CAN SOCIAL CONSTRUCTIVISM BE RECONCILED WITH SCIENTIFIC REALISM?[1]

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I. INTRODUCTION

Some of my best friends are scientific realists. Some of my best friends are social constructivists. The two groups appear to be mutually exclusive. No scientific realist of my acquaintance is a social constructivist. No social constructivist is a scientific realist.[2] I would like to be both. Is this possible?

As I understand the matter, a *scientific realist* is someone who holds

(a) that at least some scientific theories are true and known to be true in an absolute sense which precludes the possibility that they will be falsified by future scientific research, and

(b) that if a scientific theory is true, the entities whose existence is postulated by the theory must actually exist at such times and places as are determined by observation when those observations are interpreted in the light of the theory.

Likewise, the social constructivist is someone who holds

(a) that scientific knowledge consists in a body of texts created and validated as true by the part collaborative, part competitive activity of a scientific community,

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1 Paper presented to the Course on the Philosophy of Science at the Inter-university Centre, Dubrovnik, Yugoslavia, April 11th 1990.

2 In the discussion following the presentation of this paper at Dubrovnik, Brian Baigrie cited Nancy Cartwright (1983) and Ian Hacking (1983) as instances of philosophers who have attempted to combine these two positions. As I understand them, the position that Cartwright and Hacking are defending is a version of of scientific realism which asserts the existence of the theoretical entities of science, while denying the truth of the scientific theories within which the existence of such entities is postulated. The only sense I can make of this view is to suppose that what they are claiming is that not all the propositions comprising a given theory are true and, hence, that the theory *as a whole* cannot be so described. They must, however, concede that at least *some* of the propositions comprising the theory are true and known to be true. For to claim that the theoretical entities of science exist and yet to deny that the propositions which assert their existence are true is a straightforward self-contradiction. While this position undoubtedly commits Cartwright and Hacking to the view that scientific theories and laws of nature are social constructions rather than features of the universe, these authors do not appear to address the problem of how to resolve the apparent contradiction between this social constructivist view of scientific theories and their claim to endorse scientific realism with respect to theoretical entities.

(b) that what is held by a scientific community to be true and known to be true and hence what entities are held to exist is subject to continuous revision and change over time as new hypotheses are rejected or accepted and as one scientific revolution succeeds another.[3]

If scientific realism and social constructivism are formulated in this way, it is apparent that the bone of contention between them is the issue as to whether or not *any* of the propositions of scientific theory are true and can be known to be true in a sense which precludes their subsequent modification and/or rejection in the light of subsequent research. The scientific realist, it would seem, is committed to an affirmative answer to that question. For, unless the relevant scientific theories are true and are known to be true without qualification, the claim that the entities postulated by those theories actually exist falls to the ground. Similarly, it would seem, the social constructivist is equally firmly committed to a negative answer to the same question on the grounds that there are no scientific theories and hence no existential propositions which presuppose those theories of which we can predict with certainty that they will not be displaced by future changes of theoretical perspective. It seems we have a straightforward contradiction between two totally irreconcilable positions.

II. FIVE PRINCIPLES OF ONTOLOGY

I shall argue, however, that the position is not as desperate as it seems at first sight. In order to see why this is, we need to remind ourselves about certain basic logical features of existential claims, their truth conditions and their epistemology.

As I see the matter, there are five principles of ontology, principles, that is, governing the meaning of the verb *to exist* and the way the truth of statements containing that verb and its equivalents is established. These principles are implicit in a philosophical tradition extending from what I take to be Plato's earliest

3 In the discussion after the presentation of the paper at Dubrovnik, it was argued by Barbara Tuchanska that this way of stating the social constructivist position stacks the cards in favour of a reconciliation with scientific realism. My reply was and is that, given that one's object is to achieve a reconciliation between the two, it may well be that one must either water down one's scientific realism in order to accommodate a strong version of social constructivism or water down one's social constructivism in order to accommodate a strong version of scientific realism. Faced with that alternative, my inclination would undoubtedly be to choose the latter rather than the former; and, if that be a sin, I plead guilty.

discussion of the problem of universals in the *Phaedo* down to contemporary predicate logic. They are as follows:

(1) All existential claims are particular, i.e., what is asserted is the existence of one or more individuals or an amount of some stuff; this is expressed in predicate logic by the fact that only the singular quantifier ($\exists x$) has existential import;[4]

(2) the number of individuals or the amount of stuff that actually exists in a case where an existential proposition is true, though often unspecified and unknown, is always determinate and, in the case of spatio-temporal existents, finite;

(3) to assert the existence of something is always to assert the existence of something of a particular kind, something that falls under the scope of some universal, concept or predicate; this is expressed in predicate logic by the fact that by itself the existential quantifier ($\exists x$) says nothing; something is said only when we add either (Fx) where F is a predicate or ($x = a$) where a is a proper name grasp of whose reference arguably requires knowledge on the part of both speaker and listener of the kind of thing the referent is;[5]

(4) in a case where something exists as a matter of contingent fact rather than as a necessary truth (as in the case of numbers), it either is or depends for its existence on the prior existence of one or more concrete particulars or "substances", where a concrete particular or substance is a bounded physical body located and extended in three dimensions of space and one of time;

(5) where the existence of something is a matter of contingent fact rather than necessary truth, the question as to whether or not it exists cannot be decided without, at some stage, taking the results of observation into account; since without observation there is no way of determining the spatio-temporal location and extension of the concrete particular or particulars involved.

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4 John Worrall (personal communication) has objected, if I understand him correctly, that logic in general and predicate logic in particular is "ontologically neutral" and should not be used in support of one ontology rather than another. While appreciating that two wrongs do not make a right, I would plead in my own defence that if Quine can use the principle that "to be is be the value of a variable" in support of his logicist ontology, I can't see why I should not invoke other features of predicate logic in support of the conceptualist alternative.

5 See previous note.

III. TWO INTERPRETATIVE ASSUMPTIONS

What are the implications of these principles for the issue between the scientific realists and the social constructivists? In attempting to answer that question I shall make two assumptions, one of which I shall take for granted in what follows, and another which I shall have subsequent occasion to challenge. The assumption I shall take for granted is that the theoretical entities whose existence the scientific realist asserts and the social constructivist is inclined to call into question are entities whose existence or non-existence is a matter of contingent fact (rather than a necessary truth, as in the case of the existence of numbers). I shall also take for granted that it follows from this that determining the existence or non-existence of such entities is either a matter of, or indirectly involves, determining the occupation of one or more particular volumes of space over time by a concrete particular or substance of a particular kind. The assumption which I shall make provisionally, but will subsequently have occasion to question, is the assumption that the social constructivist is not questioning our claim to know the existence of the more obvious features of our physical environment: the sun, the moon, the earth, the land, the sea, mountains, valleys, plains, rivers, clouds, rain, plants, animals of a variety of species including our own, and a whole range of human artefacts from stone tools to computers.

IV. SCIENTIFIC REALISM AS AN EXTENSION OF NAIVE REALISM

Now it is my contention that if the social constructivist concedes *that*, in other words if he or she concedes that we have incontrovertible observational evidence for the contingent spatio-temporal existence of these more obvious feature of the common environment we all appear to inhabit, then he or she has no rational justification for refusing to accept the claims of scientific realism. For if we accept the existence of our own and other people's bodies which we can see and feel and of the sun and moon which those of us blessed with the power of sight can all see with the naked eye, why should we not accept that the universe also contains things like the cells of which our bodies are composed and galaxies beyond our own galaxy which can only be observed with the assistance of microscopes in the one case and telescopes in the other? But if *that* is granted, why should we refuse to concede the existence of invisible entities such as electrons or a black hole in the centre of a galaxy? After all, we have a well grounded theory in which postulating the

existence of such entities not only explains phenomena like the image on the television screen in the one case and the grouping of stars around the galactic centre in the other case, but precisely why such entities should be invisible, not only in fact, but in principle.

V. SOCIAL CONSTRUCTIVISM AND RADICAL CONCEPTUALISM

I conclude, therefore, that if social constructivists want to claim, as they clearly do, that the existence of the theoretical entities of science is a matter of social decision and agreement, they will need to establish that the same is true of the entities whose existence, as we ordinarily suppose, is a matter of common observation. In other words, in order to establish the position the social constructivist needs to be able to establish that the principle whereby observations are theory-laden is as true of common observation as it arguably is of scientific observation. Nor is that by any means an idiosyncratic position to adopt. We have already seen that to assert the existence of something makes no sense unless we specify what kind of a thing it is whose existence is asserted. In order to made an existential claim we have to subsume a particular under some, universal, concept or predicate.

Now there is a long line of philosophers from Plato down to Quine who have held that the universe is divided intrinsically and independently of human conception into classes or kinds. But there is an equally ancient doctrine which Plato discusses and argues against in the *Parmenides* which holds that universals are the product of the mind and, in the case of those universals which are embodied in language, are the product of decision and agreement by and within the social group constituted by the speakers and interpreters of a particular natural language or code. This theory, the theory that universals are constructed, either by the individual mind or by tacit agreement amongst members of a social group, is generally known as "conceptualism". If conceptualism in this sense is true and if it is also true, as has been suggested, (principle 3 above), that you cannot assert the existence of something without subsuming that something under some universal, concept or predicate, it follows that tacit social agreement as to how the entity in question should be classified and described is a necessary pre-condition for any claim that such a thing exists.

It is my belief that social constructivism can be made plausible if and only if

(a) it is interpreted as an application to the theoretical entities of science of a more general principle, the doctrine of conceptualism which holds that universals are mind-made, and

(b) conceptualism is true.

But if that is correct, the question with which we began, namely `Is social constructivism compatible with scientific realism?' now becomes the question `Is *conceptualism* compatible with scientific realism?'

VI. CONCEPTUALISM AND SCIENTIFIC REALISM I: KANTIAN IDEALISM

In order to deal with *that* question we need to recognize that conceptualism, the doctrine that the mind imposes its own self-generated classification on the particulars of which reality consists, comes in two varieties one of which is incompatible with scientific or any other form of realism and another which is, or at least purports to be, compatible with both. We may call these two varieties of conceptualism: the Kantian variety and the Aristotelian[6] variety. Although the term `conceptualism' is more often used in referring to the Aristotelian variety of the doctrine, it is the Kantian variety which is, on the whole, more familiar to philosophers. Kant's conceptualism manifests itself partly in the fact, that, in speaking of universals, he invariably uses terms like `concept', `intuition' and `category' all of which serve to emphasize their mind-dependent nature. But it manifests itself above all in his doctrine of `transcendental idealism'. According to this doctrine concepts are of two kinds, *a posteriori* concepts, and *a priori* concepts. *A posteriori* concepts are acquired by a process of learning from experience. Though Kant does not explicitly say so, we can assume that *a posteriori* concepts are learned by some process of abstraction from the experience of instances of the kind in question. But since, according to Kant, "experience without concepts is blind", any such process of abstraction from experience presupposes some initial interpretation of the relevant experiences in terms of concepts that are *a priori*. For Kant it is these *a priori* concepts or "*a priori* intuitions", as he call Space and Time, which are of interest. These *a priori* concepts and intuitions are not and could not be learned. For, according to Kant, we cannot begin to form an *a posteriori* concept like 'human being'

6 There is some disagreement among scholars as to whether Aristotle was in fact a conceptualist. The view that he was is supported by Lloyd (1981) and Frede and Patzig (1988). The more traditional view that Aristotle held that universals exist *in re* independently of human conception is supported by Fine (1980) and Tweedale (1987). What is not in doubt is that, whatever his view of universals, Aristotle was most concerned to ensure that his view was consistent with realism in respect of the particulars of which physical reality is composed.

or 'motor car' without first having interpreted the visual and other sensory experiences which such objects present in terms of the more basic concept of a three dimensionally extended body at some distance from the observer's body in external space. Now it may be that part of the concept of a three dimensionally extended body at a distance from the observer's body is learned *a posteriori*. But what cannot be learned, according to Kant, is the fundamental intuition of a spatially extended array. That has to be *a priori*.

In saying that certain concepts and intuitions are *a priori*, Kant does not want to concede that human beings have an innate grasp of such concepts. The reason for this is that to inquire into the origins of the *a priori* is to go beyond the limitations of the human intellect. Kant takes it as axiomatic that nothing can be intelligibly said which does not already presuppose this system of *a priori* concepts and intuitions. It is a system, moreover, that cannot be challenged. There is no way that a proposition which expresses an *a priori* concept or intuition, such as the principle that every event has a cause, can fail to be true. Nevertheless these *a priori* concepts are not supplied by some agency external to the mind. They are fundamental conceptual dispositions which the mind brings to all its experiences and which enter into all the interpretations it makes of those experiences. Consequently, according to Kant, there is no way that we can get behind this *a priori* conceptual apparatus and acquire knowledge of things as they are in themselves (Kant's *noumena*) uncontaminated by our conceptual scheme.

Thus we see that the Kantian version of conceptualism ends up in a form of idealism in which the physical and, for that matter, social environment is a product of an *a priori* conceptual scheme whose truth and adequacy we can never challenge, but which, since it originates from the mind rather than from things as they are in themselves, can never provide us with the ultimate assurance that things really *are* as they seem. But, although transcendental idealism is plainly incompatible with any kind of strong version of scientific realism, it does not provide much comfort for social constructivism either. True it accepts that the physical and social environment are in the last analysis constructions of the mind. But the mind is the mind of an isolated individual subject, not the shared conceptual scheme of a social group, as the social constructivist requires.

VII.CONCEPTUALISM AND SCIENTIFIC REALISM II: ARISTOTELIAN REALISM

This brings me to my exposition of the other Aristotelian variety of conceptualism which, as I see it, offers the possibility of reconciling social constructivism and scientific realism. This variety of conceptualism differs from the Kantian variety in that it does not insist on the *a priori* character of our basic conceptual scheme. Nor does it insist, as Kant does, that no new concept can arise out of experience that is not already conceptualized. Some philosophers in this tradition, such as Locke, insist that "there are no innate ideas", all our concepts are derived, in the first instance, by a process of learning from previously unconceptualized experience. Contemporary Aristotelian conceptualists can afford, I believe, to be more relaxed about this issue. If one looks at the matter from an evolutionary perspective, it seems eminently reasonable to suppose that complex living organisms, such as birds and mammals, not to mention human beings, should have acquired in the course of evolution an innate propensity to form concepts corresponding to the most general characteristics and, in some cases, the more specific features of the objects they are liable to encounter in the environment for survival in which they are adapted by their genetic constitution. Nevertheless, it remains the case that the focus of attention in this variety of conceptualism is on the process of learning, generally referred to as "abstraction", whereby the mind acquires an abstract idea or concept of a kind of thing from repeated exposure to the experience of encountering positive and negative instances of the kind in question.

VIII. DEFECTS IN TRADITIONAL ACCOUNTS OF ABSTRACTION I: ABSTRACT IDEAS AS MENTAL PICTURES

The doctrine of abstractionism, the thesis that the mind abstracts concepts from experiences of unconceptualized resemblances between particulars, is fundamental to the realist version of conceptualism which I am attributing to Aristotle. It is a doctrine, however, which has received short shrift from philosophers ever since Locke's version of it (*The Essay Concerning the Human Understanding*, 1690/1961, Book II, Chapter XI, Section 9) was savaged by Berkeley in the Introduction to *The Principles of Human Knowledge* (1710/1949). To my knowledge, the doctrine was not discussed specifically by Kant; though, as we have seen, it is not difficult to reconstruct what his attitude to it would have been. For if experience without concepts is blind, how could concepts be abstracted from unconceptualized experiences? More recently, versions of the doctrine propounded by the philosopher H.H.Price (1953)

and the psychologist George Humphrey (1951) have been criticized by Peter Geach in *Mental Acts* (1957, Chapters 6-11). It is my belief that all these criticisms of the doctrine are based on misconceptions about the nature of the process of abstraction which appear in the descriptions of it which are given in the philosophical literature. These accounts of which that given by Locke is the best known and most representative are defective in three respects. The first defect of the standard philosophical accounts of abstraction is that they tend to treat an abstract idea or concept as a mental picture of the kind of thing in question. This lays such accounts open to Berkeley's retort

> "If any man has the faculty of framing in his mind such an idea of a triangle as is here described, it is vain to pretend to dispute him out of it, nor would I go about it. All I desire is that the reader would fully and certainly inform himself whether he has such an idea or no. And this methinks can be no hard task for anyone to perform. What more easy than for anyone to look a little into his own thought, and there try whether he has, or can attain to have, an idea that is here given of a general idea of a triangle - which is neither oblique nor rectangle [i.e., right angled], equilateral, equicrural, nor scalenon, but all and none of these at once." (Berkeley 1710/1949 Introduction, Section 15)

This form of objection is circumvented, as soon as we begin to think of an abstract idea or concept, not as a palpable introspectible image, but as a recognitional capacity, the ability, to use Berkeley's example, to recognize instances of the universal ‘triangle’ regardless of whether the particular triangle with which we are confronted is oblique, rectangle, equilateral, equicrural, scalenon or whatever.

IX. DEFECTS OF TRADITIONAL ACCOUNTS OF ABSTRACTION II: PICKING OUT COMMON FEATURES

This brings me to the second respect in which standard accounts of abstraction are defective. For, if having a concept consists in the capacity to recognize instances of a kind as instances of that kind, it cannot in general be the case, as standard accounts of abstraction imply, that we acquire the ability to recognize instances of a kind, by picking out or noticing some feature or set of features which the instances in question have in common, if "picking out" and "noticing" here are simply synonyms for "recognizing". It is no doubt

the case that there *are* concepts which we acquire in this way. The concept 'triangle' is perhaps a case in point. It could be that we learn to recognize triangles by first learning to recognize angles and then learning to recognize triangles by counting the number of angles which a figure possesses and accepting the figure as a triangle if and only if the number of angles is three. But if this is how we proceed in the case of a concept like 'triangle', it cannot be how we proceed in the case of all concepts. For it is evident that we can only learn to recognize triangles in this way if we already possess

(a) the concept of an angle and

(b) the ability to count, and hence, in some sense, the concept of number.

It follows that if, as the Aristotelian conceptualist maintains, all our concepts are, or could in principle be, acquired by the process of abstraction from experiential encounters with instances, abstraction cannot be a process which requires that the abstracter already possesses the ability to recognize the feature or features which instances of the kind in question have in common. But if abstraction is a process whereby the individual learns to recognize instances of a kind on the basis of experiential encounters with instances of a kind *without* any pre-existing ability to recognize the feature or features which those instances have in common, there are two conditions which must be satisfied:

(1) there must be something which consistently distinguishes experiences of instances of the kind in question from experiences of instances of other kinds;

(2) there must be some way the abstracter can tell when he or she is encountering an instance of the kind in question and when not.

X. DEFECTS OF TRADITIONAL ACCOUNTS OF ABSTRACTION III: NEGLECT OF NEGATIVE INSTANCES

This points up the third defect of standard philosophical accounts of abstraction. These accounts tend to assume that simply pointing at instances of the kind in question suffices to enable the pupil to abstract the relevant concept. In fact, in order to acquire a new concept in this way, it is essential that the pupil be exposed to a variety of instances which differ from one another in all respects other than those which are distinctive

of the kind in question, and to a contrasting set of negative instances which resemble the positive instances in all respects apart from their *lack* of those features which are distinctive of the kind in question.

XI. ABSTRACTION AS PATTERN DISCRIMINATION LEARNING

The process of abstracting a concept, in the sense of a recognitional capacity, from the experience of encountering a variety of positive and otherwise similar negative instances of the kind in question, under conditions where feedback is supplied as to when the response is correct and when incorrect, is one which will be familiar to those who remember the kind of psychology which was practiced before psychology lapsed into the obscurantism of the so-called "cognitive revolution." It is the process of discrimination learning described by Lashley (1930) on the basis of the results obtained from studies of the behavior of the rat using the so-called "Lashley jumping stand" (Figure 1). In this situation the rat is compelled by a blast of air from behind to jump towards one or other of two cards, which are distinguished by the two shapes drawn on the two cards by the experimenter. One of these shapes is selected by the experimenter as that towards which the rat must jump in order to secure food and avoid the aversive consequence of making the incorrect choice, that of bumping its nose against a card which is locked in place and falling into the net below. Contrary to Locke's dictum that "brutes abstract not" (Locke 1690/1961, Book II, Chapter XI, Section 10) a rat can rapidly learn under these conditions to recognize new instances of the same kind of shape and to that extent "abstract" the concept, say of a triangular shape, from the variety of positive and negative instances presented to it. What may be regarded as a stage in the development of just such a concept is illustrated by Figure 2 taken from an experiment with rats as subjects published by Lashley (1938). Here the rats were

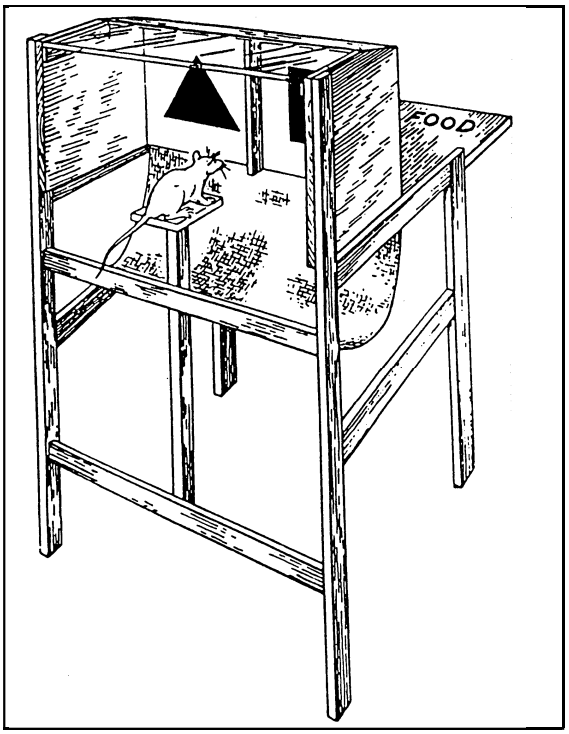

Figure 1 The Lashley Jumping Stand
(*From Munn, 1950, after Lashley 1938*)

trained using combination *b* with the triangle as the positive stimulus and the cross as negative. Subsequent testing with combinations *c* to *n* showed transfer of this initial training to combinations *c*, *d*, *f*, *g*, *h*, *j*, *k*, and *n* and in the case of one rat to combination *l*. There was no transfer on the basis of *this* initial training to combinations *e*, *i*, and *m*. However, there can be little doubt that with further training using a greater variety of positive and negative instances, including triangles of types other than the equilateral, a rat could be trained by this method to abstract triangularity as such.

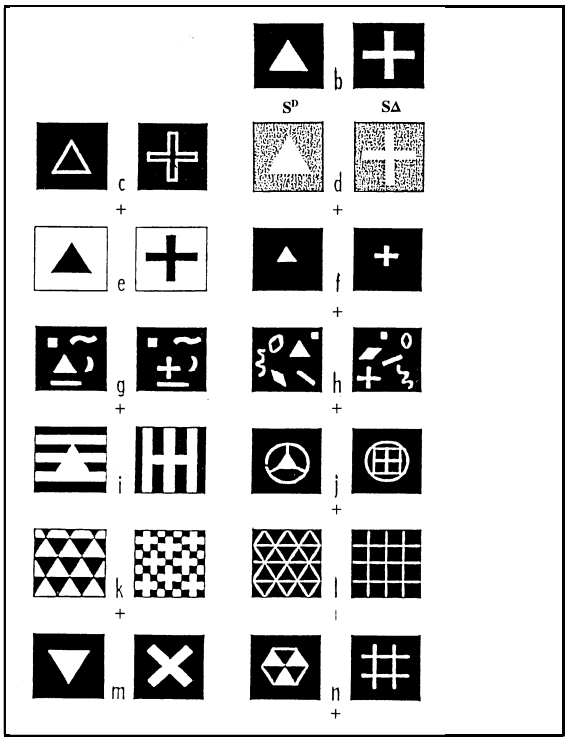

Figure 2 Pattern discrimination learning
Training stimuli *b* Generalization to pairs +
(*Munn, 1950, after Lashley 1938*)

XII. PATTERN DISCRIMINATION LEARNING (ABSTRACTION) IN NEURAL NETWORKS

Figure 3 is taken from a much more recent publication, the 1988 Revised Edition of Paul Churchland's *Matter and Consciousness*. It is used by Churchland to illustrate a problem in perceptual recognition which is to be handled by a neural network or parallel distributed processor (PDP). The task is to develop a device which when fitted to a submarine will learn to detect mines on the seabed on the basis of the characteristic echo which they produce when a sonar pulse is reflected back from them. The problem arises because the echoes produced by mines and those produced by rocks on the seabed are indistinguishable to human observers, even when presented with a graphically presented frequency distribution for the two cases. In order to train the network to recognize the echo distinctive of mines, a trial area of seabed is marked out where the positions of all the echo-producing rocks are known. Among these are placed a number of mines of all the main types likely to be encountered in reality, distributed at random but with their positions recorded. The network is then hooked up to the sonar device in such a way that the frequency pattern of each echo encountered by the device as the submarine moves over the training area is fed as an input into

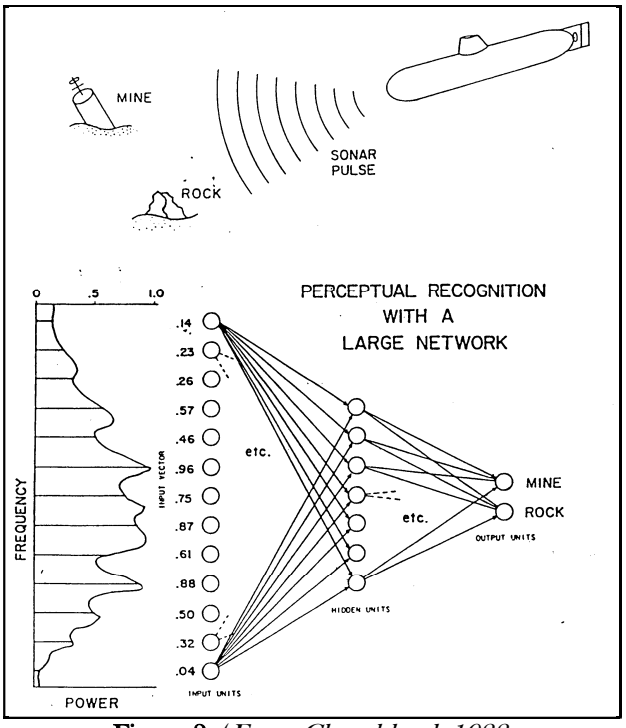

Figure 3. (*From Churchland, 1988, after Gorman and Sejnowski*).

the network. As each echo is received, the system is required to make a response indicating whether the echo is of a rock or a mine. As each response is made, a separate computer uses information about the position of the object from which the echo is coming in order to determine which response ("rock" or "mine") is the correct one. This computation is then compared with the response given by the network and an appropriate "correct" or "error" message is fed back.

Initially the responses produced by the network are completely random, but after a number of experiences of the pattern of input, output and feedback-message relations, the number of errors begins to decline with a consequent increase in the proportion of correct responses, until eventually errors are completely eliminated and the system is ready for service in the real world.

The analogy between the behavior of the network in learning to recognize mines by the echo they produce from the sonar device and the behavior of the rat when learning to recognize triangles in Lashley's experiment is exact. In both cases the problem is to distinguish between two classes of stimuli: triangles and crosses in the case of the rat, echoes from mines and echoes from rocks in the case of the network. In both cases the organism is required to choose between two alternative responses: jumping towards the left or right hand card in the case of the rat, signalling "mine" or "rock" in the case of the network. In both cases each response gets a feedback: the opportunity to feed *versus* bumping one's nose and falling into the net in the case of the rat, "correct" *versus* "error" messages in the case of the network. In both cases a concept, in the sense of an ability to recognize instances of a kind is acquired as a consequence of repeated sensory encounters with positive and negative instances of the kind, provided only that those positive and negative instances are marked off from one another by the appropriate feedback.

Because of the changes which this basic process of abstraction undergoes when concepts are expressed in language, examples of this kind of "unconscious" discrimination learning in adult humans are relatively rare. Probably the best known example is the case of the chicken sexer who learns to make reliable discriminations of the sex of a day-old chick by the way it feels when held momentarily in the hand, something which the untutored cannot begin to do, and which relies on responding to cues whose nature the chicken sexer is entirely unable to specify (Figure 4).

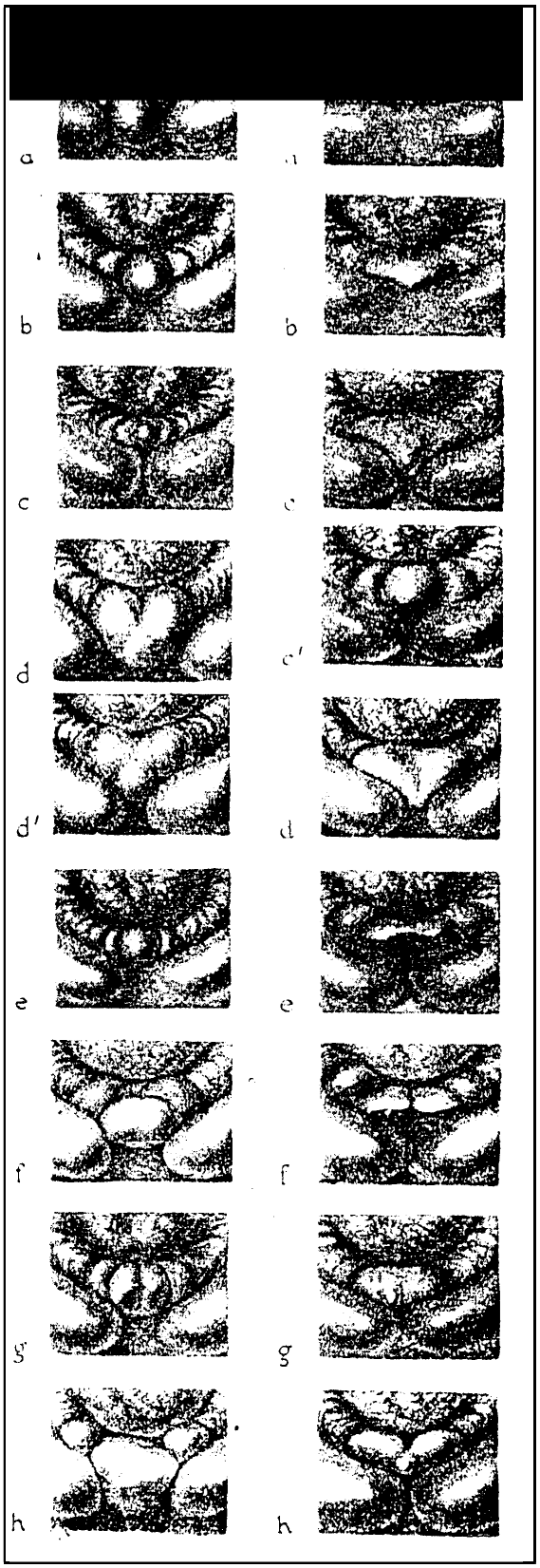

Figure 4 External genitalia of male (left) and female (right) day-old chicks *(Canfield, 1941)*

XIII. ARISTOTELIAN CONCEPTUALISM AND SCIENTIFIC REALISM

I have spent a considerable time discussing the process of abstraction. This is because, as I see it, only by understanding this process can we hope to give substance to the claim that is made by what I am calling the Aristotelian variety of conceptualism, namely, that to hold that universals, types or kinds are mind-made constructs is not inconsistent with the claim

(a) that most of the universals thus created are genuinely instantiated, and

(b) that the classificatory system represented by the universals which the mind creates in this way do indeed break up the universe of particulars along its natural lines of fracture.

Only if we are satisfied that we can tell with tolerable certainty both whether or not our concepts have actual instances and whether or not they correspond to actual resemblances between the particulars which instantiate them, can the conceptualist avoid the ultimate scepticism of the Kantian position. Only if that scepticism can be avoided, is there any hope of reconciling conceptualism with scientific realism.

But without conceptualism in some form, there is no way that we can accommodate the massive body of psychological and sociological evidence which shows that our conceptual schemes, both individual and social, are acquired, acquired, moreover, in a way which makes them subject to all those motivational and social constraints which affect other forms of individual and social behavior.

It is my contention that the process of concept abstraction considered as the kind of pattern-recognition learning process, described by Lashley in the case of the rat and by Churchland in the case of the artificial neural network, satisfies both these requirements. The requirement of scientific realism, that the resulting conceptual scheme should correspond to the way things are in themselves, is satisfied

(a) by the fact that we are dealing here with a biological process which has evolved over centuries so as to enable the organism to respond effectively and economically to the environment as it is,

(b) by the fact that it operates by detecting some, often complex, pattern of resemblances between what are marked off as positive instances of encounters with the kind in question which is absent in the case of those marked off as negative instances, and

(c) by the fact that in the natural environment the positive and negative instances are marked off by the actual consequences making one response rather than the other - either the card falls and you get to the food or you bump your nose and fall into the net.

XIV. ARISTOTELIAN CONCEPTUALISM AND SOCIAL CONSTRUCTIVISM

At the same time, the psychological and sociological factors in concept formation emphasized by the social constructivists are allowed for

(a) by the fact that on this model concepts are acquired through the unconscious detection by the mind of actual resemblances between encountered particulars, not, as proposed by Kripke (1972/1980), through the development of a rigid connection between words and naturally occurring mind-independent universals or "natural kinds",

(b) by the fact that in living organisms a response feedback is identified as a "correct" message or as an "error" message by the motivational attitude of the organism, in other words by whether the organism in question likes ("correct") or dislikes ("error") the immediate and conspicuous consequences of the response (in animals these likes and dislikes are for the most part biologically determined, as in the case of the rat's liking for food and dislike for bumping its nose and falling into the net; but in the human case, as we all know, they are either modified or acquired *de novo* from the social context in which individual behavior occurs),

(c) by what I take, contrary to Fodor's (1975) language of thought hypothesis, to be the fact that in the human case, and only in that case, concepts are embodied in language.

XV. THE EMBODIMENT OF CONCEPTS IN LANGUAGE AND THE PHENOMENON OF SUGGESTIBILITY

Of these it is the embodiment of concepts in language which is most significant from the standpoint of the social constructivist. The recognitional capacities acquired by animals and pre-linguistic human children are narrowly constrained by actual resemblances between the experiences of encountering what are judged to be instances and non-instances of a particular kind, by virtue of the real-life consequences of responses based

on those classifications and by biologically determined motivational attitudes towards those consequences. The social consequences of behavior, the feedback the organism receives from other individuals of the same or different species in response to its own behavior, plays a role which is not in principle any different from the feedback the organism receives from the physical environment in reaction to its attempts to manipulate that.

But with the embodiment of concepts in language, a number of social factors begin to play a role in determining the character of the individual's conceptual scheme which have no counterpart in the pre-linguistic state of development. One overriding factor is the need for members of a linguistic community to adopt and maintain a shared conceptual scheme without which linguistic communication within the community would be impossible. Another less obvious but perhaps equally potent factor is attested by numerous experimental studies in the field of social psychology which show that where there is a conflict between the error/correct feedback messages being delivered by the physical environment and those being delivered by the social environment in the form of the judgments made by others, it is the latter that tend to win out at the expense of the former. This phenomenon of "suggestibility", as it is usually called, combines with common observation to give backing to the social constructivist's claim that fashionable opinion within the scientific community is a more powerful determinant of the scientific theories that are accepted at particular times and places, than are the results of observation and experiment.

While the influence of fashionable opinion within the scientific community cannot be discounted, the social constructivist must concede that scientific communities differ from, say, religious communities in that it is part of the ethos of the social group that concepts and hypotheses formulated in terms of those concepts must be submitted to rigorous observational and experimental test before they are incorporated into the official corpus of scientific knowledge. By so doing, the scientific community has a powerful corrective to the otherwise universal practice of giving preference to the error/correct messages being received from the social group over those being received from the observation of what actually happens or is the case. Provided the tests of observation, experiment and practical application are sufficiently rigorous, we may be satisfied, I believe, that the theoretical concepts of science do, indeed, carve up the universe, by and large, along its natural lines of fracture, and that entities falling under its concepts do, indeed, exist.

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