Mathematics* G. H. von Wright, R. Rhees, G. E. M. Anscombe (eds.) (2nd ed.), Blackwell, Oxford.
Wittgenstein, L.: 1986, *Conversations 1945–1951* (with O. K. Bouwsma), Hackett Publ. Co., Indianapolis.
Wolpert, L.:1992, *The Unnatural Nature of Science*, Faber, London.
Wood, E. M. and N.: 1978, *Class Ideology and Ancient Political Theory*, Blackwell, Oxford.
Zilsel, E.: 1942, 'The Genesis of the Concept of Physical Law', *Philosophical Review* **51**, 245–279.
Zilsel, E.: 1942a, 'The Sociological Roots of Science' *American Journal of Sociology* **47**, 544–562.
Zilsel, E.: 1976, *Die sozialen Ursprünge der neuzeitlichen Wissenschaft*, Suhrkamp, Frankfurt/M..
Ziman, J.: 1978, *Reliable Knowledge. An Exploration of the Grounds for Belief in Science*, Cambridge University Press, Cambridge.