



SCIENCE AND NATURE

*The annual of
Marxist philosophy
for natural scientists*

LLOYD MOTZ A Tribute to Lester (Hank) Talkington	1
CLAUDE M.J. BRAUN vs. TALKINGTON On Trends in the Status of Dialectical Logic: A Brief Study of Lefebvre, Ilyenkov and Wald	2
GORDON WELTY—A Review Essay The Attack on Margaret Mead and the Dialectics of Anthropology	14
WILLIS TRUITT, seeking unity within the opposites On Art and Science	30
GEORGI N. MITEV & ALEXANDER K. STOLCHEV The Humanist Perspectives of "Valeomedicine" With an international dialogue	44 49
CARL SHAMES, on a meeting in West Berlin Activity Theory: A Marxist Approach to Psychology	54
CARL SHAMES, the humanization of science Individuality, Democracy and Human Rights	65
LESTER TALKINGTON: toward a Marxist paradigm On Contradiction within Scientific Knowledge	75

Our masthead emblem symbolizes the dialectical interpenetration of science and nature, suggesting the manifold interconnections between scientific knowledge, ideal in form, and material nature, reflected in this knowledge.

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A Tribute to Lester (Hank) Talkington by Lloyd Motz, Astronomy (Emeritus), Columbia University

THE FIRST ISSUE OF *Science and Nature*, which grew out of the collaborative efforts of Lester Talkington, Hyman Cohen, and myself, appeared in the fall of 1978. We three had started a discussion group, the Dialectical Workshop, and as the project grew, with the participation of increasing numbers of scientists, and philosophers and historians of science, the idea of a journal became ever more attractive to Talkington and Cohen. Knowing, as an author and subscriber to various scientific journals, how difficult and costly it is to start a new journal in this area, I was hesitant about the idea although I agreed with them that such a journal was desirable. So persuasive was Talkington, however, that I overcame my skepticism and went along with my two colleagues. *Science and Nature* was thus born, with the three of us as its editorial committee.

If I had known then Talkington's remarkable talents and dedication to our, initially meager, publication project, I should have cast aside all doubt and accepted the inevitable success of the journal. By the time of its third issue *Science and Nature* had received international recognition and acquired an editorial committee of fifteen known scholars; its list of contributors was global, including outstanding scientists, mathematicians, and philosophers. All of this stemmed from Talkington's efforts and his own financial resources. At no point in the development of this journal did Hank doubt that any issue he was planning would appear, and each issue, with increasing richness, did appear exactly as he had planned it.

How tragic it is, then, that our beloved and self-sacrificing editor was seriously injured in an automobile accident on November 2, 1988 and, after a valiant struggle to survive, died in Nyack Hospital on February 3, 1989. This issue of *Science and Nature* is, thus, necessarily incomplete, but, even so, it is a beautiful example of Talkington's remarkable ability to enrich an issue, not only by his excellent editing, but also by his written contributions. In this issue his paper "On Contradictions within Scientific Knowledge" presents an analysis of the contradiction between the subjective and objective aspects of knowledge suggesting that this contradiction can be resolved, or, at least, understood by a historical materialist approach. Whether we agree or not, we are stimulated and provoked by papers of this caliber. This should be the role of journals such as *Science and Nature*, for they must be the conscience of the scientific community. That our journal has been such is a great tribute to Talkington's genius.

On trends in the status of dialectical logic: A brief study of Lefebvre, Ilyenkov and Wald

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WITH A COUNTERVIEW BY LESTER TALKINGTON:
ON THE HEURISTIC ROLE OF DIALECTICAL LOGIC

HENRI LEFEBVRE'S *Dialectical Materialism* was originally published in French in 1939. Evan V. Ilyenkov's *Dialectical Logic* was originally published in Russian in 1974. Henri Wald's *Introduction to Dialectical Logic* [1975] was presumably first published or at least composed in Romanian.

These three books are reviewed here in an attempt to assess the current situation with regards to dialectical logic. Is the construction of a substantive, powerful (i.e., compelling) system of dialectical logic possible? What is the status of dialectical logic with regard to ontology, epistemology, formal logic and other major sectors of philosophy? What are the major categories of dialectical logic? What are the agreements and disagreements between major Marxist thinkers on these issues? What new problems remain to be dealt with in regard to the future of dialectical logic?

Lenin [1915] wrote in *Philosophical Notebooks*: "Marx applied in *Capital* to a single science, logic, dialectics, and the theory of knowledge ... three words are not needed, it is one and the same thing" [319], and "Logic is the science not of external forms of thought, but of the laws of development of all material, natural and spiritual things" [92-93]. Lenin's concern here was to combat Hegel's subjectivism and mysticism. In refuting Hegel on "subjective logic" and the theory of concepts, he stated that the "question of truth" is: "Not psychology, not the phenomenology of mind, but logic" [175]. Awareness of the context of these statements, helps to understand that Lenin was not really interested in the status or fate of traditional formal logic and was looking ahead, optimistically, to an all-encompassing dialectical materialism to be elaborated in the future.

Not surprisingly, this proposition by Lenin met with some resistance from professional logicians who virtually unanimously considered and continue to consider theirs the science of correct reasoning. Lenin did not make any suggestion as to what fate should be reserved

for the old, yet undeniably noble, activity he no longer recognized as "logic." This, and other aspects of the proposal, left for the Marxist philosophical community a legacy of acute terminological controversy which has only become more acute with the passage of time. This is particularly evident in the Soviet Union today (for a survey of current Soviet discussions in philosophy, see Moran [1982] "On the interpretation of antinomies and dialectical contradictions").

WE BEGIN our survey of this legacy with the earliest published of the 3 treatises, that of Lefebvre, upon which we shall dwell quite briefly since only a few passages in the book are explicitly devoted to the topic of dialectical logic. In the late 30s, Lefebvre was concerned that under Stalin's influence formal logic was being dismissed as "invalid", its interface with dialectics therefore being ignored. He was also concerned that the interpretation (analysis, investigation) of thought (including the science of psychology) was being dismissed while only the laws of nature (and of society only within the narrow framework of economic determinism) were of concern. Hence his treatise amounts to a defence of Marx's early writings against Stalinist dogmatism (and the mature Marx's and Lenin's "hypostatization" of dialectical logic) and of historical materialism against an overly schematic, rigid, simplified "dialectic of nature".

Here, Lefebvre's exposition parallels his interest in the concern of the young Marx with the young Hegel's *Phenomenology* which gives an impression less ominous (for Lefebvre) than his later concern (and Lenin's) with (or rediscovery of) the mature Hegel's *Logic*.

Lefebvre says that Marx's *Economic and Philosophical Manuscript* of 1844 "rejects dialectical logic only to accept the theory of alienation" [p. 65]. In short Lefebvre's plea was for a dialectical materialism which does not function as a doctrine or "dogma" but as an "investigation", an open-ended "world view". For Lefebvre there could be no dialectical logic based on the traditional definition of logic. What then was the difference between formal and dialectical logic? Lefebvre's substantive contribution at this level was to elaborate what he considered the two central categories of dialectical logic, namely content versus form and concreteness versus abstraction:

(a) The materialist dialectic accords the primacy explicitly to the content. The primacy of the content over the form is, however, only one definition of materialism. Materialism asserts essentially that Being (discovered and experienced as content, without our aspiring to define it *a priori* and exhaust it) determines thought.

(b) The materialist dialectic is an analysis of the movement of this content, and a reconstruction of the total movement. It is thus a method of analysis for each degree and for each concrete totality—for each original historical situation. At the same time it is a synthetic method that sets itself the task of comprehending the total movement. It does not lead to axioms, constancies or permanencies, or to mere analogies, but to laws of development [p.102].

To summarize, Lefebvre's position is that 1) the construction of a system of dialectical logic is futile and must be limited to a "dialectical materialist world-view" 2) this world-view accords major status to "concrete" thought and "content" of thought 3) formal logic is valid in that its role is to deal with "abstract" thought and thought "forms" 4) formal logic is subsumed within dialectical materialism.

LET US NOW turn our attention, still in chronological order, to Ilyenkov's treatise. The reader who up to now has been bewildered by the identification of dialectical logic by Marx and Lenin with the *laws of development of all that exists* may be comforted to learn that this is interpreted by Ilyenkov to refer to the *laws of the history of thought* rather than of *all that exists*. This specification brings us partly back into standard philosophical lexicon even though Ilyenkov explicitly states that his position is an integral adoption of Marx's and Lenin's previously reported definition of dialectical logic.

Ilyenkov writes that logic consists of the determination of the "objective laws of subjective activity". These laws are the "congealed" structures of mankind's thought, not the individual or "specific" ones.

Logic as a science is not at all interested in the specific features of the thinking of the physicist or chemist, economist or linguist, but only in those universal (invariant) forms and laws within which the thinking of any person flows, and of any theoretician, including the logician by profession, who specifically thinks about thought... [otherwise logic would] ignore the historically formed division of labor between logic and psychology, depriving psychology of its subject matter [p. 314].

So here again we find a Marxist philosopher struggling with the difficult legacy bequeathed by Marx and Lenin.

What does Ilyenkov have to say about the relation of dialectical logic to formal logic? Dialectical logic, he writes, provides a means of resolving contradictions which leave formal logic impotent, this being due of course to dialectical logic's capability of conceptualizing movement, and more particularly *development*.

Which categories of dialectical logic does Ilyenkov consider to be central? At this level, we find that Ilyenkov takes up one of Lefebvre's central categories, namely that of *concreteness* which he carries further into a defense of realism against nominalism.

The stand of formal logic, oriented on finding the abstract, common element in every single representative of one class (all having one and the same name) yields nothing in this instance. The general in this sense cannot be found here, and cannot for the reason that there actually is no such thing, not in the form of attribute or determination actually common to all the individua, in the form of a resemblance proper to each of them taken separately.

It is quite clear that the concrete (empirically obvious) essence of the link uniting the various individua in some "one", in a common multi-

tude or plurality, is by no means posited and expressed in an abstract attribute common to them, or in a determination that is equally proper to the one and the other. Rather such unity (or community) is created by the attribute that one individuum possesses and another does not. And the absence of a certain attribute binds one individuum to another much more strongly than its equal existence in both [pp. 349-350].

The radical materialist rethinking of the achievements of logic (dialectics) carried through by Marx, Engels, and Lenin, was linked with affirmation of the objective reality or the universal, not at all in the spirit of Plato or Hegel, but rather in the sense of a law-governed connexion of material phenomena, in the sense of the law of their being joined together in the composition of some whole, in the context of a self-developing totality or aggregate, all the components of which were related as a matter of fact not by virtue of their possessing one and the same identical attribute, but by virtue of a unity of *genesis*, by virtue of their having one and the same common ancestor, or to put it more exactly, by virtue of their arising as diverse modifications of one and the same substance of a quite material character (i.e. independent of thought and word) [p. 354, emphasis added].

ANOTHER category which Ilyenkov considers central to dialectical logic is the materialist resolution of the mind-body problem. In this respect Ilyenkov was convinced in 1969 and remains so today [Moran 1982, 104] that to identify thought with language is a major vice of idealism. Universal laws of thought cannot be reduced to language forms (grammar, syllogistic reasoning, etc.), and it is in this sense primarily that dialectical logic transcends and subsumes formal logic because it can and does deal with non-language forms of thought. With respect to the materialist category of the *ideal*, Ilyenkov radically departs from Lefebvre's position (summarized above) of content as primary over form, precluding the possibility of a rigid system of dialectical logic). For Ilyenkov, a system of dialectical logic is indeed possible, though it does not yet exist.

The ideal is therefore nothing else than the form of things, but existing outside things, namely in man, in the form of his active practice, i.e., it is the socially determined form of the human being's activity...[p. 260].

It is clear that the ideal, i.e. the active form of social man's activity, is immediately embodied, or as it is now fashionable to say, is "coded", in the form of the neuro-cerebral structures of the cortex of the brain, i.e. quite materially. But the material being of the ideal is not itself ideal but only the form of its expression in the organic body of the individual [p.261].

Notice that emphasis here is placed on form over content, a necessary operation if one is to promote the project of building a *system* of laws, a doctrine of true universals, i.e., a *dialectical logic* as such. And this is indeed what Ilyenkov envisions.

HENRI WALD also believes in the possibility of a *system* of dialectical

logic. He defines dialectical logic as the "concrete history of thought about thought". Similarly to Lefebvre and Ilyenkov, he believes that dialectical logic subsumes formal logic, but only in a particular sense because, in his opinion, both have a specific and different subject matter. Dialectical logic deals with the most general laws of the "self-movement of correct thinking" [p. 113], whereas formal logic deals only with the "elementary relationship of concepts in correct thought" [p. 122]. In short here we observe even further distancing from the definition of dialectical logic bequeathed by Marx and Lenin.

The subject matter of dialectical logic is no longer stated to consist of all things nor even of all thought, but only of the "laws of development of correct" thought. This march toward definitional restraint may well be the necessary stepping stone towards the possibility of planning the construction of a system of dialectical logic. Indeed, Wald is the only one of the 3 authors reviewed here who specifically proposes and discusses *laws* of dialectical logic. Hegel's formulation of three dialectical laws (the struggle and interpenetration of opposites; the passage from qualitative to quantitative change; and the negation of negation) is not considered to define *dialectical logic* in a way which is acceptable for most Marxist commentators, including Lefebvre, Ilyenkov and Wald.

The most fundamental laws of formal logic, Wald writes approvingly, are 1) the law of identity, 2) of non-contradiction, 3) of the excluded middle and 4) of sufficient reason. Taking up the formulation of a Romanian Marxist, A. Joja, he proposes that these correct laws understood materialistically in their development (both historical and ontogenic) reformulated as laws of dialectical logic are 1) the law of contradictory predication 2) of determinate negation and 3) of the double negation [p. 102]. Wald further states that all three can be reduced to the first, and that the laws of formal logic enjoy only "relative validity" whereas the laws of dialectical logic enjoy "absolute validity" [p. 108], even though dialectical logic must "observe the laws of formal logic" [p. 115]. He states with more prudent terms than his predecessors that "by observing the laws of dialectical logic, thinking can detect the inner objective contradiction that governs self-dynamics of things from *lower to higher*" [p. 122, emphasis added]. Nowhere in his book does Wald hypostatize "development". We find in Wald's 5th chapter a fascinating technical discussion of the laws of dialectical logic, including the issue of simultaneous contradiction, in the same respect, the necessity (implacability) of the laws of dialectics, etc. We will not review this discussion here because it would not suffer summarizing. A general impression though of Wald's discussion and of more recent discussion [Moran 1982], is that Marxist logicians everywhere recognize the law of contradiction as the key problem of dialectical logic, and have reached a level of high technical sophistication in these discussions, but no unanimity.

Problems remaining to be solved

The following are problems which have not been raised directly by the authors reviewed, but which, in the opinion of the reviewer, will necessarily emerge and will require resolution as a condition for the further development of dialectical logic.

1. Several contemporary Marxist authors agree with Wald's definition of dialectical logic [Konstantinov *et al.* 1974, 239; Rosenthal and Yudin 1967; Frolov 1984]. Furthermore, contemporary authors are clearly manifesting parsimony in the use of Hegelian-like metaphors in the treatment of the method of dialectics and its sub-discipline, dialectical logic. Nevertheless, a great deal of attention will have to be paid to the issue of terminology and other aspects of exposition such as the nature of examples provided. In particular, it should be realized that simple bi-polar oppositions and their associated dialectical contradictions (therefore, objects of dialectical logic) analyzed by the Marxist forefathers are not and cannot be generalized as prototypes for all cognition! It is important therefore that a more exhaustive and balanced matrix of types of change and motion, based on all the modern sciences be considered as a base for the further improvement of Marxist dialectical philosophy. It is incredible, that to this day, most high ranking Marxist philosophers (and philosophical collectives) continue to use terms such as "development", "lower to higher", "external to internal" to *define* the object of dialectical logic, though in reality, those terms apply only in a metaphoric sense. This poetic mode of thinking about dialectical logic is definitely a problem to be overcome if a positive *building* phase is to be ushered in. If dialectical logic is the investigation of the laws of *development* of correct thought, as many contemporary authors propose, does this not imply: That correct thought unfolds as a living thing, i.e., contains the full prototype of its highest elaboration in its historical insemination, as a living thing *develops* according to the genotypic program? That there exists some kind of conventionally accepted criterion for determining what is correct thought in general? That *progression* of thought in general is an *essential* property of history in general?

Might it be suggested that there is no *historical* "development" of thought whatsoever? Might it be recalled that though criteria of truth have been adopted world-wide in the scientific realm, this does not apply to thought of any non-scientific sort? Is it too boorish to remind dialectical optimists that not all, and even not much, of the history of thought can be characterized as "progressive", "proceeding from lower to higher", "developing", and that regressive, higher-to-lower and degenerative thought processes also require explanation?

2. Marx was quite clear and concise in recognizing his investigative method (enquiry) in *Capital* as abstract and his expository method (presentation) as concrete. In fact, the former is referred to as the descent into the abstract and the latter as the ascent to the concrete ("Afterword," second German edition of *Capital*). There are as-

surely many aspects to this distinction but, for the purpose of this review, the one worth mentioning is that it is the presentation, the finished polished multi-faceted synthesis of Marx's *Capital*, which is most commonly associated with dialectical logic at the expense of the more analytic, abstract, arid, investigative work so evident in the first 6 chapters of *Capital*.

Marx wrote of the ascent to the concrete that "it may appear as if we had before us a mere *a priori* construction". This, or an *a posteriori* tracing, an empty shell of the *a priori* construction, is indeed not only what the edifice of dialectical logic might look like, but what it might in fact be, if it is to be built on the basis of dogmatism rather than rational criteria. For if just anybody sets out, even with the best of intentions, to write the system of laws of the development of all correct thought, he/she will be soon intellectually lapidated, as was Auguste Comte when he published his positivistic anthropology of cognition composed of a 3-rung historico-developmental ladder (mysticism, theism and positivism). Comte's scheme, which was immediately ridiculed by his contemporary community of philosophers, including Marx, suffers from the typical tendency of positivism to hypostatize a linear concept of biological growth and historical evolution, logic and phylogeny, and logic and so called social "progress". Surely, contemporary Marxists will not be so naïve in their own attempts to make sense of the history of thought. Furthermore, how far can we really be expected to get in such a venture?

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On the Heuristic Role of Dialectical Logic

THE COUNTERVIEW OF LESTER TALKINGTON:

WITHIN the body of Marxist theory, dialectical logic represents an area of confusion and contention where Claude Braun and I have debated our opposing views without resolution. I have no quarrel with his conclusion on the trend represented by these three books, but disagree strongly on the desirability of "systematizing" (read formalizing) dialectical logic.

Braun's approach to this question does indeed represent that of a good many Marxists — both Soviet and western — who really consider traditional formal logic as the fundamental mode for human, or at least *scientific*, thought processes and therefore believe that dialectical logic must conform to that rigorous mode of thought.

My own approach is to recognize that dialectical logic and formal logic represent a unity of opposites — two contradictory modes of thought that coexist by necessity since formal logic has its useful role but can account for only a lesser part of the actual thought processes in the human mind. I find myself agreeing with Lefebvre* on the all important point — that dialectical materialism functions not as a dogma but as "an open-ended world-view" for the investigator — what I see as a heuristic tool of great value. From this utilitarian standpoint, the thrust of the proposals by Ilyenkov and Wald seem to be in the wrong direction.

Let me be more specific about the contradictions between formal and dialectical logic that provide the basis for this necessary unity of opposites in the total of human thought:

1) *Dialectical logic is inherently informal*, whereas formal logic is completely dependent on rigorous adherence to the classical rules, such as the excluded middle. There can be no rigorous rules that apply to *all* real-life problems, but the principles of dialectical materialism are very helpful as *heuristics* — aids to thinking creatively — in the exploration of a problem to discover its underlying regularities. Since there is no useful way to formally codify procedures for applying materialist dialectics in a heuristic manner, it is inevitable and even desirable that these principles be applied creatively in a metaphoric or *poetic* manner. (This is an aspect of the *human* side of science that few lay people ever get to know.)

2) *Dialectical logic deals explicitly with content*, whereas formal logic must, by definition, ignore the content of premises and propositions. Certainly, human thought must have some useful mode for dealing with the content of concrete problems which usually present themselves in some more or less "illogical" form. In fact, sifting through

*I disagree with Lefebvre on various other points, including his stress on the primacy of the young Marx' writings.

and working with the content of a specific problem is the way to determine the dialectical relationships of its internal logic. (While Marx, Engels and Lenin certainly criticized Hegel for the idealist orientation of his dialectical philosophy, they never failed to credit him for the actual materialist orientation in his application of dialectics to material problems.)

3) *Dialectical logic is concerned with historical process*, whereas formal logic is helpless when confronted with phenomena that undergo qualitative change through quantitative development. It is precisely because dialectical materialists think about the world in terms of contradiction and *unity of opposites* that they are able to take advantage of existing contradictions in order to help speed up development and change in the natural processes of an existing world. Moreover, the logic of dialectics requires looking into the past history of a process in order to better understand what's happening in the present and what's likely to happen in the future.

4) *Dialectical logic provides the basis for informed judgment*, whereas formal logic *requires* the input of this informed judgment as the basis for the formulation of realistic premises and propositions. Dialectical logic sees the world as a whole and thus promotes the search for relationships and interactions between phenomena that may not be so obviously related. It is the combination of *historical* and *holistic* approaches that makes dialectical logic far more powerful than the systems approach as the basis for an informed judgment in the formulation of a complex problem.

5) *Dialectical logic is not a science and never provides formal proof*, whereas formal logic is a science but can provide only formal proof. Dialectical logic seeks its validation in practice, whereas formal logic in itself has nothing to say on the evidence of practice. By focusing attention on practical results, dialectical logic helps keep scientific theory in touch with material reality. In this respect, materialist dialectics is the enemy of dogmatism, so it is not surprising that dogmatic Marxism (e.g., under Stalin) ends up with some distorted or perverted version of dialectical materialism.

6) *Dialectical logic and formal logic interact with each other continuously in the development of scientific theory*. Dialectical logic provides the creative mode of thought for the inductive process, for generating hypotheses and so forth, while classical formal logic provides the complementary mode of thought for the deductive process; together they make up the scientific mode of thought.* This is a dialectical process in which the dialectical mode of thought must predominate in the phase of investigation (the Descent into the Abstract!), while the deductive mode must predominate in the phase of presenting these results for evaluation by others (the Ascent to the Concrete!).

* For more on creativity and the dialectical mode of thought, see Talkington, "Is the Creative Process Rational?" [S&N No.7/8, 78-90].

THESE SIX POINTS summarize my understanding of the legacy from Marx, Engels and Lenin on the topic of dialectical logic. It is a difficult legacy since the masters never found time to leave us a connected statement on the topic. We find some rather casual asides by Marx in the text of *Capital*, some notes by Engels in the uncompleted *Dialectics of Nature*, some annotations to Hegel's *Logic* in Lenin's *Philosophical Notebooks*, and not much more to point the way. A great deal of the analysis given above reflects my effort to apply a general understanding of Marxism to the particular problem of defining a dialectical logic.

Given the institutionalized position of classical formal logic in our western culture, and the deep distortions of Marxism introduced by Stalin, it is hardly surprising to find among Marxists an eclectic confusion of misreadings from this scanty legacy. Some of these misreadings can be seen in the discerning account by Moran [1982] of Soviet debates over the concept of dialectical contradictions. Some such misreading probably explains the Soviet trend, seen by Braun, toward systematizing (formalizing) dialectical logic. From what I have been able to learn, this is not a dominant trend among Soviet philosophers today, but only one form that the confusion takes.

However, Moran [1982] says much that tends to support my views on dialectical logic. For instance, he gives an excellent example of the dialectical mode of thought when he presents two views concerning the contradiction between appearance and reality. According to Moran, a dialectician might express this contradiction in the form of an antinomy: "Appearance is and is not reality." He then cites an alternative nondialectical view: "Appearance is a side of reality, but not the essence of reality" [120]. Moran argues that the second view does not "resolve" the contradiction, which continues to exist objectively and must be taken into account:

Both opposing moments, essence and appearance, are required for the correct understanding of reality. The only contradiction that is resolved is our antinomial way of depicting the situation. That is, we make progress in knowledge and revise our antinomial expression . . . Antinomies express the struggle of opposites, which is a permanent feature of objective reality. . . Thus, the need to discover more fully the correlation between appearance and *essence* as a unity of [interpenetrating] opposites is felt as an objective necessity . . . [121]

Braun himself seems to have misread the Afterword of *Capital* (second German edition) — one of the rare passages in which Marx explicitly discussed his *dialectical method*, emphasizing the *necessary* contradiction between the (dialectical) process of discovery and the (formal) method of presentation:

Of course, the method of presentation must differ in form from that of inquiry. The latter has to appropriate the material in detail, to analyse its different forms of development, to trace out their inner connexion.

Only after this work is done, can the actual movement be adequately described. If this is done successfully, if the life of the subject-matter is ideally reflected as in a mirror, then it may appear as if we had before us a mere *a priori* construction.*

Braun quotes part of the above passage and then, in effect, disputes it by arguing that

the finished polished multi-faceted synthesis of Marx's *Capital* . . . is most commonly associated with dialectical logic at the expense of the more analytic, abstract, arid, investigative work so evident in the first 6 chapters of *Capital*.

Here is surely the crux of the disagreement between us. Braun sees dialectical logic applying to the "finished polished multi-faceted synthesis" — in which "the life of the subject-matter is ideally reflected as in a mirror" — whereas I see dialectical logic applying to the "abstract, arid, investigative work" of the discovery process — in which one has "to appropriate the material in detail, to analyse the different forms of development, to trace out their inner connexion." Obviously, on the point that Braun disputes, I feel that I'm on the side of Marx.

Another issue raised by Braun concerns the Lenin annotation of Hegel's *Logic*, which reads in full:

Logic is the science not of external forms of thought, but of the laws of development "of all material, natural and spiritual things," i.e., of the development of the entire concrete content of the world and of its cognition, i.e., the sum-total, the conclusion of the History of knowledge of the world.

Here Lenin contrasted formal logic, which indeed is a "science of the external forms of thought," with dialectical logic, which indeed deals with the laws of development of the entire concrete content of the world. Braun may be right to criticize Lenin for characterizing this logic as a "science," but note the context of Lenin's annotation. First, Lenin was responding to passages in Hegel that demand a logic for thinking about "all natural and spiritual things," about "substantial content." Second, he used the traditional term "science" to embrace both the new and the old logic. My approach, seeking to preserve both the spirit and intent of Lenin's annotation, does not treat dialectical logic as a science like formal logic.

Dialectical logic is best seen as a general and highly useful mode of thought — in which the time-tested dialectical principles provide heuristic aid for thinking creatively about a non-idealized world.

* 1873 Afterword to the second German edition of *Capital* [NY: International 1967, i, 19]

Do Business Executives Also Use Dialectical Logic?

Successful Executives Rely on Own Kind of Intelligence

I.Q. can't explain achievement, but *thinking style* can.

According to a growing number of psychologists, research shows that, although the best executives almost always do at least moderately well on I.Q. tests, their rating on these tests is simply not the factor that distinguishes those who advance from those who do not. This caused the psychologists to search for some other way to measure "practical intelligence."

Their recent research suggests that practical intelligence can be characterized by the mental processes involved, that the most successful corporate leaders think in a style notable for its *complexity of approach to decision-making processes*. The hallmarks of this cognitive complexity include *the ability to plan strategically without being rigidly locked in to one course of events; the capacity to acquire ample information for decision-making without being overwhelmed and being able to grasp relationships between rapidly changing events*.

In a simulation where executives spent hours making decisions for a fictitious company, those who displayed greater cognitive complexity were *better able to make connections between decisions*, and orchestrated the entire sequence of decisions toward a crucial single decision. Executives who demonstrated this *cognitive multidimensionality, seeing multiple connections and considering longterm consequences*, were also judged, in independent ratings by their peers, to be better planners and more competent decision-makers.

"Multidimensional thinking does not make much difference for success at low or middle-level jobs," said one psychologist. "But it's particularly important in *an environment where there is great uncertainty*, where an executive's every decision makes all the difference." Among the competencies of a good manager, said another, is *the ability to spot hidden patterns in an array of facts*. Practical intelligence is not related to years on the job, said still another: "Tacit knowledge is not automatically acquired with years of experience. It's *what we learn from experience*, rather than experience *per se* that seems to matter."

— Abridged from Daniel Goleman, *NY Times* 31 July 1984 [italics added].

THESE PSYCHOLOGISTS are puzzled to find that good executives are good investigators who, in thinking about their problems, make use of what Marxists call spontaneous dialectics — evidenced in the italicized passages of news report above. No matter what it's called, materialist dialectics provide a logic or mode of thought that does enhance practical intelligence. Marxists have long known this is true in politics, science, etc. Why not in the executive suite too? (The research also found good executives treat their underlings better.)

The Attack on Mead and the Dialectics of Anthropology

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A REVIEW ESSAY

The well-publicized attack by Derek Freeman [1983] on the Margaret Mead study of Samoa [1928] has raised a number of questions about anthropological research and communication, ranging from professional ethics to the dialectical understanding of science. These questions involve substantive matters as well as methodological canons. Now we have the long-awaited assessment of the Mead-Freeman controversy by Lowell Holmes [1987], a valuable intervention that provides answers to a number of these questions, especially those relating to professional and substantive issues. Their two books are briefly reviewed in panels on the facing page. Here we focus on some areas of philosophical interest in the development of U.S. anthropology: the history and role of the doctrine of "falsifiability" in anthropology and in science generally, the relationship between Boasian anthropology and biologism, and the relation between both these doctrines and historical materialism.

To anticipate somewhat, we first show how the "falsifiability" canon has a longer and perhaps more interesting history than the popular accolades to Karl Popper would acknowledge, and that it entails a dialectical conception of science and its development. Next, in light of these dialectical considerations, we show that Boasian anthropology is indeed the negation—the simple negation—of biologism. While giving our attention to such biologistic contemporaries of Franz Boas as Herbert Spencer and Karl Pearson, we remark that today's chic variant of the same biologism is called "sociobiology." Finally, the dialectical negation of both these doctrines (biologism and Boasian anthropology) is shown to be social evolutionism and its philosophical recapitulation, historical and dialectical materialism.

"Falsifiability" and dialectics

Freeman dedicated his book to none other than Karl R. Popper, and indicated in his preface that he takes very seriously Popper's methodological strictures [1983: xii]. Long before Popper had popularized the neopositivist notion that science advances through the promotion

of "falsifiable" propositions, however, practicing scientists employed this methodological strategy in their research. A good example in 1920s social science was Bronislaw Malinowski's *Sex and Repression in Primitive Society* [1953], where he reported that the "Oedipal complex" among Trobriand Islanders focused on the mother's brother, i.e. the uncle, rather than the child's father. The Freudianism of *Totem and Taboo* had maintained that specific tensions between child and father were present in each and every culture [cf. Jones 1951]. Malinowski's findings thus served to "falsify" the universalistic pretensions of psychoanalytic doctrine [cf. Grünbaum 1984, ch. 1].

Another example of such research was Margaret Mead's *Coming of Age in Samoa* [1928], where she held that adolescence was not an especially difficult period of a Samoan girl's life. Holmes, with extensive field experience in American Samoa, says: "I confirm Mead's conclusion that it was undoubtedly easier to come of age in Samoa than in the United States in 1925" [1987: 103; cf. 173]. Since biologistic doctrine had maintained that the storm and stress of adolescence was physiologically (hormonally) determined, the universalistic pretensions of biologism were thus "falsified" by Mead's findings. And Mead thereupon initiated a long series of studies questioning the universality of such a conception of adolescence [cf. Offer, 1969: 181].

INDEED, the use of "falsifiable" propositions by practicing scientists and, even more relevant for our purposes, their methodologically self-conscious attempts to "disconfirm" scientific theories long antedate even Malinowski and Mead. Consider a work by famous French physiologist Claude Bernard, *Introduction à l'étude de la médecine expérimentale* [1865]. This is an early and far-reaching statement of the doctrine of "falsifiability." It states the essence of the methodological position which was popularized by Popper in the next century. Bernard rejected the notion of symmetry between induction and deduction in scientific explanation; he held against the inductivists that there is but "a single form of reasoning: deduction by the syllogism" [1865: 83]. Furthermore, he rejected the notion of symmetry between verification and disconfirmation [cf., however, Bitsachis, 1987: 432]. Bernard maintained that "when a datum disconfirms a preconceived idea [i.e. an hypothesis], the researcher must reject or modify his idea. But even if a datum fully confirms the preconceived idea, the researcher must still question it, for reason itself still demands a counterproof [i.e. falsifiability]" [1865:87]. Bernard summed this up as follows: "when one wishes to find the truth, one is able decisively to establish one's own ideas only by seeking to refute one's own conclusions" [1865:92]. (The reader not familiar with Bernard's profound and comprehensive methodological discussion on the need to promote "falsifiable" propositions and theories is invited to examine in detail the First Part of his *Introduction*.)

It is of some interest to inquire why Bernard is renowned today for

his contributions to the science of physiology, while his methodological contributions have apparently been forgotten—at least in the Anglo-American philosophical tradition. Some brief remarks may suffice for now. First, consider the particularities of the case. Bernard was obliged by severe illness to set aside his research during the 1860s; it was during this time he wrote the *Introduction*. Upon recovering his health, he plunged back into his scientific practice. Thereafter he had neither time nor inclination to elaborate or to popularize these methodological insights. More generally, intellectual conditions in the 1860s and '70s were also unfavorable for Bernard's sophisticated insights. The popular philosophers of science were positivists Auguste Comte and Augustin Cournot in France, Herbert Spencer in Britain, and empiricists William Hamilton and John Stuart Mill. Thus a thinker of Bernard's stature was clearly too advanced for the times. A century later, such insights would have warranted a knighthood.

IT IS ALSO of interest to consider why Popper's renown comes from popularizing a methodological contribution that in all honesty should be credited to Bernard. This has potential as the nuanced topic of a doctoral dissertation. And such a study might consider what Paul Lazarsfeld, leader of Popper's Viennese Boy Scout troop, once told me: it may reflect Popper's sense of social inferiority. "Poor Karly," said Lazarsfeld, "he was always chasing some girl who loved someone else." More generally, it may reflect the ideological need in the West for a philosophy of science champion with unimpeachable anti-Communist credentials and proclivities.

This need emerged with the general crisis of capitalism and the success of socialist revolution in Russia (a need only heightened by advent of the First Cold War). Philosophers of science with stature, such as Otto Neurath and Bertrand Russell, had ambiguous ideological credentials and orientation. Popper, by contrast, is a remarkable conjunction of undignified grasping and self-aggrandizement with uncompromising anti-Communism. Not a practicing scientist, he had few other demands on his time; he could popularize these methodological insights as his own and, along the way, champion "free enterprise," the "marketplace of ideas," etc. Hence, celebration of *Logik der Forschung* [1935] had to await publication of "Poverty of Historicism" [1944/5] and *The Open Society and Its Enemies* [1945].

Much the same can be said of the conditions when Freeman's book was published. This awaited the reactionary Reagan-Thatcher-Kohl era of the Second Cold War, when so many Western intellectuals and publicists eagerly sought any scrap of evidence for "nature" against "nurture." Their ranks counted not only the neoconservatives seeking support for their racism but also the "liberals" flinching before the deepening crisis and the demands it presents for resolute and united action of all peoples in the anti-monopoly struggle. Better, these latter feel, that the possibilities of political action should be

disproved, or at least disparaged.

IN LIGHT of the preceding, it is ironic to find Freeman invoking a Popperian methodological stance in his critique of Mead's Samoan researches. Within a more sophisticated worldview—one to which even Sir Karl aspired in his more mature writings—this would suggest Freeman's project amounted to negation of a negation. The canon of "falsifiability" must be incorporated within appropriately dialectical logic. Thereby Mead's negation of biologicistic thinking is itself negated—by a dialectical negation—through the scientific critique of Mead. All this *sublates* the original thinking, raising the scientific discourse to a higher level which incorporates the original thought while correcting its errors. Dialectics is thus *sufficient* to comprehend science and its advance [cf. esp., Marx-Engels 1975 xxv 123-32; 606ff].

This process of scientific advance through dialectical negation is not simply one of confronting "theories" by "facts" and negating the former in terms of the latter. At several points, Freeman seems to hold this simplistic position—for instance, with regard to delinquency rates and their bearing on the theory of adolescent turmoil [1983: 255 ff]. As Bernard has cautioned, the exigencies of the disconfirmation process are far more subtle. On the one hand, "all theories are false, literally speaking; they are only partial and provisional truths." This might incline us towards negating the theoretical proposition in terms of the "facts." On the other hand, he continues, "numerous causes of errors are able to slip into our observations" and "frequently the means of establishing a fact fail us or are very imperfect" [1865: 69]. For instance, Freeman's use of delinquency rates overlooks the crucial distinction between town and country [cf. Holmes, 1987: 152; Marx-Engels, 1975: v, 64 f]. And this might incline us towards preserving "theories" in the face of the "facts." Bernard concludes that one is able to believe in one's observations or one's theories only conditionally, depending upon science [1865:71]. Thus the validity of the scientific endeavor comes to depend upon the scientific process itself—a notion which is inherently dialectical. Scientific advance can only be understood dialectically, in terms of dialectical negation. Not only is dialectics sufficient, as we have just seen; it is thus *necessary* as well.

Unfortunately this does not seem to be the case in Freeman's book, even though he invokes—in its very final paragraph—the notion that biologism was the "thesis," Boasian anthropology was the "antithesis," and "the time is now conspicuously due for a synthesis" [1983: 302]. Perhaps this means we still can look forward to more from Freeman. In the meanwhile, we find Freeman operating throughout—as the very subtitle of his book proclaims—at the level of "Making and Unmaking," i.e., at the level of simple negation, what Engels has very accurately labeled "barren negation" [M&E xxv 607]. Already in his "Preface" Freeman acknowledges that he is not

"constructing an alternative ethnography of Samoa." Of course he cannot; his field studies were in *Western Samoa*, not the site of Mead's study in *American Samoa* which differed significantly in terms of economy, social organization, and colonial history [cf. Holmes, 1987: 149, 173].

The evidence and argument which Freeman presents has instead the specific purpose of "scientifically refuting" Mead's claim that her findings on Samoa falsify (i.e. constitute a "negative instance" to) biologism. Freeman intends to do this by demonstrating that "the depictions on which Mead based this assertion are, in varying degree, mistaken" [1983: xii ff]. Under the circumstances, not fully familiar with Mead's site, and dependent on case studies by others (including those of Lowell Holmes), Freeman's intervention has an abstract subjective quality to it. On one hand he is amassing bits and pieces of evidence against Mead, almost like juxtaposing counters in a board game. On the other, the ethnographic tradition does not prepare an anthropologist for concrete scientific thinking outside the limitations of the case study. Hence the tendency to abstract thought, to subjectivism, to "making and unmaking."

IT MAY INDEED be more accurate to conceive of the relationship between biologism and Boasian anthropology as one of simple negation. Biologistic doctrine maintained that biology was destiny. The Boasians retorted that culture set the terms in which human action could be expressed, i.e., culture was destiny. On one hand, the truth of biologism would simply negate Boasian doctrine. On the other, the truth of Boasian anthropology would negate biologism. While *both* claims cannot jointly be true, *neither* claim is necessarily true. Freeman's intervention must be assessed in the same light.

If Boasianism and biologism are simple negations of one another, this leaves open the question of what constitutes the dialectical negation of both. Here biologism is simply another instance of vulgar materialism despite its acceptance of certain scientific trappings such as theories of biological evolution [for an example, cf. Pearson 1937: 276 ff]. Boasian anthropology in turn was based on a conjuncture of neo-Kantian idealism on the one hand, and empiricism on the other. Hence both biologism and Boasian anthropology are manifestations of what Frederick Engels called the "Metaphysical Worldview" [cf. Marx-Engels 1975 xxv 338-342].

What will constitute the "synthesis," to use Freeman's own term, that raises this scientific discourse to a higher level? As a heuristic, it may be useful to consider that a positive and its negation are both forms of Being. If we then consider what is *Becoming*, we may recognize the form which dialectical negation will take in this case. The form of *Becoming* for both biologism and Boasian anthropology was *social evolutionism*, as well as what came to be its philosophical recapitulation, historical and dialectical materialism. (The paradigmatic exemplar of social evolutionism is, of course, Engels' [1972] *Origin of*

the Family, Private Property, and the State.) An awareness of this *Becoming* is evident in both the Boasian anthropological and the biologistic writings, where we find each expressing greater hostility towards social evolutionism than towards one another. The reason for this hostility is also evident—it is social evolutionism's search for nomothetic (law-like) explanations of societal transformation, a search which places the future of the capitalist order in serious doubt.

Boasian anthropology versus social evolutionism

Franz Boas expressed his opposition to the evolutionary theory of society in his earlier as well as his later writing. In his 1896 article on the "Limitations of the Comparative Method of Anthropology," he observed that anthropology, as understood by his contemporaries, implied that "laws exist which govern the development of society, [and] they are applicable to our society as well as to those of past times and of distant lands." Further, Boas complained that his contemporaries increasingly believed that their "studies must be confined to researches on the laws that govern the growth of [modern] society" [1940: 270]. This has corrupted anthropological research, in Boas' opinion, to the point that "the object of investigation is to find the *processes* by which certain stages of culture have developed. The customs and beliefs themselves are not the ultimate objects of research" [1940: 276]. Boas was very dubious about the merits of the entire project as well as its methods.

Boas recommends to us "another method, which in many respects is much safer." This amounts to "a detailed study of customs in their relation to the total culture of the tribe practicing them" [1940:276]. He refers to this "safer method" as the "historical method," the "inductive process," and indicates that "its application is based, first of all, on a well-defined, small geographical territory, and its comparisons are not extended beyond the limits of the cultural area that forms the basis of the study" [1940:277]. Needless to say, this self-imposed limitation on science precluded an evolutionary theory of society. Moreover, it elevated the genre of autobiography to the level of the universal, in the peculiar form of the ethnographic case study.

Boas returned to this theme in his later writings. We find him arguing in [1930] in "Some Problems of Methodology in the Social Sciences" that "the early attempts of [Lewis Henry] Morgan to associate social organization and economic conditions have proved to be fallacious." He continues: "more recent attempts to interpret forms of culture as due to purely economic conditions have been equally unsuccessful" [1940: 266-267; but cf. Blumberg and Winch 1972]. At this point, the reader might be tempted to concur with Boas; after all, it is not "economic conditions," whether "purely" such or otherwise, which are a causal factor, but economic relations and activities. However, Boas has seriously misrepresented Morgan on this point. We must recall that Morgan was concerned with "modes of subsis-

tence" or "modes of life"—which in turn defined "ethnic periods," "ethnic stages," "ethnic conditions," etc. [1877: 8]. But Boas, in rejecting nomothetic social science, would also dismiss the relevance for anthropology of both "economic conditions" and "economic relations and activities." With reference to his own era, Boas concludes: "similar observations may be made in regard to social organization and industrial activities. There is no significant law that would cover all the phases of their relations" [1940: 267; but cf. Gordon *et al.* 1982].

IN THE FACE of Boas' continuing and categorical rejection of the evolutionary theory of society, his comments on biologism may be seen in their proper perspective. But Freeman is clearly unwilling or unable to assume that perspective; he has simply misrepresented Boas here. Rather than dismissing the significance of biology and heredity for anthropology, Boas in fact made substantial contributions to this topic [cf. also Gerson 1976: 125; Holmes 1987: 1-2, 16; and Leacock 1987: 177]. As a devoted neo-Kantian, Boas held that biological explanations had their proper sphere, as did social and cultural explanations; only the two spheres did not overlap. As early as his 1887 article on "The Study of Geography," Boas held that "there exists another object[ive] for science besides the deduction of laws from phenomena." [It is not our point here to address what such an empiricist and inductivist conception of science might mean.] For Boas, such "deduction" was physicalist: "it is our opinion that there is another object[ive]—the thorough understanding of phenomena" [1940: 641]. Such "understanding" is the hallmark of neo-Kantian dualism [cf. also Parenti, 1986: 21].

Boas found direct relevance of these dualist doctrines for anthropology. Before the turn of the century, he had distinguished several spheres of anthropology—that of physical anthropology and that of social anthropology [ethnology] and linguistics. It was an ontological difference: "That part of human history which manifests itself in the phenomena that are the subject of physical anthropology is by no means identical with that part of history which manifests itself in the phenomena of ethnology and of language." The first set of phenomena are *natural*, biological if not physical; those of ethnology and linguistics are preeminently *cultural*. Characteristically, Boas concluded by noting a methodological consequence: the "branches of anthropology must proceed each according to its own method" [1940: 171].

Boas continued to accept the neo-Kantian bifurcation of anthropology throughout his career. In 1936 he observed that "during the last decades physical anthropology and social anthropology [ethnology] have drifted more and more apart" [1940: 172], again recognizing the drift as both substantive and methodic. "This seems unavoidable on account of the difference in subject matter and the necessity of a thorough biological training for the one branch, while the other requires a knowledge of ethnological methods" [1940: 172]. Boas' debate with the biologistic writers was thus one demarcation of the

sphere of culturalistic explanations (*Geisteswissenschaften*) from that of physicalist explanations (*Naturwissenschaften*), implicitly accepting the independence of each [cf. also 1940: 268]. It was far from the utter rejection characterizing Boas' assessment of the evolutionary theory of society.

ONE OF BOAS' first graduate students, Alfred Kroeber, carried this discussion further [Freeman 1983 ch. 3]. "A genuine problem exists," he maintained, in the "blending of nature and nurture." He went on: "this problem cannot be solved by the historical sciences alone because they do not concern themselves with heredity. Nor can it be solved by biology [which cannot] operate with the non-biological principle of tradition [i.e., culture]. Here then is a specific task and place in the sun for anthropology: the interpretation of those phenomena into which both organic and social causes enter" [1923: 3].

Kroeber's assessment of the biologistic approach is a measured one. "The biological aspects of man must be interpreted in terms of biological causation, his cultural aspects in terms first of all of cultural causation. After they have been thus resolved, the cultural causes may reduce to ultimate factors of heredity and natural environment" [1923: 87]. Biologistic thinking [e.g. Pearson, 1937: 304] would scarcely contest that! In summing up his position, however, Kroeber was somewhat more resolute; he confided that in the explanation of cultural phenomena, "environment and heredity are in the main superfluous. They need not be brought in" [1923: 192]. Contrast that to his harsh assessment of social evolutionism. These conceptions are "threadbare, descended to material for newspaper science or idle speculation, and evidence of a tendency toward the easy smugness of feeling oneself superior to all the past" [1923: 9].

Let us consider one aspect of evolutionism. Social evolutionism—in its most coherent form—holds that a cultural artifact is an element of the superstructure (i.e. a symbolic reflex) of a particular mode of production in given geographical, climatic, and other environmental conditions. Similar modes in similar environments can generate similar artifacts, the latter being independent of one another (so-called *parallelism*). Kroeber, however, was a *diffusionist*, holding that similar artifacts can indicate cultural "borrowing" from societies at different stages of socioeconomic development [1923: 195]. The difference between the two views—a difference which has long exercised anthropologists [cf. Boas, 1974: 273-278] as "Galton's Problem" [cf. Naroll, 1970]—can be understood in that parallelism looks to the sphere of production, while diffusionism looks to the sphere of circulation, for the explanation of cultural change.

At this point, Kroeber moves to the level of particulars. He gives the example of the Double-Headed Eagle of Hittite origin, incorporated into the heraldry of the Romanov dynasty in Tsarist Russia. It was also found among the decorative motifs of the Huichol tribe of Mexico. Kroeber concluded that diffusionism prevailed: Cortez must

have carried the symbolism to Mexico [1923: 203]. But Kroeber was forced to recant on this diffusionist point almost immediately, having discovered in a museum a prehistoric Nazca Peruvian bowl displaying the double-headed eagle, a motif clearly antedating the conquistadores; it was indigenous to the New World. "Here then we have a clear case of an early independent origin or parallel" [Kroeber, 1933: 16]. And what does this entail for diffusionism? Such evidence notwithstanding, Kroeber did not revise his assessment of social evolutionism. Clearly "falsifiability" has its limits.

Biologism versus social evolutionism

Let us next turn to the supporters of biologism. Not all biologicistic thinkers were Social Darwinists, of course—Auguste Comte comes readily to mind. But Social Darwinists such as Herbert Spencer, Francis Galton and Karl Pearson were much more relevant to the Boasian anthropologists than was the manic Comte. We will focus our attention on Spencer, with occasional reference to Pearson.

Social Darwinism had some affinities with the theory of natural selection, and Social Darwinists sought to create the impression that there were many more. There were, however, basic differences between the two doctrines. It will be useful to draw some contrasts. Most profoundly, Social Darwinism held that the struggle for existence tended to preserve and perfect the biological ideal-type. As Herbert Spencer put it, "human beings are subjected by pressure of population to a competition for the means of subsistence...on the average the tendency is for the select of their generation to survive, so, little by little, producing a better-adapted type" [Spencer, 1904: 451]. He did not simply intend a tautology—the "survival" of the "select," those "selected" to "survive." Rather, two factors were operating here: decreasing fertility and "use-inheritance" (Lamarckism). Those individuals with lesser fertility have "greater mental activity," more productivity, etc. and through the "sublimation" of these efforts thereby become the "select of their generation." Furthermore, whatever is "used" by this generation's survivors becomes an acquired characteristic and is "inherited" by the next [cf. Spencer, 1898:I, 610 ff].

The theory of natural selection, by contrast, held that the struggle for existence tended to generate *new* biological forms (morphogenesis) rather than to preserve and perfect types (morphostasis). Variation occurs stochastically, and the *most* fertile variant in a given environment tends to survive [cf. Marx and Engels, 1975: xxv, 63-64]. Thus the variant which is selected does not necessarily possess progressive characteristics any more than did the other variants [cf. also Gould, 1977: 13]. As a contemporary observer of these ideational developments, Leonard Hobhouse, commented, Spencer's conception of pan-evolutionism was a "descriptive formula" while the theory of natural selection in biology was "causational." It is the latter

alone which would "enable us to predict the future or infer the character of the unrecorded past" [1911: 106-107; cf. also Marx and Engels, 1975: xxv, 518]. Indeed, the Social Darwinist doctrines are not only non-scientific, but must be seen in the light of their Malthusian and conservative overtones. To the extent natural selection *does* operate in human society, Social Darwinist doctrines are in effect ruling class apologetics, justifying exploitative policies against those whose participation in productive labor is being selected for, those with higher fertility rates, those of the working class and non-European heritage.

BOTH DOCTRINES had implications for understanding the societal realm. On the one hand, the basic presuppositions of the biologicistic doctrines—vulgar materialism ramified by mechanistic analogies—were extended straightforwardly to the social sciences. Spencer [1898: i, 596], for instance, maintained that "social evolution forms a part of evolution at large" [cf. Pearson, 1937: 301; also Freeman, 1983: 296, who argues from the *potentiality* for evolution to the *products* of evolution]. Spencer sought to prove this claim by a careful selection of "facts" which would not disturb his "descriptive formula." Hence his is what Adolf Grünbaum has called "enumerative inductivism" [1976]. The unidirectional change in general from *homogeneity* to *heterogeneity* which he postulated as a cosmic process was understood to be instantiated in the societal change from the *militant* (i.e. the "military" or "despotic" type) to the *industrial* type of society. It is suggestive of his sense of evidence that Spencer refers here to Norway [1898: i, 579]. Finally, he indicates that struggling against this societal change and the increasing social division of labor is misguided and fruitless [cf. Hobhouse, 1911: 20-23].

Pearson, deeply influenced by Bismarck's "Prussian Socialism," argued that the human struggle for existence manifests itself at the level of the *individual* (the Spencerian sense of struggle) and at the level of the *nation* (which Pearson called the "Socialistic" sense), as well as in humanity's struggle against the environment [Pearson, 1937: 306 f]. According to Pearson, there is no such struggle as that between antagonistic classes; he would simply define it out of existence. "Socialism" thereby becomes the perverted National Socialist ideology, wherein "class struggle" becomes the antagonistic relation between "plutocratic nation" and "proletarian nation."

But Pearson goes even further. Humanity's struggle against nature he calls "Humanism," with evident positivist echoes. Pearson's "Humanism" is "satisfied" when "a capable and stalwart race of white men should replace a dark-skinned tribe which can neither utilize its land for the full benefit of mankind, nor contribute its quota to the common stock of human knowledge." In the end, there is no such struggle as that for national liberation; for Pearson it becomes "the struggle of civilized man against uncivilized man and against

nature" [1937: 310]. Predictably, his reference to "uncivilized man" is to the Black South African (i.e. the "Kaffir"; cf. 1937: 309, note).

Freeman, for all his espousal of a "More Scientific Paradigm" in anthropology [1983: 294 ff], seems to follow Pearson's lead here. He seeks a system theory incorporating both *genetic* and *exogenetic* elements [1983: 299]. The genetic elements of this system are straightforward enough, but what is one to make of the "exogenetic"? Definition in terms of the genetic and its simple negation, characteristic of biologicistic thought [cf. Holmes, 1987: 13], reduce the categories of the social and the cultural to residual status.

FROM the standpoint of dialectical materialism, it is likewise unacceptable scientifically that Freeman can find no place for social structure in his "More Scientific Paradigm". His entire discussion of the "exogenetic" in Chapter 20 is limited to cultural reflections rather than their structural bases [1983: 294-302]. This, despite the well-documented reciprocal relationship between cultural elements such as language, and social structure—culture affects social inequality, as Freeman's favorite illustration of the language of etiquette shows, but inequality affects linguistic culture as Dell Hymes [1974] and Wm. Labov [1972] have amply demonstrated. And this, despite the fact that the various ethnographies of Samoa, upon which Freeman depends, highlight the significance of social structure, political power, and the control of economic resources [e.g. 1983: 123]. What Pearson would attain by a definitional sleight of the hand, so Freeman would accomplish with another sleight of the hand. More Scientific, indeed!

Not all Social Darwinists were so brazen as to dismiss the issue of social antagonism out of hand. With specific reference to class struggle and the Paris Commune of 1871, Spencer pontificated that "the relation of master and workman has to be tolerated, because, for the time being, no other will answer as well." And what was the answer, in his conception? *Laissez faire!* Spencer continued: "this organization of industry we now see around us must be considered as one in which the cost of regulation, though not so great as it once was, is still excessive...under better systems to be expected hereafter, there will doubtless be a decrease in the cost of regulation" [1876:229]. Apparently Spencer was unaware of the economic concept of externalities, which makes clear that the cost to the enterprise, incurred by regulation, amounts to a benefit for the community, and the benefit to the enterprise, resulting from non-regulation (or deregulation), amounts to a cost for the community through pollution, wasting of resources, industrial accidents, shoddy merchandise, etc. Of course, Spencer lived in an era before Bhophal and Judge Douglas Ginsberg.

By contrast, the theory of natural selection in biology has been understood to be independent of processes of social evolution. Julian Huxley has made two points which bear on this claim. First, he stressed that "all or almost all of the increase in man's control over

nature have been nongenetic, owing to his exploitation of his biologically unique capacity for tradition" [1964: 573]. Thus biological evolution is not *necessary* for the societal evolution of humanity. Second, he suggested that exterminating humanity would end forever the possibility of culture and thereby social development, even though biological evolution were to continue [1964: 571]. Thus the "Planet of the Apes," a popular movie depicting the cultural dominance of apes over humanity following a nuclear war, can never be more than science fiction. Biological evolution is no longer *sufficient* for societal evolution. Jointly, these points establish that biological evolution is logically independent of social evolution, rendering the latter distinct from "evolution at large." Of course, the societal process can be understood to be constrained by biological capacities and conditions, as it is by geological, climatic, and other conditions, but that is another point [cf. Marx-Engels 1975: v, 42n].

THIS independence was acknowledged both by the [pre-Boasian] anthropologists and by the theorists of natural selection. Edward Tylor, perhaps the most eminent British anthropologist of that era, in his *Primitive Culture* [1873], "strenuously" advanced a "theory of development or evolution," yet it "scarcely" had any need to mention the work of Darwin [1958: xvi]. In that book, Tylor presented a theory of selective advantage in human society based on group affiliation which depended more upon such traditions as the early historical materialism of Montesquieu's *De L'esprit des lois*, on his conception of the advantage of a "society of societies" [Livre ix, 1], than upon the vulgar materialism which traced selective advantage to the "mixing of stocks." On the other side, Thomas Huxley pointed out as early as the 1860s that human culture emerged with the evolution of the human capacity for "intelligible and rational speech" [1898: 155]. This was a cumulative and intergenerationally transmittable product which had movements distinct from those of biological processes. Thus anthropology and the theory of natural selection in biology have both acknowledged that social evolutionism must be formulated in its own terms, not as a weak shadow of biologicistic doctrine. We can recognize that the two different spheres, societal and biological, find their unity only in the framework of dialectical materialism.

All of this requires a social science which is categorially rich enough to address not only the dialectic of *general* and *particular*, i.e., *modes of production* in varying *natural environments*, but also the *specificity* of social relations, consciousness, and culture (including language). To the extent that human genetic endowment is relevant to such a social science, it is an aspect of the natural environment. The particularities of the latter have some bearing on the specificity of society, but they are largely mediated through the mode of production. Such a dialectical anthropology carries us far beyond the youthful endeavors of Margaret Mead in the 1920's, and beyond the strivings of Derek Freeman in the present decade, for that matter.

Conclusion

Thus, as class struggle intensified during the later decades of the 19th century, we see that Socialism, Marxism, historical materialism, Morgan's social evolutionism, etc.—virtually any aspect of science revealing the significance of dialectics—all became increasingly disreputable in “higher circles.” And their reputations in those circles only worsened with the onset of the general crisis of capitalism and the Bolshevik Revolution. As evidence of the latter, we find the persons and the periods hopelessly confounded. For instance, we find Engels described as “the most explicit Bolshevik spokesman” [Leslie and Kerman 1985; 116], though he died in 1895, some years before the 1903 split between Bolsheviks and Mensheviks. The primary task of “reputable” academics in the West—and even aspiring academics—came to be the promotion of doctrines and Meta-physical Worldviews which did not threaten the bourgeois order. Thus the popularity of the two competing approaches, Boasian anthropology and biologism.

All this bears on our understanding and practice today, as the 20th century wanes and along with it, imperialism as well. As we have seen throughout this essay, it is essential to recognize the dialectical considerations and implications of science and its development. We must first assess the ideological significance of a discipline such as anthropology—as well as its artifacts (e.g. monographs, essays, etc.)—in class terms, and only then weigh the merits of the controversies between the several forms of apologetics and obfuscations. That caveat seems relevant to understanding the anthropology of the 1980s no less than that of the 1880s.

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The two books in brief

Lowell D. Holmes, *Quest for the Real Samoa: The Mead-Freeman Controversy and Beyond*. South Hadley, MA: Bergin and Garvey 1987. x+209 pages, bibliography, index, \$29.95.

IN 1954 HOLMES undertook a deliberate restudy of the village Ta'u in American Samoa, studied in the mid-1920s by the late Margaret Mead. Here he reports conclusions from this unique restudy and subsequent Samoan studies. The work assumes great importance in the light of Derek Freeman's attack on Mead and her Samoan studies.

Holmes' book begins by reviewing the background of Mead's research for her *Coming of Age in Samoa* [1928]. Next, he considers the use and misuse of "methodological restudies." Then he gives findings from his own restudy of American Samoa in four chapters on culture, social organization, religion, and the life cycle. Another chapter considers how historical change may have affected comparisons one could draw between his and Mead's findings. Assessing Mead, he finds "the validity of her Samoan research is remarkably high" [p. 103].

Since much of the controversy about Mead's Samoan studies turns on the issue of the Samoan personality, Holmes devotes a chapter to a review of the various psychometric tests of Samoan subjects. Then he closes by addressing the topic we have all been waiting for, his assessment of Mead's sharpest critic, Derek Freeman. Holmes concludes that anthropological work "should not be something that attempts to close the door on all further investigation and purges alternative interpretations. This is the effect of [Freeman's book,] *Margaret Mead and Samoa* [p. 175].

Overall, Holmes' book is strongly recommended for its substantive contribution to Micronesian ethnography, and even more so for contributing to the scientific and professional development of anthropology.

Derek Freeman, *Margaret Mead and Samoa: The Making and Unmaking of an Anthropological Myth*. Cambridge MA: Harvard University Pr. 1983, xvii+379 pages, index. \$25.

When Margaret Mead, in *Coming of Age in Samoa* [1928], concluded that adolescence in Samoa was not particularly stressful, she thereby cast serious doubt upon biologicistic thinking in the social sciences. Derek Freeman says he knew by 1943 that someday he would have to "face the responsibility of writing a refutation of Mead's Samoan

findings" [p.xiv]. His book has four parts. The first juxtaposes Francis Galton's biological determinism to Franz Boas' "cultural determinism." The next suggests that Mead, as Boas' graduate student, got the task of proving cultural determinism by finding a "negative instance" to falsify biological determinism. The third, "A Refutation of Mead's Conclusions," has 11 chapters on such topics as the historical setting of Samoa, aggression, religion, childrearing, adolescence, and the Samoan ethos. Of the two concluding chapters, one casts Freeman's final slanders against Mead's Samoan studies and another, "Towards a More Scientific Anthropological Paradigm," praises the contribution sociobiology has made to our understanding of other cultures.

This book is hardly science; it is tendentious, its reasoning specious, its evidence selective. Perhaps because of these characteristics, its publication date was well timed. On internal evidence, it appears that Freeman had completed the draft by the mid-1970s while Mead was still alive, a consideration which may have delayed publication. By the early 1980s, however, the cultural climate was ripe for a sociobiological attack of this sort. Resurgent racism was just then calling for 'scientific' legitimation. Of course, the moment would have been lost had publication been delayed. Progressive trends were again to the fore by mid-1980s. Consider by contrast Lt. Col. Oliver North's media circus of the summer of 1987—so soon forgotten! Perhaps Ollie should have had Harvard University Press package him and promote his line, as Freeman had a few years earlier!

On Art and Science

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Introduction

THE activities involved in the *production* of artworks and of scientific hypotheses or theories, as specialized forms of labor, are part of the material basis of society. Such production is neither superstructural nor ideological in nature. Often, however, the end products of these activities, i.e., works of art and scientific doctrines, are appropriated by various classes for ideological uses. In aesthetics, this is seen in theories about the autonomy of artworks—Eagleton [1989] goes so far as to argue that the whole enterprise of modern European aesthetics is ideological. In science this appropriation is seen in discourse about “laws of nature” in which “laws” take on an almost Platonic existence—as standing behind and directing observed phenomena—or when an ontological status is attributed to scientific truth or scientific measurement.

Those who argue that art or science are either totally ideological or that they are totally objective make an identical mistake in divorcing activity from product, or separating practice from theory. Any adequate analysis (here I argue for Marxism) must unite these elements.

Some illuminating examples of the ideological use of specific artworks and scientific doctrines are given [1]. These are drawn from art-historical studies and from works in the social relations of science.

I conclude with the question: How can we determine which scientific theories and which works of art are more adequate approximations of nature and society? A provisional answer suggests that epistemological procedures suffice for the critical validation of scientific theories, but cannot be easily applied to the arts, where functional criteria are more useful.

1. Some other examples in my studies are: Science and values (*Research in Philosophy and Technology* vol 1, 1978); A myth of creativity (*Revolutionary World* vols. 49/50, 1982); Art for the people (*The Arts in a Democratic Society*, D. Mann, ed., Bowling Green 1977); On the liberation of aesthetic consciousness (*Art in Society* Summer 1972); Toward an empirical theory of art (*The British Journal of Aesthetics* Spring 1971).

Material basis versus ideological superstructure

ART AND SCIENCE are transformative human activities in which the materials of nature are reshaped under cognitive direction. This means that they are highly specialized forms of labor. The origins of science, which can be traced to tool-making in hunting and gathering communities, in later agrarian economies and in the technology of industrial societies, comprise a history of the development of human productive forces—forces that dictate the structure of work relations. But the production of art, though not properly economic, is also part of the material basis of society and may even predate the production of tools in human pre-history [cf. Truitt 1989]. The question of whether the earliest art had a utilitarian function cannot be determined, although much has been written about it. But even if it did not have such a function it was part of what Marx called the human “species essence” (*Paris Manuscripts of 1844*) and therefore part of the material basis of human social organization. In order to get at the sense of what is meant by saying that both art and science are part of the material basis of society we must think of both as producing or transformative activities.

One aspect of these transformative activities is mimetic. The arts reproduce nature and social relations by way of familiarizing, internalizing, and humanizing these environments. Scientific activity reproduces the “useful” structures found in nature and then later reproduces the laws of nature with the purpose of technical mastery of the environment. The end results of these activities are, in addition to any obvious utility, interpretive. Thus theories, as pictures, attempt a cognitive map of reality in an objective or quantifiable construction, and pictures (art) are subjective interpretations aimed at figurative, colorative, or other, one might say, qualitative constructions. As end results these theories or art works are appropriated ideologically and reflect, within the superstructure, the level of development of the productive forces in the societies where they are created—which is to say they are, at least in part, ideological.

Now to say that art is part of the material basis of society is heresy to a certain tradition within Marxist theory of art, namely, the tradition that traces back to Plekhanov [1912] and his followers who believed that *all* works of art were ideological or could be explained by some social equivalent. But, oddly, this is not very different from the most prevalent bourgeois theory of art, formalism, which teaches that *no* work of art is ideological and that we must understand *works of art* in terms of their structural properties alone. What these positions share is an undialectical focus on the final product—the work of art—divorced from the productive activity. In science we find similar tendencies: in phenomenology (Husserl and his followers including Marcuse) the claim that *all* scientific theories are ideological, and bourgeois positivism which claims that *no* scientific

theories are ideological as long as they meet some test of confirmation, i.e., are not metaphysical in nature.

Marxism, when it distinguishes between the activities of scientific discovery and the variety of theories that are the consequences of this activity; Marxism when it distinguishes between the artistic activities of producing art and the final variety of representations, stands somewhere between these antagonistic and abstract outlooks.

Finding a place for art

THE problem of how art fits into the superstructure or how art is integrated into an ideological system (as a form of consciousness) is complex. Marx [1859] was the first to recognize this complexity or difficulty, as can be seen clearly in the following passage from his *Contribution to the Critique of Political Economy*:

It is well known that certain periods of highest development of art stand in no direct connection with the general development of society, nor with the material basis and the skeleton structure of its organization. Witness the example of the Greeks as compared with the modern nations or even Shakespeare. As regards certain forms of art, as e.g., the epos, it is admitted that they can never be produced in the world-epoch making form as soon as art as such comes into existence; in other words, that in the domain of art certain important forms of it are possible only at a low stage of its development. If that be true of the mutual relations of different forms of art within the domain of art itself, it is far less surprising that the same is true of the relation of art as a whole to the general development of society. The difficulty lies only in the general formulation of these contradictions.

Exploiting the problematic nature of this passage, or for other reasons, many aestheticians assume the apparent lack of correspondence or connection between the development of the productive forces and of artistic production to be an unsolved or unsolvable problem. I disagree with this interpretation. Rather than questioning the explanatory power of historical materialism, Marx was calling attention to a problem about certain works of art and certain periods of artistic production. Indeed, Marx' real question was: How can art, produced in the context of the political economy of ancient Greece, still hold an appeal in the era of modern capitalist production? How can the artistic, ideological values of the Greeks seem to be timeless? What is the solution to the anachronism?

Besides the fact that a great deal of art from a great many cultures and periods has an appeal for us, and can be appreciated by modern Europeans (Egyptian, African, Mayan, Japanese, etc.), which suggests a fundamental aesthetic need, there are particular factors pertaining to Greek civilization, some of which we have already noted, that may help to explain a special kind of appreciation. For example, since the Renaissance, the ideal of classical perfection has been held up as a model of artistic achievement. This was certainly not so in the

Christian Middle Ages in the West nor in the iconographic tradition of the East—in both of which sensuous perfection was suppressed. Also the naturalistic attitude of the Greeks, reflected in much of their sculpture, is broadly shared in the post-Renaissance and modern era. And finally let us note that the Greek philosophers and historians speak more directly to us, for we share many of their concerns including a quest for empirical accuracy, a preoccupation with democracy and tyranny, and the many problems of a market economy. These interests are quite unlike the alien theological discourses and disputations of the Middle Ages which are largely unintelligible to us; although we can appreciate some of their attempts at art.

What we discover in Classical Greek art are not "eternal charms" but, in a way, recognition of similar attitudes, concerns, and values which have accrued to Western Culture especially since the Renaissance. The problem that Marx cites, in other words, is a complex one. Such generalizations do not provide a solution but merely point the way to one. I do not, however, have such difficulties in describing the ideological or superstructural qualities of most cultural products.

IT IS a postulate of Marxism that ideology reflects the level of the development of the productive forces and their corresponding social relations. Thus when social relations take the form of classes in struggle, it is commonly expected that the prevailing ideologies will be bearers of the values and interests of the prevailing classes or the ruling classes. This is said to be true of artistic representations inasmuch as they comprise part of the superstructure and ideology of society. To the extent that those were or are "societies" that are not divided into classes it should then be possible to show that its art immediately reflects the forces and relations of production in a more direct and less distorted way. This was demonstrated by Raphael [*Prehistoric Cave Paintings*, 1945] in his study of communities in which there were few, if any, class distinctions:

Paleolithic art is centered around the animal; there is no place in it for the middle axis, for symmetry and balance inspired by the structure of the human body. Rather, everything is asymmetric and shifted. The objects are not represented as they appear when seen from a distance, as we are accustomed to seeing them in paintings from the times of classical antiquity, but as near at hand—for the paleolithic hunters struggled with the animal at close quarter, body against body; only the invention of the bow, which in the paleolithic age meant a revolution comparable to the invention of the boat and the plow in the neolithic age and the steam engine in the Christian era, made the distant view possible. Finally, the object of paleolithic art is not to picture the individual existence of animals and men, but to depict their group existence...

This shows one way in which art may convey "truth" about social relations. But there are many more ways in which it can lie, since class societies multiply the possibilities. We shall cite a few examples.

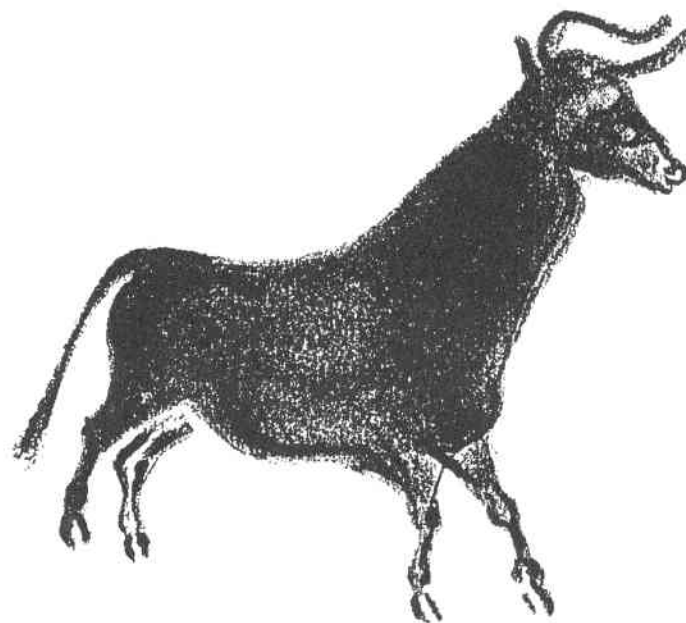
Probably the first instances of pictorial distortion for ideological purposes that scholars have taken note of are the "law of frontality" in Egyptian art and the "iconographic" dogma of Christian Orthodoxy. Both of these are cases of the attempts of authority to control art in the service of reaction. On the other hand, the Marxist scholar H. Deinhard [1970] has shown how the works of Giotto reflect a progressive tendency in the fourteenth Century. In her study of "The Massacre of the Innocents" she explains how

The relation existing between the new structure of Giotto's picture and the new capitalist social structure of his time is not direct; rather it is mediated by a new mentality, the new rationalism. This mediation takes place in such a way that the new mental attitude appears as a *presupposition* of the pictorial structure whereas this very presupposition is the *end result* of the extra-artistic structural changes which took place in the course of historical development (p 34).

EARLY Florentine capitalism is characteristic of the early forms of capitalist development, that is, its development is realized in the gradual rationalization of labor: commodity production for a market economy, increasing division of labor and specialization of activities and functions which are rationally interconnected. Neither this society nor Giotto's paintings can be understood from the standpoint of earlier feudal structures of solitary production. What is required conceptually is the standpoint of the entrepreneur "...who determines the process as a whole and channels it...without participating..." (p. 35). Here Giotto's pictorial form conforms structurally both in terms of the relational forms and the directional thrust of the major protagonists: author, agents, and victims. The nascent mercantile capitalism of Florence is shown to be a fundamental formative principle in Giotto's work.

Turning to examples in our own century, we will note only in a very cryptic fashion the ideological ambience of well known works and artists. When Duchamp introduced a urinal entitled "Fountain" into an art exhibit in Paris in the early part of this century, critics imbued with the purity of spirit that we call formalism raced to their typewriters to extoll such aesthetic qualities as the urinal's gleaming white porcelain surface which justified its inclusion. None were concerned with the obvious insurgency of such a presentation: to challenge the criteria of aesthetic and cultural competence established by bourgeois institutions, rules by which only uncritical and culturally neutral works were deemed artistically acceptable.

Much of modern art has set itself the task of rendering a grotesque reproduction of grotesque reality (Wunsch, Kollwitz, Kofka, Grosz), but some artists are content with a neutral depiction, or perhaps even an endorsement of things as they appear, for example, consumerism—hypostatized in real life reproductions of soup cans or scouring pads. Andy Warhol's paintings are typical in this respect. In these



from Raphael, *Prehistoric Cave Paintings*, 1945

works we find a random collection of dead objects, hanging together on the canvas like so many turnips, as shorn of their earlier life as the piles of shoes left over from Auschwitz or, as F. Jameson [1982] writes,

the remainder of tokens of some incomprehensible and tragic fire in a packed dancehall. There is therefore in Warhol no way to complete the hermeneutic gesture, and to restore to these oddments that whole larger lived context of the dancehall or the ball, the world of jetset fashion or the glamour magazines. Yet this is even more paradoxical in the light of biographical information: since Warhol began his artistic career as a commercial illustrator for shoe fashions and a designer of display windows in which various pumps and slippers figure prominently. Indeed, one is tempted to raise here...one of the central issues [of contemporary capitalist culture] and its possible political dimensions: Andy Warhol's work turns centrally around commodification, and the great billboard images of the Coca-Cola bottle or the Campbell's Soup can, which explicitly foreground the commodity fetishism of a transition to late capital, *ought* to be powerful and critical political statements.

But, of course, they are not. Nor was Kerouac's introduction to the world of the esthetes what has been called the hallucinatory worlds of pot, and the mushroom, of heroin and lysergic acid, the Reichian world of deviant sex and the mystical exercises of oriental sects [cf. Dymshits 1969]. These anti-novels spoke to a generation without values yet in rebellion against bourgeois values, a generation without "ideological" alternatives. And what are we to make of Mailer, the once promising novelist of the real world with a progressive political perspective who now surrenders to a kind of voyeurist journalism that fetishizes cultural decadence and abnormality.

IN POETRY, when we look at the modernist tendencies unleashed by Eliot and Pound we realize that *The Waste Land* is at once a condemnation of history and the echo of the collapse of bourgeois culture. From the standpoint of poetics the poem is fragmented, yet its symbolism points to a transcendence of the rottenness and dinginess of a disintegrating epoch. The solution from the standpoint of the poet lies in the restoration of the romantic, organic unity of precapitalist European civilization. But this poem is not the product of the traditional structures of pre-capitalist discourse and modes of communication. Its forms are vital and to an extent progressive; it is rife with the 20th century. Yet the moral and social content is anachronistic. Eliot embraces a royalist, Anglican conservatism in an era of the progressive struggles of democratic forces which, to borrow a phrase from C.P. Snow, "has the future in its bones."

More recently, the poet has given up the role of the writer in favor of the embodiment of an individualistic lifestyle as in the "Beat Generation" or, at the opposite extreme, becomes an affirmative reflection of the social and cultural environment, a communicator of common life experiences (from "happenings" to McDonald's), a pur-

veyor of the civic values of prevailing institutions and popular activities as in poets Pinsky or McMichael [2].

We can see that works of art are not ideologically neutral. They are complex reflections of ruling values and, in some instances, attempts to repudiate the domination of such values. Yet institutionally, in universities, art schools, and museums, art has become a powerful, formative element of the superstructure—for example the continued propagation of the principles of abstract expressionism. Yet, to the extent that as an activity art is the expression of a basic human need, like other forms of labor, it is part of the material basis of society. The problematic aspect is that like the intellectual labors comprising philosophy and science, its products are often appropriated and distorted in the service of exploitation and oppression.

Finding a place for science

NOW WE TURN to examples of science and philosophy performing similar ideological functions in our grotesque 20th-century reality.

Lukacs' [1981] study of irrationalism was an important contribution to our understanding of how the 19th century biological doctrine of vitalism [3] was appropriated by the fascists. The Nazis transformed vitalism into an ideological component of their anthropomythology: "Universal biology is perfected in man's image of himself... This anthropology replaces exhausted philosophy" [Kriek, *Volkish, politische, Anthropologie*; quoted in Lukacs p535].

The fascists employed vitalism and subjectivism to "solve" what they found to be an insoluble dilemma of anthropologism in philosophy. The anthropological idealism of classical German philosophy had to be expurgated and overcome. Thus,

"Hitler is not *less* than the idea—he is more than the idea, for he is real." Kriek gave an extremely clear picture of how this reality of life is manifested: "Destiny demands the heroic man of honour who is receptive to every order." The order was, of course, to come from the Fuhrer: "The personality of the pre-ordained Fuhrer is the arena in which the fate of the whole is decided." What the Fuhrer and what the National Socialist movement wanted was nothing else than a religious revelation. Kriek vigorously defended the notion that such a revelation was possible even

2. See, for example, Robert Pinsky's collection of verse, *An Explanation of America*, Princeton 1979.

3. Vitalism was one of the various philosophical strategies designed to refute materialism. Also known as *Lebens-philosophie*, its claim was that living things cannot be reduced to material elements in any sense (not even as [Hegel's] emergent qualities of material organization) and that any living system contains a substantive entity that imparts to the system powers possessed by no inanimate thing. It was the dominant ideology of the German imperialist era and helped shape the reactionary, anti-communist doctrines of the post-World War I period.

today: "But God speaks within us directly as the people setting out to battle." [Lukacs p536]

Here all antinomies of vitalism's nihilistic relativism resolve into the National Socialist myth — every question resolved by obedience.

Lewis Feuer's [1974] study of the convergence of scientific theory and political interest is also valuable in this regard [4]. According to Feuer, Heisenberg's indeterminacy-uncertainty theory was motivated by his hatred for Communism, an ideological consideration—not a scientific issue. Heisenberg's youth was spent amidst the chaos of class struggle following Germany's defeat in World War I. He felt deep patriotic loyalties to the German Nation and hatred for those forces seeking to overthrow the militaristic tradition: the materialistic Marxists and Communists. He lived in Munich where a revolution in 1919 proclaimed the Soviet Socialist Republic of Bavaria.

HEISENBERG was not simply a witness to the events of the revolution. He joined an anti-communist military detachment and helped overthrow the Socialist government of Bavaria. During this time he also began to study physics. The materialistic interpretation of physics that he found in his textbooks, classes, and lectures greatly distressed him. He thought it was deterministic and it offended his personal romantic idealism. And so he came to equate his two objects of hatred. He began to see physical materialism as a symbol for Marxism and Communism.

While serving in the anti-communist military group, Heisenberg had a very important insight: While on sentry duty on the roof of the Theological Seminary, he lay in the sun reading Plato's *Timaeus*, the refutation of Democritean materialism, a cause which he himself was now to take up. He was revolted by the Marxists and Communists who jeered at the old Bavarian society. Their materialism was crude and abhorrent to him. He was a lover of the old ways and the classics. And he decided to oppose Communism not only with his gun but also go to war against materialism in physics and replace it with a Platonic conception of spiritual or mathematical forms. In this way he could strike out at the harsh determinism of the vulgar scientific materialists and the Marxists at one and the same time. His deep patriotism, love of military tradition and excitement with war were threatened by Marxists and Jews who ridiculed patriotic idealism. At a physics conference Heisenberg avoided a meeting with Einstein whom he had heard was one of those Jews who scoffed at patriotism and the sacrifices of war.

Toward the end of his Munich anti-communist activities, Heisenberg joined a proto-Nazi youth group called the White Knights (der

4. EDITOR'S NOTE: One may ignore Feuer's Social Democratic prejudices and excessively Freudian interpretations while making use of his well-referenced information on social and political backgrounds.

Weisse Ritter). This group was anti-democratic, anti-humanist, contemptuous of social progress, and anti-semitic, advocating the expulsion of all Jews from Germany. In this organization Heisenberg enjoyed being a member of a regenerating elite anti-communist class rendering homage to the trinity: *Gott, Ich, und Waffe* [God, self and arms]. The White Knights blended in well with the Nazis.

Just as Heisenberg hated and feared the materialism of the Marxists, he hated and feared the possibility that materialism in physics might be proven true [cf. Forman 1971]. By 1920 he was convinced that the whole of modern atomic physics was false and he saw his role as a theoretical physicist as providing a new idealist foundation for physics. Along with avowed Platonism, Heisenberg [1962, 71f] invoked the theme of vitalism even before the Nazis took it up, declaring: "We Germans...tend to look upon logic and facts as a sort of straightjacket. We think that freedom lies only where we can tear this straightjacket off—in fantasy and dreams."

Einstein and Mach

FEUER [ch. 1] portrays the contrast in Einstein's intellectual development as a student: Zurich, where he studied advanced physics at the technological university from 1896-1900, was a haven for social revolutionaries of all kinds: Marxists, left-wing Zionists, anarchists, Nihilists. Einstein greatly admired the great German Marxist leader Rosa Luxemburg who had studied in Zurich, 1889-90. After her murder by the German government in 1919, he wrote that she was too good for this world and the German people didn't deserve her.

In Zurich at this time Einstein and his revolutionary student colleagues subsisted on little more than tea and ideology. Among these young student revolutionaries was one Fritz (Friedrich) Adler who was to become Einstein's closest friend and who was to play a unique role in Einstein's intellectual development. Adler, too, was a student of physics but he was also a leading student political activist, considering himself a party comrade since the age of 15. Much later he was to become internationally famous: in 1916 he assassinated the Austrian prime minister as a protest against his policies of political suppression. During the trial, Einstein stood by his friend and offered to testify. Einstein and Adler lived in the same house in Zurich and it was from Adler that Einstein learned a great deal about Marxism and Socialism.

Adler was also a follower of the physicist-philosopher Ernst Mach and he and Einstein spent many hours discussing the politics of Marxism and its relation to Mach's philosophy of science.

As for Einstein's own political views, somewhat later he wrote:

"I honor Lenin as a man who completely sacrificed himself and devoted all his energy to the realization of social justice...men of this type are the guardians and restorers of humanity." [Reiser 1930, 14]

It was under the influence of Adler and Mach's physical theories that Einstein developed his conception of relativity and ideas about space and time. And when Einstein, in later years, criticized Mach's philosophy of science, it was from the same standpoint that Lenin [1909 ch 1, sect 6] criticized Mach in 1909. Mach's views of the history of science made a deep impression on Einstein for they had the effect of sweeping away all absolutes. And Mach himself had shared the same socialist political sympathies as Einstein. He was a member of a Viennese Fabian socialist group and, in his youth, an enthusiastic supporter of the revolutions of 1848 which had failed. The principal conclusion of Mach's physical studies that impressed the young Einstein was the relativist conception of space and time.

It might be said that the chief components of Einstein's student intellectual development were two: the relativist epistemology of Ernst Mach and the revolutionary social outlook of Karl Marx — which at that time were blended together in the minds of many young Marxist intellectuals. Like his young Marxist colleagues at this time, Einstein felt that a scientific revolution would go hand in hand with a social revolution. The young Marxists felt a kinship with Mach's critique of absolute space and time, believing this critique to be the basis of a theoretical revolution in the sciences.

WHEN MACH died in 1916, Einstein wrote in a tribute: "Apparently Mach would have arrived at the theory of relativity, if at the time when his mind still had the freshness of youth, the question of the velocity of light had already engaged the attention of physicists" [Vasiliev 1924, 206f]. And so, Einstein's revolutionary enthusiasm is inseparable from his commitment to "relativity". This is nowhere made clearer than in the name he gave his new theory — the theory of relativity. This is because the theory of relativity, though revolutionary indeed, is not relativist at all.

An analogy may help show the non-relativist character of this system: When we speak of ethical relativism, we mean there is no absolute good valid for all people. In physical relativity, however, each observer's frame of reference is equally valid with that of any other observer, and there exist laws of transformation that correlate the different descriptions of an objective reality, so that finally invariant laws, valid for all observers, can be stated. But the political force of the term "relativity," a symbol of rebellion against absolutisms of all types, seems to have been a controlling factor in Einstein's use of language. A more appropriate name for Einstein's system (which we realize has some difficulties) might be "the theory of invariance"[5].

5. EDITOR'S NOTE: See the comment on relativity and relativism at end of this paper.

Summing up

How do we know which theories and which works of art are closer approximations of nature and society? In the case of the sciences we have epistemological procedures that allow us to distinguish between pseudo-theories (those that are ideologically distorted) and theories that more closely correspond to the world. For Marxists these procedures are genetic, referential, and practical. But this seems an odd question, or an inappropriate criterion for works of art, for artistic representation. Programmatic socialist realism does not provide a clear answer to the question of the fidelity of art to reality. I think the question, What is progressive art? lacks specificity. Not only because of significant differences among the various arts — graphic, plastic, performative, tonal, etc.—but because what is "realistic" or "progressive" will vary from nation to nation, from one culture to another, and in different historical periods. Very little unites the works of Rivera, Mayakovsky, Brecht, and Sholokhov, except that their works were progressive. And at earlier stages of social development we say that the works of such diverse artists as Goya, Corbet, Pushkin, and Balzac were progressive.

My conclusion is that we must apply functional criteria to the assessment of art works. Does a particular work of art, or performance, enhance our historical grasp of the present? Does it point us in the direction leading to a greater sense of humanity, is it humanizing? Does the work engage our consciousness and bring insight? Can it be meaningful for people in struggle? Or is a work of art purely hedonistic, a depiction of abject resignation, a grotesque reproduction of a grotesque reality with no hint of alternative possibilities? Is a work or performance a mere playing with structures, a mute abstraction, addressed only to a closed circle of the initiated, the cultural elite? Such a functional approach will enable us to disclose the ideological component of artistic representations.

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A comment on relativity and relativism by the editor

FEW SCIENTISTS will agree with Truitt's sweeping statement that relativity theory is not relativist at all (though they may have different and even opposing reasons for their objections). It seems to me that, when the limits of applicability of relativity theory are finally determined in practice, we will find that contradictions introduced by the relativist influence of Mach are involved in these limitations. The only safe (Marxist) position is to keep an open mind on such matters, since the inevitable contradictions within relativity theory have yet to be revealed in a concrete way. Scientific skepticism of this type in no way invalidates the usefulness of $E=mc^2$ nor does it weaken Truitt's thesis concerning a vast gulf between the social-political world views of young Heisenberg and young Einstein during the period when they gave birth to their respective concepts of indeterminism and relativity.

It may yet turn out that relativity theory has some limiting defect that is philosophically akin to the incompleteness properly charged by Einstein against quantum indeterminacy. In other words, the distorting effect of philosophical idealism on theoretical constructs does not necessarily depend on whether the scientist has a left or right political orientation. We all know scientists who, as one Italian comrade put it, wears a "red sweater" to the rally but not into the laboratory. Recall the cogent *physical* Marxism of the late J.D. Bernal:

The influence of the positivism of Ernst Mach on the theoretical formulation of modern physical theories was a predominating one. Most physicists have so absorbed his *positivism* in their education that they think of it as an intrinsic part of science, instead of being an ingenious way of explaining away an objective world in terms of subjective ideas. This was brilliantly exposed by Lenin in his *Materialism and Empirio-Criticism*; but the mystifications of theoretical physics have still continued, and it will take many years of argument and experience, including political experience, before the logical basis of physics is cleared of ideas that have nothing to do with the material world [*Science in History*. MIT 1971,746].

The Humanist Perspectives of "Valeomedicine"

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With an international dialogue:

U.S. comments and Bulgarian response.

THE situation of contemporary medicine is ambiguous and controversial. Pride and admiration for its tremendous progress go hand in hand with anxiety over its ability to overcome the evil diseases of today's civilization and make people healthier. It is hope against fear.

We are witnessing a rapid progress in the biological sciences that, together with the highly sophisticated new technologies and ever increasing capital investment in the field, tend to make people feel secure about the future of medicine. Yet some doubt whether our present efforts go in the right direction. The cure of diseases that ruled in the past does not save us from today's new dangerous challenges to health. The increasing amounts of money and effort invested in medical techniques and services obviously have not brought a corresponding improvement in the health status of people.

What has gone wrong? The answer to this question is connected with the trivial but often forgotten statement that *health* is the true goal of medicine. Throughout its history medicine has been dominated by the concept of disease, establishing the approach that the road to health passes through the cure of disease. The effect of this approach has been that most of the effort was made to *restore* health rather than to *promote* health.

Though the limitations of such an approach were obvious long ago, and many people, in and out of medicine, have pointed out the importance of a healthy way of life, the history of medicine is mainly an illustration of the more limited approach. Aristotle's thought that "health ensues from health" has never been realized as a model for medicine centered around the problems of promoting health.

The primary attention given to disease and its cure is easily understood. People never complain about health. It is disease that worries them, the fear of disease gives first place to its cure and is the main reason for thinking of health as a mere absence of disease. The

complexity of the problem of promoting health, the difficulties in formulating a theoretically clear and empirically meaningful definition of health, the relatively slow progress of biology in the past, the domination of empiricist and mechanistic-reductionist explanations in science with all their methodological flaws and limitations, and, last but not least, the fact that public health was neglected or its importance underestimated in societies of the past—all these factors help explain the domination of the traditional approach. The main limitation of curative medicine consists in its *passive role*: only when disease comes upon us does medicine intervene to restore our health, seeking to repair what can still be repaired though often too late to change things for the better.

The problems and controversies in medicine today show clearly the need for a radical change tomorrow. If medicine is to fulfill our expectations and its true humanist goal, its future development should give priority to promoting health. However, such a dramatic change as the creation of a new health-oriented model could scarcely find its theoretical solution only from within medical science itself. The necessity for a philosophical discussion of such a theoretical model is fully in accord with the social function of philosophy and its concern for human problems.

ONE of the primary difficulties in constructing a health-oriented model stems from the vagueness of the concept of health, both on the empirical and the theoretical levels. Today many theoreticians agree that health is not merely the absence of disease but a positive quality in itself, though they may disagree about what this quality is. For example, many authors criticize the definition of health adopted by the World Health Organization (a state of complete physical, mental and social well-being [1]) as being too broad and too relative. The broad view, ingeniously analyzed by L. Kass [1981 p10] as "a creeping medical imperialism," is a tendency that "is ironically a consequence of, or a reaction to, the opposite and more fundamental tendency—namely, to treat health as merely the absence of known disease entities, and more radically to insist that health as such is in reality nothing more than a word."

However, the serious attempts to define health today aim at a more positive if not rigorous definition. Even on the empirical level and in everyday life we often distinguish between health and unhealth and speak about degrees of health, as in saying that someone is healthier than someone else. We make such statements without reference to any particular diseases but simply with reference to the well-functioning of the body, its fitness and vitality. For us health is not a ghost but an objective reality.

1. "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." From the Constitution of the World Health Organization, *Off. Rec. Wld. Hlth. Org.* 2. 100.

On a theoretical level we face the difficulty that health is an integrative property of the organism and can be understood only in the context of the whole. Among some authors on philosophy of medicine there can be traced a close understanding of the nature of health as "an excellence of the body", "the integration of the nature of health as capabilities and capacities", or "the psychophysiological capacity to act or respond appropriately in a wide variety of situations", harmony and perfection of bodily function, integrity, etc. [Whitbeck 1981, Engelhardt 1981, Kass 1981]. The concepts of wholeness and well being are clearly embodied in all such definitions. In accord with such notions we consider health a biological property [2] that manifests itself on the organismic level and can be conceptualized as a relative harmony between morphological structures and the corresponding physiological functions, a harmony of connections and interactions on all levels that insures the integrity of the organism and its adaptation to the environment.

IN ITS recent history medical science has been strongly influenced by mechanistic-reductionist views and by a methodological empiricism that resulted in compartmentalization and medical isolationism, regarding as utopian the possibility of a general theory of medicine. The empirical method, understood as wide use of observation, experiment and induction, is essential to the progress of medicine, but taken by itself it carries the danger of empiricist methodology, namely, the treatment of theoretical knowledge as a mere collection or summing up and systematization of empirical data.

Today's new developments in science and technology strongly suggest a shift from empiricist methodology and the mechanistic-reductionist approaches to substantialist and holistic approaches. The substantialist approach is not new for philosophy and is always connected with the essential theoretical cognition, with the explanation of empirical data on the basis of the fundamental inner nature of the objects, of their wholeness and the interdependence of their parts,

2. In claiming so we fully appreciate the important role of social factors in human health and disease. As far as *human* biology is concerned, it could be properly understood in the broader context of the social, i.e., humans as "bio-psycho-social" systems. This approach implies that social factors should not be treated as contingent events but as parts of a greater socio-cultural whole. While this position is popular among Marxist philosophers in the socialist countries during the last decade, a debate is going on about the biological or social nature of health and disease. In our mind, from the fact that social factors play an important role in the etiology of many disease and in the determination of human health, it does not follow that health and disease are social entities themselves. Any factors that affect health and disease are mediated *only* through *biological* mechanisms and that makes it appropriate to define health and disease as biological properties.

of the unity of elements, properties and relations. The substantialist and holistic ideas are strongly presented in contemporary science through the influence of systems methodology. The systems approach provides therefore the necessary conceptual and methodological tools for a new synthesis in medical science.

A BASIC reorientation of medical science must lead to a theoretical model that would encompass both health and disease and their mutual transitions. In our opinion such a model should be based on the idea of *adaptation* as the essential substance of health and disease, and therefore a necessary theoretical key for their integrative interpretation. From a biological point of view health and disease are merely forms of adaptation [cf. e.g., ref5 1973], and their nature and mutual transitions can be understood in the relation of organism to environment. The organism as a complex system is characterized by a set of internal and external interactions that aim at securing its dynamic stability in a changing environment.

Organismic organization may be regarded therefore as a function and means of adaptation. The relative harmony of the structure and functions of the organism that guarantee its integrity, wholeness and negentropy can be conceptualized as health. Similarly, disease can be understood as a particular impairment of that harmony and dynamic stability. Moreover, we support the view that disease "is not a notion symmetrical with, or opposite to, health. Health and *unhealth*, i.e., health and falling short of health, are true contraries, not health and disease" [Kass 1981 p 11].

Since health and unhealthy are each a matter of degree, disease being only an overt form of unhealthy, this raises the important question about *intermediate* states. Between health and unhealthy lies a broad intermediate region [cf. ref7 1982 pp 48-54] representing not a separate state but effects from the dynamics and mutual transitions of the opposites. The knowledge of the intermediaries should be an issue of vital importance for medicine, both theoretical and practical, and this problem has yet to be faced seriously.

If health is not merely the absence of known disease entities but a unique property of the living organism, it is logical to admit that promoting health should be at the center of our theoretical and practical efforts. Empirically, and often outside of medicine, people conceive the importance of a healthy life style and understand that following simple traditional prescriptions for healthy life habits is more effective than the most sophisticated medical tools. Theoretically, however, our knowledge about health and the possibilities for promoting it is a *terra incognita* for medical science.

One may argue that medicine is the art of healing and not of promoting health; this is correct to some extent. Hence, the formation of a new branch of science, concentrated on studying health and the

promotion of health, is a vital necessity. We propose the name *valeology* [3] for such a future science. The progress in biology and other branches of science make possible today the solution of the problems involved: the already existing knowledge in physiology, genetics, immunology, dietetics, pediatrics, biochemistry, biophysics, molecular biology, psychology, sociology, ecology, physical fitness, etc., can serve as a starting point for a theory of health.

THE systems approach and its more concrete form as the theory of biological systems [4], with their respect for wholeness and integrity, dynamic stability and self-organization, unity of elements, structures and functions, information and negentropy, would provide the methodological and theoretical scheme for a new conceptual synthesis, namely the *science of valeology*.

Its true object must be the profound knowledge of the structures, processes and mechanisms that secure the adaptation of the organism, the conservation of its integrity, wholeness and well-functioning in a changing environment. The theoretical knowledge of health will be the sure basis for promoting health. Such a radical shift supposes, of course, a relatively high level of science and technology, a developed and democratic health-care system and considerable capital investment. In the long run, however, such a strategy is sure to pay off and to result in considerable saving in the costs of medical care as well as a considerable improvement in people's health.

Such a scheme in no way underestimates or ignores the present curative medicine which, we may claim, will be provided a new chance for its further development. Traditional medicine and valeology should be complementary to one another, mutually enriching the scope and depth of their researches. The common ground of such cooperation we see in the intermediate states, the dynamic transitions between health and disease.

3. Valeology—from Latin *valeo, valere*—to be healthy, to be strong. The term *valeology* was introduced by Brekhman [1982].

4. We have in mind first of all the pioneer works of L. von Bertalanffy [e.g., 1968] and all subsequent developments in that field. The systems approach is a promising conceptual and methodological tool to overcome the fragmentation of medical science and to achieve a theoretical deepening and unity. One of the serious obstacles in this respect is that a human being is an extremely complex, multilevel, hierarchical system compared to the presently limited methods of analysis. Systems theorists have pointed out the enormous difficulties we face when crossing levels [see Mesarovic et al. 1970]. One example of the problem is the uncertainty in the interpretation of the obvious impact of the psychological level on human health and disease and its theoretical integration within the current medical model. The implication of diachronic analysis in systems approach is another problem that needs further attention.

The study of the intermediaries would reveal new prospects for the theoretical interpretation of the nature of health and disease, with important practical consequences for preventing disease and promoting health. While valeology would study health in itself, medicine would take advantage of that knowledge in fulfilling such ends as the restoration of health and the prevention of particular diseases. On the other hand, valeology would reveal new aspects of the problem of disease in the opposition of health and unhealthy, in studying the intermediaries and the weak points of health that provide the chance for the advent of disease.

Such a complementarity of the valeological and the medical models makes it reasonable to speak about a *valeomedical* model. In our opinion such a strategy is in full accord with human needs and hopes, and will logically lead to the formation of a new science, *valeomedicine*. We don't foresee a quick solution of that problem, but the first tentative steps today make us optimistic about the future. The necessity of such a development coincides with long cherished human desires for health and longevity.

Inseparable from the lofty ideals of medicine, the humanist perspectives of valeomedicine provide their true continuation.

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SOME COMMENTS FROM THE U.S.

ON both conceptual and methodological grounds, I was profoundly disappointed with the statement prepared by the Bulgarian philosophers Mitev and Stoichev. They seem unacquainted with the enormous debate on the nature of health and medicine among Marxists in the Western world. There is a lot of good Marxist work discussing the political nature of health and medicine and the implications of that reality for the United States. The authors refer approvingly to "mainstream" authors whose work has been transcended by far more

exciting and interesting Marxist work.

I enclose two articles that deal with the material basis upon which the knowledge of medicine is based. The absence of politics and power in the understanding of what is health and medicine makes the Mitev and Stoichev article so profoundly disappointing.

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THE ESSAY on philosophy of medicine by Mitev and Stoichev is an interesting piece, along lines also discussed in this country, and in some of my essays in philosophy of medicine (see the *Journal of Medicine and Philosophy* for past 7-8 years). Sorry I'm so inundated with other commitments that I couldn't give you a longer comment.

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MY overall reaction is that they have a well-nigh idealistic approach in believing that a redefinition or theoretical rectification "will be the sure basis for promoting health." Actually, what is needed are policy and political decisions leading to practice that will result in theoretical changes in the conception of health and medicine.

Name withheld.

IT'S GOOD to see our colleagues in Bulgaria join with progressives here in questioning the medical model—as a way of thinking about health and disease, and of practicing medicine—that has been shown time and again to work against people's real interests. The authors aptly point out the correspondence between the elitist practices of the medical profession and the mechanistic disease-oriented worldview. The connections of the ideology and practice of medicine with the capitalist system are well documented, as is the actual suppression by the medical profession of alternative practices such as midwifery. Progressives in the U.S. have also challenged these practices, offering a holistic preventive view of wellness. Here the systems model has proven useful, seeing people as bio-psycho-social systems.

While it is clear that the mechanistic disease model has to be discarded, I am left with several questions regarding the authors' turn to systems theory. It is not clear to me just how the systems model leads to a concept of wellness or health. Stability seems the basic concept here and, judging by the number of people who smoke, drink, and eat poorly even when they have a choice, I am not sure that the systems concept as proposed has adequate explanatory power.

The authors don't bring up the psychological level, though it is more clear each day that psychological factors are central in health

and disease. Stress levels affect cancer, heart disease, recovery, the immune system. Just about all aspects of health seem to respond to attitudes and emotional well being, not to mention the more global relation of psychological factors in people's willingness to care for themselves and pay attention to information on the effects of smoking, drinking, so on. Traveling between California and East Europe, one can't help note the societal and cultural differences in people's apparent awareness of their own physical well-being. I'm not sure how the authors' concepts take account of these factors.

Clearly, it is not sufficient to challenge a theoretical perspective: the practice of medicine is deeply entrenched in the structure of our system. A real transformation—to focus on health and prevention, to address emotional and nutritional needs of people—will require reorganizing the entire health care delivery system. Those who study the question say that achieving this will require profound political, organizational, socio-economic and psychological changes. It would seem that socialist societies would be far more amenable to these changes and providing models of enlightened progressive practices.

I think this kind of constructive dialogue should be continued and hope we can find ways for the West and East to work together.

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THE RESPONSE FROM BULGARIA

The papers by V. Navarro and M.W. Wartofsky were very much appreciated. Marxist philosophers here have discussed some of their ideas, and find they provide a common ground for fruitful dialogue.

As a partial response to criticism concerning social/psychological factors and concerning the systems theory model, we have expanded the relevant footnotes [Nos. 2 and 4 were originally only one sentence each. *Editor*] But we feel obliged to make this further response:

First of all, we address the statement that we have "a well nigh idealistic approach" because we believe in the need for a basic theoretical reorientation of medical science. As Marxists, we consider as self-evident the dominant role of social practice and social relations in every field of human endeavour; hardly any ingenious theoretical project can come to reality in the absence of adequate material factors in society. Obviously, it is absurd to talk about health promotion in places where people are dying of hunger.

It is true that the realization of the "valeomedical" model implies a real democratization of health care systems and basic humanization of social relations. But this does not mean that science should stop developing new theoretical schemes, and thus to inspire us with clear and attainable goals for the future. The practical realization of such

goals evidently transcends the domain of medicine and cries out for fundamental socio-economic and political changes.

This is also a reply to Navarro's strong criticism of "the absence of politics and power in the understanding of what is health and medicine." We are not sure that his approach is identical with the Marxist interpretation of science. We think that some of his interesting ideas lose much of their value because of the extreme sociologization of the problems. The claim that medicine and other sciences are essentially ideological led to the well-known Stalinist deformations in science, which Navarro rejects himself in his articles. This approach belongs already to the history of Marxist thought. Strong ideological motives, of course, still determine the nature of the *social sciences*, but it would be erroneous to claim that medical science is ideological in its nature.

We agree with Wartofsky's position that health and disease should be interpreted in the broader context of the socio-cultural domain, but the claim that disease is a "socio-historical and cultural phenomenon" leads to a terminological ambiguity. As all social factors are mediated by and have their impact *only* on the basis of biological mechanisms, we tend to define health and disease as biological properties. To call them social seems an emotional reaction against the one-sided, reductionist-mechanistic approach that still exists in medicine.

We appreciate this opportunity to express our views and are ready to take part in further discussions in *Science and Nature*.

Georgi Mitev, Alexander Stoichev.

A LATER COMMENT FROM THE U.S.

LIKE many an idea, the authors' proposal—that medicine be directed more towards the promotion of health than the cure of disease—is not new, but there comes a point in history when its realization is made possible. Today, with the tremendous advance in genetics, immunology, biophysics, molecular biology, nutrition, psychology, microsurgery, etc., a science dealing with the promotion of health—*valeology*—becomes a possibility and, in time, a necessity.

Mitev and Stoichev state: "Theoretically, however, our knowledge of health and the possibility for promoting it is a *terra incognita* for medical science." I believe this state of affairs exists due to the increasing *fragmentation* of medical practice. Doctors have become isolated skilled professionals though their patients, of necessity, remain whole. Even with a national health service, capitalist or socialist, this specialization and fragmentation still exist, though perhaps less blatantly. The day has passed of the old "family doctor" who *knew* his patients and their families. To achieve "harmony of connections and interactions on all levels that insures the integrity of

the organism and its adaptation to the environment," we need a new form of medical practice consistent with these necessities.

I believe this new form of the "family doctor" is evolving in Cuba. Fidel Castro is credited with the idea of developing an advanced type of physician who will *integrate* the practice of medicine, becoming the true "guardian of health." Briefly, *each medical student choosing this Family Doctor field is, after internship, given a home and office in a defined community and becomes the central figure to whom families come for any and all forms of medical advice and treatment.*

In time, the doctor gets to *know* his/her patients and their families, who in turn get to *know* the doctor. A central aspect of this plan is that, if a patient requires consultation with a specialist, the Family Doctor arranges for the consultant to come to the office where all three will meet. The Family Doctor becomes the integrative agent using any and all specialized facilities to assist in treatment of the patient. The Family Doctor makes home visits periodically to evaluate and promote health practices regarding diet, sanitation, exercise, mental health, etc. The young physician will also enroll for a three-year post graduate education in pediatrics, obstetrics and gynecology, and psychiatry.

A NEW BREED of physician is thus emerging, who will become the true specialist in medicine. To facilitate this program, despite Cuba's economic limitations, each Family Doctor is being provided with a computer to further coordinate and integrate all information locally and nationally. Today there are approximately 4,000 such Family Doctors and it is hoped to have 20,000 by the year 2000.

As participant in a psychiatric congress in Havana (Sept. 87) I had the opportunity to see this new program in action. The young woman physician we visited displayed an amazing degree of composure and competence in a modest office with one nurse for assistant. I am sure it was because she knew that, if needed, she had the combined forces of Cuban medicine at her disposal.

In the first year of her practice she developed a program of exercise and social activities for the otherwise sedentary retirees of the community. An unexpected finding emerged: for those members of the group who suffered from high blood pressure, there developed a significant remission in the illness. She is now starting a study to share her findings with the other Family Doctors in the country.

Just as the advent of nuclear weapons brings up the possibility, and necessity, of a world without war and with peace as its goal, so the latest developments in medical and associated science and the accompanying increased human longevity, now demand a world without hunger or epidemics, with universal health as its goal.

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ACTIVITY THEORY: A Marxist approach to psychology

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IN OCTOBER 1986, West Berlin's College of Arts hosted the first International Congress on Activity Theory. This was also the first effort to bring together under one roof researchers, theorists and philosophers working in the tradition of the Soviet psychologists Leontiev and Vygotsky. The majority were from West Germany, West Berlin and the Benelux and Scandinavian countries, the latter two having hosted previous, smaller conferences focusing on pedagogics. The U.S. group included Michael Cole, Norris Minick, Alex Kozulin, and Sylvia Scribner, who are largely responsible for introducing Vygotsky and Soviet psychology to the U.S. Also represented were Italy, Canada, East Germany and the Soviet Union, the last two not in numbers corresponding to their importance in this field.

The purpose of the conference was to assess the state of affairs, and to consolidate and advance work in this materialist direction of psychology begun in the 1920's. At that time, Vygotsky and his followers, especially Leontiev, set out to organize a new psychological theory and body of knowledge, firmly based in Marxist principles. Their goal was to overcome the dualisms, fragmentation and reductionism that characterized psychology and to develop a view of human functioning as purposive, conscious, and embedded in social-historical and cultural processes. The split of the "inner" world of consciousness from the "outer" world of social and natural determinations was to be overcome. Just as labor served Marx's purpose in resolving this dualism, the principle of "activity", extending and concretizing the labor concept, would do this for psychology. To be human is to be active and productive, engaged in the transformation and appropriation of nature. Human activity, then, was the founding category of this new materialist psychology.

For Vygotsky, Leontiev and the others of the Soviet "cultural-historical school", the implications of this effort go beyond the bounds of traditional psychology; they recognized the historical significance of this effort to concretize Marx's world view in a psychological science as central in humanity's developing self-knowledge. For instance, how does the principle of reflection, outlined by Lenin, actually operate? How exactly does labor shape or produce

the person? How do human needs arise? How is consciousness shaped by social and cultural factors? Addressing these questions, psychology has broad social and philosophical implications. In the 60 years since its origins, although a considerable body of empirical work and theoretical discussions have accrued, the controversies, ambiguities and difficulties remain and Vygotsky's goal of a unified Marxist-based psychology remains elusive.

These issues were prominent in the concerns of the conference organizers and participants. Speakers referred often to the continuing fragmentation within psychology and among the social and natural sciences, and to the need for partisanship and international cooperation in the task of developing a unified science and vision of humanity. This science must be concrete and empirically based, while not reducing people to biological processes, or falling into metaphysical generalities. Michael Cole of the U.S., in particular, stressed the need for international cooperation in advancing a new human science capable of contributing to the solution of the political and ecological crises of our times. This new science must overcome not only the theoretical fragmentation and controversies that characterize the human sciences, but also the geographic or national insularity within which most theoreticians and researchers operate.

Background for the Congress

THE PHILOSOPHICAL PROBLEMS. Kant was the first modern philosopher to see that what makes us specifically human is an active principle, i.e. the organizing activity of the mind. Humanity is characterized by activity, but this activity is purely mental, ideal. Fichte extended this principle to the self, or ego, which he claimed is not a static self-contained subject, as it was for Descartes, but is active, or rather, is itself activity. Hegel developed this category considerably further, and here too, it is the basis of his conception of what makes humans human. Through productive activity, or labor, humanity objectifies itself, its powers and capacities, then newly acquires itself through these objectifications, thus moving forward. Hegel's early interest in labor, however, gave way to idealist formulations of activity as the self-movement and development of the absolute spirit. Individuals are human by virtue of being moments of and vehicles for the realization of this development.

While Hegel's early formulation played an important role in Marx's 1844 work, Marx's later works generally refer only to labor, although he occasionally seemed to use this interchangeably with activity. Marx saw humanity as essentially active—externalizing (objectifying), reincorporating and developing itself through productive labor. Central for Marx, though, is the concept of this activity as a material process: it is activity not of an isolated mind, ego or spirit, but of material beings engaged with the social and natural world. Marx's "First Thesis on Feuerbach" proclaimed the basis for his rein-

terpretation of Hegelian idealism by resolving its antithesis to scientific materialism: human activity is not mental, but is sensuous, material. This is the key, for Marx, to overcoming the duality between subject and object, between the inner world of meanings and the outer world of determinations, a duality that persists in social thought today.

Serious philosophical problems confront us as we attempt to understand this Marxist concept of "activity". Are people to be thought of as active only in the sense of labor, or does the concept of activity have a broader significance? Are we to think of activity as pertaining to individual people, or to humanity as a "species being"? That is, does activity have some supra-personal basis, consistent with Marx's methodological dictum that the individual is not to be taken as the starting point for analysis, but rather that analysis "ascends from the abstract to the concrete"? Are the objects of activity natural, cultural, or social-historical in a sense other than culture? How can we think of people as individuals in a social-historical and natural "environment" and at the same times as products of that environment?

THE SOVIET "cultural-historical school" of psychology. Responding to the behaviorism and reflexology that dominated much of psychology in the early 20's, Vygotsky asserted that consciousness and conscious action must be the central object of study for psychological science, since it is this that distinguishes humanity. Unlike earlier introspectionists who saw consciousness as a self-contained realm and, of course, the behaviorists who denied consciousness any status whatever, Vygotsky sought to study consciousness as integral to cultural and historical relations. Human experience is social, historical and conscious, and the inner world is a transformed, internalized version of the outer, social world.

Vygotsky devoted much of his research to the study of this transformation from the outer to the inner. He extended Marx and Engels' analysis of the tool as the essential mediating moment that makes labor a humanizing process, to culture as a system of symbolic and sign "tools" that mediate activity in the production and expression of higher mental processes. Here we see Vygotsky's debt to Bakhtin and semiotics. Social-historical processes in these studies were represented as "culture", which in turn was seen as a system of social conventions and personally meaningful symbols and signs. Language then became, for Vygotsky, the cardinal representation of culture, and of social relations. Activity here is seen as culture on the individual level, embodied in the symbolic forms of speech, play and gesture. The conventional meanings of culture are transformed by activity into the personal sense of individual thought and speech processes. This distinction between meaning and sense then became, for Vygotsky and Leontiev, the way of seeing the relation of the individual to the social.

A central issue for Vygotsky, and for all subsequent discussions, is naturalism, that is, the assumption common to psychological theories that the individual is in essence a natural being, living in a social environment. From psychoanalysis to sociobiology, the dominant view in Western psychology is still based on naturalism. For Vygotsky, psychology must clarify the transformation of the natural to the human: although the individual as an organism is natural, the individual as a psychological being is fully social and all inner processes are culturally based. In human development, the higher functions supersede (*aufheben*) the lower, natural processes such as simple attention and perception. Here we have the first attempt in this tradition to formulate a dialectical relation between the natural and the social.

VYGOTSKY'S WORK was to be criticized as not materialist in the Stalinist era beginning in 1929, and he died of tuberculosis in 1934. Leontiev and others continued working in his tradition while making some central changes. Though inner mental life was still seen as a transformation of outer processes, Leontiev attempted to base the theory on actual material operations and relations, not on symbolic and cultural forms as did Vygotsky. He saw this as restoring the activity concept to a materialist foundation. Although the work of this group was eclipsed by "official" Pavlovian psychology for many years, this new broader concept of activity continued to be developed and elaborated.

In 1962, Leontiev received the highest recognition for his work, and his formulation of activity theory became the new "official" basis for Soviet psychology. Returning to Hegel's formulation, Leontiev analyzed activity as a development process of objectification and acquisition. He traced the origin and development of the psyche from the irritability of the most primitive life forms through human higher mental processes, based on the transition from the natural to social world. From the lowest to the highest, the life process is active in its essence—an engagement with the environment. Activity now became what Leontiev called a "molar concept", referring not to thought processes in a cultural context, but to the functioning of the individual as a whole, in the context of social-historical reality as a whole. While this view may be more consistent with modern materialism, it is certainly a tall order to bring it down to a level of specific, empirically testable concepts. This tension between the demands of the philosophical basis and the need for a concrete empirically based science plagued Leontiev's work throughout. For instance, while Leontiev saw that the basis and logical structure of activity cannot be centered on the functioning of the individual, but rather pertains to "species being" on the social level, he was ultimately unable to devise concepts necessary to concretize this.

SOME PROBLEMS of Marxism in science and socialist ideology. Leontiev's work has spawned a considerable body of theory and research in the fields of cognition, learning, child development and education, rehabilitation and labor psychology in the socialist countries, particularly in the Soviet Union and the GDR. The theoretical and political controversies associated with the development of this science are instructive in the difficulties of formulating a Marxist approach to science. This has involved resolving the contradiction of scientific investigation not only with a particular philosophy but with an "official" interpretation of that philosophy that is subject to the vicissitudes of political life. The struggle between centralism and pluralism now taking place in the Soviet Union on a political level surely will have its reflection on the theoretical level. While few today would openly advocate the Stalinist position that the three are identical, neither has Marxist thought and practice fully outgrown this position. It remains for Marxists to clarify the dialectical relations between politics, philosophy and science.

Throughout the development of activity theory, and more broadly of psychology in the socialist countries, we see a tension between the need for concrete science on the one hand and for the satisfaction of philosophical and political demands on the other. While Vygotsky's work was exacting as concrete science, his goal of philosophical adherence to Marxist principles was unrealized. Leontiev was more philosophically systematic, but as he developed his philosophical principles, he was increasingly unable to apply them to concrete research. In addition, appreciation of his work required a more sophisticated understanding of the concept of materialism than the one prevailing in the Pavlovian era when the tendency was to equate "material" with "tangible", resulting in biological reductionism that still persists among many Marxist psychologists.

THE UNFORTUNATE TENDENCY in the Soviet Union and GDR has been to collapse philosophy and science into each other, rationalizing the scientific work with a highly altered version of Marxist philosophy, and often substituting philosophical rhetoric for concrete social analysis. Systems theory and ideology provides a good example. Lomov and Kossakowski, principle ideologues of psychology in the USSR and GDR respectively, and both with a background of engineering psychology, proclaim that systems theory is the modern form of dialectics. Thus, the reduction of the concept "social relations" to microenvironmental "social factors" is proclaimed to be consistent with Marxism. The political assertion that the socialist countries have achieved a full harmony between the individual and the society is reflected in the scientific notion that systems are based on internal methods of self-regulation. The interaction of the individual with the society, in this view, far from embodying fundamental tensions and contradictions, is simply the territory of acquiring

regulatory functions, transferred from the social to the individual systems.

SYSTEMS IDEOLOGY, in the socialist as well as capitalist world, is a managerial point of view, which makes it possible to study complex interactions without identifying underlying relations and contradictions. It is neopositivist in that it has no theory of the production of the elements or boundaries of a system, enabling the investigator to select systems and elements at will. Though management has its place in social development and microsocial analyses are necessary for the development of an empirical science, this is a far cry from dialectics—Marxism must accept the necessary tension between philosophy and empirical science just as that between social ideals and realities.

An essential principle of Marxism is that for dialectical thought to reach the level of concrete facts, it must be based upon an analysis of fundamental social relations and contradictions. The assertion in the socialist countries that these have ceased to operate, and the absence of a Marxist analysis of socialist development, has had disastrous effects on the development of social thought as a whole, effects with which Gorbachev must struggle today. Just as market forces must be both adopted and understood in the context of socialist development, systems theory and the bourgeois level of scientific theory as a whole must be understood in the context of a comprehensive Marxist theory of the development of scientific thought. That is, Marxism must become far more sophisticated in understanding its own political and theoretical development.

Similarly, while the idea that all human activity is conscious and purposive may be ideologically attractive to some, few serious 20th century social thinkers would try to support this view. Though we must discard the ideological trappings of psychoanalysis and other forms of bourgeois irrationalism, we still must confront the real complexities of human behavior and motivation. The serious psycho-social problems of Soviet society, e.g., low productivity, alcoholism, alienation, and corruption have been identified by Gorbachev as central targets in his restructuring plans. Until recently, these problems were not even acknowledged publicly, and Soviet psychology lacks the concepts and categories necessary to address these issues. This is an indicator of the price paid when science becomes subservient to political policy.

Leontiev, it should be noted, vigorously opposed the reduction of activity theory to the systems model, and he understood well the political significance of this debate. The reduction of the human being to less than human factors in the name of science invariably accompanies dehumanizing practices in the social-political sphere. He championed the cause of a Marxist understanding of the "human factor", fully individual and social, not reduced in any way to bio-

logical or micro-social systems. Ultimately, however, he was not able to effectively challenge the taboo on analyzing socialist social relations and contradictions, and in the absence of necessary corresponding work by philosophers and political economists, his vision of a unified Marxist psychology, like Vygotsky's, was unrealized.

While proponents of activity theory in the capitalist countries often ponder the issue of how an orientation developed in the socialist world must be modified for use in the West, a more fundamental question is, what are the problems in extending the Marxist philosophical understanding of the human being to the level of concrete science, and what philosophical, epistemological and political problems confront us in this process? In this context we can consider the contribution of the French Marxist philosopher, Lucien Sève.

LUCIEN SEVE. Sève's work, though widely considered a central contribution in this field, has been little understood and few attempts have been made to apply his ambitious and abstract philosophical analysis to concrete investigations. For Sève, Marx's first Feuerbach thesis is essential but not sufficient. Humanization is not based solely on labor as such, but on the division of labor. Labor as such is an abstraction; concretely it exists only in divided form, and this division produces social relations and antagonisms. The Sixth Feuerbach thesis, with the assertion that the human essence is not in the individual but in the ensemble of social relations, provides the methodological key to this motion from the abstract to the concrete in knowledge.

The individual, according to Sève, as a social-psychological entity, is a product of activity, which logically is prior to individuality. The biological human organism, at first the basis for pre-human psychological processes, gradually assumes the role of "support" to a fully social individuality. The "ensemble of social relations" exists on the concrete level as "activity-matrices", i.e., a necessary logic of human activity. This necessary logic of social relations is ultimately temporal. Time, for Sève, is the most basic category of Marxist social dialectics, and it is here that he finds the unity of the social-historical and the individual. Sève's contribution, then, is to suggest that this relation is not simply in the so-called superstructure, i.e., cultural forms, language, and so forth—an idea common to Vygotsky and the "Western Marxism" of Gramsci, Althusser and the Frankfurt School—nor is it in microsocial man-environment relations. The logical structure of the social formation, its fundamental relations and contradictions, defines the logical structure of activity at the concrete level and produces the prevailing "forms of individuality".

Sève, along with an interdisciplinary group in France, is currently engaged in an effort to extend his and others' philosophical analyses to concrete questions for social and psychological research.

CRITICAL PSYCHOLOGY of West Berlin. In the early 70s Klaus Holzkamp and others set out to continue and modify Leontiev's

efforts, again with the aim of founding a new psychological science. Based on a modification of activity theory that takes into account class relations in capitalist society, expressed in the contradiction between the potentials for activity on the one hand and the social possibilities for their realization on the other, this group has sought to systematically reconceptualize the basic categories of psychology. Excellent analyses have been made of the transition of functions from animal to human, and of the transformation of these functions with the coming of capitalist relations. The work of this group has been very influential and controversial in European discussions, though little has appeared in English. Despite voluminous works, Holzkamp's ultimate ambition of a unified Marxist science has, like that of his predecessors, not been realized.

On the Congress itself

THE CONGRESS spanned three days, with a registration of over 700, and over 100 presentations. Plenary sessions and invited addresses focussed on overall methodological issues, the history and significance of activity theory, and its relations to specific areas of psychology and pedagogy.

Georg Ruckreim, co-organizer, and chair of the congress, declared in his introductory remarks that activity theory is partisan, with the goal of promoting the development of the all-sided individual, through grasping the entire ensemble of human activity in its significance for the individual, and socially transforming this ensemble in the interests of human development. Social scientists must cooperate in facing the present day political, environmental, social and psychological crises. Psychologists must offer a view of people as whole beings, as active, historical, and conscious. There must be a struggle against dehumanized images being promoted in the name of science. The full nature of the relation of the individual to society must be discovered. This, Ruckreim sees as the potential and challenge of activity theory.

A panel of surveys reviewed the development and status of activity theory in the USSR, GDR, FRG, Scandinavian and Benelux countries, Italy, the U.S. and Canada. The speakers from the Soviet Union and the GDR stressed the consistency of activity theory with Marxist philosophy and with the requirements and methods of psychological research in the conditions of socialism, especially with the need to address concrete problems and not simply to theorize. The pioneering work of Rubinstein received special mention as a turning point in bringing modern research methods in line with Marxist philosophy. Speakers from Finland and the FRG emphasized the turn to activity theory at the time of the student movement of the 60s and 70s that brought into focus the partisan nature of science, the fragmentation of research and theory, and the social responsibility of scientists. The goal was to uncover the true individual/society/history relation-

ship, so distorted in prevailing theories. Activity theory played a central role for some in the search for a "theory of the subject" based on real social processes, famous in the German radical movement of that time. In pursuing this motion from the external to the internal, Leontiev's work offered a new hope. Michael Cole of the U.S., spoke of the disillusionment with Piaget and ensuing fragmentation leading to sociobiology and other theoretical distortions. People seeking an alternative, an understanding of the social-cultural mediation of psychological phenomena, according to Cole, have turned with increasing interest to Vygotsky and his followers. Claude Braun, representing Canada, observing that little or no influence of this direction can be found in Canada, focussed on certain methodological and philosophical issues, particularly the need to develop further the concept of reflection. Speakers from the Benelux and Scandinavian countries, reviewed developments particularly in pedagogics and labor psychology.

CHAIRING the plenary on philosophical and methodological issues, H.J. Sandkuehler summed up the tasks facing the theory as follows: reconcile the theory of activity with Marx's concept of labor; elaborate Marx's observation that we make our own history, but only in pre-given conditions; understand the role of the subject, i.e. what and who is the agent of activity?; and address the implications of Marx's goal of overcoming divisions between living and dead, manual and mental labor.

Klaus Holzkamp emphasized that Leontiev's work and activity theory do not present a coherent whole, and that much remains to be done to unite the philosophical with the practical, particularly in articulating the relation between activity and labor as concepts. Overcoming the theoretical dualities of consciousness and the world, the individual and the environment is a long way off in practical research. Holzkamp's own development of Leontiev's work, he claimed, contributes to this by assigning centrality to humanity's active role in transforming life's conditions.

Other sessions covered a variety of theoretical and practical issues: the applications of activity theory in clinical, educational, and work settings; the theoretical status of language and tool use; problems in applying the concepts action and operation; methodologies for relating the individual to the supra-individual structures in empirical studies of the labor and learning processes; aesthetics; developmental psychology; issues of biology and natural science; applications to specific areas of learning such as science and mathematics, speech and language; cognitive psychology; and rehabilitation psychology.

In the session devoted specifically to philosophical issues, concern centered on the perennial "theory of the subject" and on the relation of biological to psychological levels of analysis, both widely debated

among the German proponents of activity theory. The present author presented an effort to develop Sève's conception of activity, particularly the idea that Marx's central discovery of the dual nature of labor must be extended to the concept of activity. The individual, and all activity, must be seen as embodying the contradiction between abstract and concrete that permeates the entirety of relations in commodity society. The individual is not the subject of this activity; the subject is the "ensemble of social relations" within which individuality, embodying a nexus of contradictions, is produced. In the author's opinion, this is the true meaning of Marx's Sixth Feuerbach thesis, and the key to advancing this theory.

IN SUM, this congress was an exciting start, but a long struggle remains toward the goals set by Vygotsky and Leontiev many years ago. Perhaps the failures should give us cause to question the vision itself. The relation between philosophy and science may be more complex than we had thought, and the path to a "Marxist science" may involve more than elucidating and applying philosophical principles. A "unified Marxist science" may not be possible at this stage of the development of knowledge and consciousness, and what may be needed instead is an analysis of stages and limitations as concrete science and dialectical materialist philosophy struggle to unite. That is, we must have a theory of the transformation of thought in the context of the transformation of society. We will overcome the limitations imposed on consciousness by commodity relations, not in one fell swoop, as an act of thought, but only step by step, in a long process of material transformation of social relations.

The meeting of progressive scientists from the socialist and capitalist world in this common effort was exciting, but disappointing too. There is a reluctance, particularly in the Soviet Union and GDR, to engage in full dialogue with Western theorists on issues in Marxist theory. Only two representatives came from the Soviet Union, although twelve had registered, and the GDR, twenty minutes away by subway, sent only three or four. Speakers from these countries in particular, as I have observed before, often take it for granted that their work represents "Marxist science", and are not open to discussing questions in this regard. Yet an open dialogue and atmosphere of intellectual inquiry and cooperation is essential if we are to progress toward the goals envisioned by this Congress: a progressive psychological science capable of addressing the pressing issues of our times.

It is not a coincidence that in unveiling his plans for "restructuring" of Soviet society, Gorbachev has pointed to the social-psychological issues, the "human factor" championed by Leontiev, as central. Gorbachev has identified the Marxist analysis of socialist relations and the understanding of human psychology as key areas requiring theoretical "breakthroughs". The new stage in socialist

development demands a new stage in theory. Hopefully, the new openness in the Soviet Union will lead to the type of intellectual honesty, courage and international cooperation necessary for these advances to come about.*

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* A second conference will be held in Lahti, Finland, 22-25 May 1990. Contact Reigo Jouttimaki, Helsinki University, Lahti Research and Training Center, Kirkkokatu 16, SF-15140 Lahti, Finland. An expanded participation by the Soviet Union can be expected at this conference.

Individuality, Democracy and Human Rights*

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I. The "human factor"

QUESTIONS about the individual, about human needs, motives, rights, potentials and aspirations, are taking a prominent place in Marxist discussions. Mikhail Gorbachev, in explaining his plan for restructuring in the Soviet Union, asserts that "people are now in the foreground of history," that the "human factor" occupies a central role in the processes and transformations underway. How are we to understand this? The economic changes underway demand complex political, social and psychological changes; changes in motivations, attitudes and relations are central to this restructuring. What challenges do these interconnections present to Marxist theory?

The task for Marxist theory today is essentially this: to realize the potential and promise of Marxism to unite the scientific method with the fullest humanism; to grasp the full breadth and depth of human life in its historical development as an objective process. This human science is the first step in humanity's consciousness of itself, a prerequisite for the next era of civilization. It is the overcoming of the dualism of an idealist dynamic of inner human processes on the one hand, and a dehumanized materialist study of empirical determinations on the other.

This split remains deeply entrenched today. It is most blatant in sociobiology and the various forms of biological reductionism in psychology and psychiatry, but it is also found in many interpretations of systems theory. These latter lose the specificity of human life processes in a tangle of supposed biological or technological systems determinants. On the other hand, we see the avant garde theories of structuralism and post-structuralism, with their roots in nihilism and relativism. These models have in common the demand that human life, in its full depth and richness, can be studied simply as an objective process. The human is split from history, meaning it is split from motion and determination. Science is accepted as necessarily dehumanized and dehumanizing.

When we look at the models of human life offered by the sciences in the last few centuries, can we wonder that people protest, turning

* Adapted slightly from a paper presented at the West Coast Marxist Scholars Conference, Berkeley, November 1987.

to religion and "creationism" for their expression of the unique origins of humanity, the irreducibility of the human essence? This position must not be left to religion and philosophies of "Spirit." The human must be seen as a unique life form, emerging from biological life. This life form achieves its independence from its natural pre-conditions gradually; it is a natural process whose form is history, which is the process of this emergence. The key to Marx's uniting of the human and the objective is his identification of the objective basis and reality of this life process: the "ensemble of social relations." The life and development of this ensemble is the subject matter of historical materialism.

WHAT, THEN, does it mean to say that "people are at the foreground of history"? There is an unprecedented expansion of the influence of subjective forces in the social and historical process. At the same time that social power is becoming ever more immense and impersonal, the importance of individual, subjective processes is growing. Marx and Engels claimed that we are leaving the era of control by unconscious, impersonal forces, or pre-history, and entering the era of human history, of conscious control of life's circumstances. This transition is in its early stages. The issues of consciousness, of intentionality, of human self-awareness, human understanding of its own inner substance, have emerged at the time of this transition. Historical forces operate increasingly through the consciousness and motives of individuals; they take the form, on the concrete level, of psychological individualities.

Thus history itself presents the growing need to understand theoretically the connection between political and economic realities and everyday life, i.e., the way in which individuals actually experience their lives, what they are conscious of, their conflicts, needs, hopes and aspirations. These are not secondary or peripheral considerations; the individual, human factors are increasingly the terms in which the historical drama is played out. A simple example: while the stock market crash represents inevitable conflicts in the nature of capitalism, and it would surely be a mistake to attribute this, along with Reagan, to psychological factors, but people's response to this can be anywhere on the spectrum from increased class consciousness and a dedication to socialism, all the way to a turn toward fascism. These decisions by individual people—the way they experience, understand and react to their reality—will be crucial in shaping the path taken within this inevitable decline of capitalism. Philosophically, this is the relation of contingency to necessity—the way that historical necessities are worked out through an infinitude of variable factors. Much of Marxist thought has been simplistic here.

We can explain this coming to the fore of the individual on the basis of the growth of the productive forces. The present stage of these forces, far from rendering the "human factor" obsolete, as so

many had feared, has actually freed people from the lower forms of manual and mental labor, and led to the emerging importance of subjective processes in the production process itself, as well as in other social spheres. The nature of modern production has called forth this modern individuality with its particular forms of consciousness, ability for scientific thought, and motivational structure. Capitalist relations of production have produced it, and this is the very center of the Marxist idea that productive relations correspond for a time to the level of development of the productive forces. The tremendous productive power unleashed by capitalism is based on the relation of capital to labor, which is not simply on an economic relation, but rather a deep human relation that produced the modern individual, within which the richness of human capacities has grown immensely. But the productive relations, at first making the development of the productive forces possible, later come to be a fetter on them. So too, individuality both facilitates and hinders development in a complex way that changes with time and in different concrete circumstances. In the long run, this individuality, an historically produced form, must be superseded by another form. It is a central challenge to Marxist theory today to understand this emergence and transformation of individuality as the living substance of productive forces and relations.

II. The theory of individuality

THIS THEORY is not simply an application of a pre-existing Marxism, already complete in itself, to a new area, i.e. psychology. Rather, it is the extension of historical materialism to the concrete level of today's realities. It is not an addition to Marxism, it is its development, necessary to catch up with the actual motion of history. A Marxism that fails to do this will find, literally, that yesterday's truths are today's empty abstractions. The materialist analysis of concrete human processes, the entire depth and range that makes up the "human factor," the subjective world, must find the integral links with the basic processes of history without in any way reducing the status and concrete, singular reality of this human factor. These basic historical processes, then, are not to be seen as external factors of the social environment: they are internal to the individual. We must see the essential identity of historical forces and the motivation of the individual, not by reducing one to the other, but by understanding the dialectic of individuality.

The coming to the fore of individuality and psychological life, under the contradictory conditions of the capitalist era, has its reflection in various bourgeois theoretical tendencies. The burgeoning field of psychology, brought on by these developments, instead of providing us with a human vision, a science of the potentials of an emancipated humanity, offers only dehumanized, mechanistic and reductionist models. The discovery that the individual is not a fixed,

ahistorical form, but rather is a product or moment in a complex informational system has been a great contribution from systems theory and structuralism. But, at every turn, these theoretical models are imbued with the relations of capitalism: the dominance of the dead over the living, the past over the present, the abstract over the concrete. The human is reduced either to biology, or to technology or to sociological abstractions.

THE BREAKDOWN of the old atomistic understanding of the individual, represented by bourgeois humanism and its Marxist adaptations, was greeted with proclamations of the "disappearance of man," just as, in physics, as the old atomism broke down, philosophers claimed that "matter" was simply an illusion. What has been passed off as avant-garde thinking in this regard is nothing but a new form of nihilism and cynicism. At the very time that questions of the individual are coming to center stage, we see a host of continental philosophers and their American echoes, all of whom find ready access to academia and the publishing world, proclaiming that all is illusion—meaning, life, the subject, time, space, even history itself. This new breed of missionaries who claim for themselves the ability to penetrate this supposed veil of illusions, has had an unfortunately strong influence on progressive social thought. The romance of French Marxism with structuralism and "post structuralism" is but one example.

On the other hand, just as physics could never return to the good old days previous to relativity and quantum mechanics, social thought, led by Marxism, must absorb the advances of the new theoretical models such as structuralism and systems theory, but go beyond, with dialectics, to a science that is fully historical and human. This science must have at its center a theory of the historical evolution of individuality as a form, the emergence of the psychological from the biological, and the negation of this form in a higher development.

The individual that we know today, the essentially separate ego, is an historical product, the culmination of the great historical era of private property in its final capitalist form. In this era, human universality has come into being in the form of separate individualities. This separation of the ego from natural and social preconditions allows one to think "I am a human being." The recognition of all people as human, and the corresponding self-recognition, is recent, and has been won in struggle. Once this universality comes into being, humanity matures through the development of all individualities. But in capitalism, this universal and particular find themselves in opposition to one another. The form of the individual is no longer appropriate for its human content and becomes a fetter upon further development. A supersession is required in which the universal and individual are reconciled. This is not a "liberation" of the individual; it is a transformation to a new human form.

The dual motion that we see in all history, toward individuality and toward communality, reaches a final point in the capitalist era, in which communality has become universality, and the individual has emerged, by definition, excluded from this community. This is alienation. The individual does not "come to experience" alienation; individuality is the appearance-form of alienated relations. Access to the human community, previously available through a variety of cultural, religious forms, is now available only through money. The longing for this lost universality, which the Hegelians and existentialists, failing to see its true historical roots, have termed "desire," is thus a necessary feature of this individuality-form. The individual is thus driven both toward individuality and toward an inaccessible universality. Perhaps it is this dual motion that Freudian psychoanalysis, failing to penetrate the mystifications of alienation, sees as dual biological forces driving the individual. While we must go beyond psychoanalysis as a model, recognition of this dual motion in the motive forces of history and the individual will enable us to extend a materialist analysis to the entire sphere of human motivation. With dialectics, we see that this motivation is not external, either in society or in biology; it is internal to individuality itself because individuality is a contradictory form. It embodies a gaining and loss of the human at the same time. That is, individuality represents both a humanization and dehumanized-humanization, a simultaneous gaining and loss of the human community.

With the abolition of private property will come a wholly new human psychological form, one in which the contradictions between the universal and particular, essence and appearance, the social and individual, will be overcome. The very abstract notion of the "new socialist man" must be replaced by the concrete analysis of the supersession of individuality as a form. The negation of the simple human community, represented by individuality, is itself negated in the creation of a new, higher form of human community. The concept of negation, then, sorely needs re-examination so we may see how it is that a negation results in greater complexity.

THE DIALECTIC of form and content must be analyzed: development of content takes place within a certain form, and at some point reaches a stage at which the form must be overthrown; at the same time, the form cannot be changed until the content has reached its maturity. These very abstract philosophical considerations have the most direct applicability to the issues such as collectivization, private ownership and market forces confronting socialist development today. The concepts of base and superstructure need careful reconsideration in the light of this understanding that the essential, necessary form assumed by human life processes is produced in the so-called base. The structuralists are right to see that individuality is historically constituted, a point that Marx made very clear in the first

pages of the Grundrisse. But they revert to mysticism when they claim that individuality is a linguistic-ideological illusion. This confinement of the "human" to the realm of superstructure, culture, language, etc., is one of the precepts of bourgeois thought that Marx overturned. Marxist thought has not yet absorbed this most basic principle—that humanity is formed and humanized through basic productive processes and that the economic and the human only appear split with class societies. With Kant, and other bourgeois philosophers, we have seen the economy, or the base, as something like the furnace room, in the basement—the ugly realm of necessity into which we must occasionally venture. Upstairs, are the dwelling quarters, in the superstructure, the realm of culture, civil society, consciousness, freedom. The entire split of so-called Western and Orthodox versions of Marxism is based upon our failure to overcome this duality.

IN ACTUAL reality there is no such split, and it is precisely in the understanding of individuality that this duality will be overcome once and for all. All moments of actual life are embedded in both base and superstructure, necessity and contingency. History is nothing other than human life in its development, and this life process has an essential unity at the concrete level of actual persons. Base and superstructure are two sides of a relation in this process, inseparable moments or aspects. Individuality as a form is produced by basic, necessary relations, but this form has no life, no reality, outside of a myriad of cultural, social structures. Psychological life is shaped by an infinitude of social processes, which operate not upon a *tabula rasa*, but within the limits of, and as the expression of historical necessity. History's basic economic facts and contradictions are at the same time human facts, that operate not as an external environment, but at the core of our beings; the contradiction between forces and relations of production is not an external circumstance, "out there" in the economy; rather, we are this contradiction in its entire concrete complexity and it is only through living people, their consciousness, motives and behavior, that these contradictions have any operative reality.

Marx's theory of abstract labor is crucial in explaining this trajectory of individuality as it is embedded in the base. The gestalt of individuality and community, in which individuality gradually crystallizes and emerges from its immersion in the group, the clan, the family, is shaped inexorably by the evolution of private property to its final form in which social labor has become a complete abstraction, fully invisible. Like the sculpture, formed by chiselling away a mass of stone, the individual is formed by the removal and abstraction of all previous natural connections to land and people and resulting isolation from human universality. Social labor becomes abstract labor, hidden from experience. And the living human community

becomes an abstraction embodied only by money, the God of capitalism. This modern individual, then, is a negative form, a negation of humanity's earlier integral connectedness. This negation will itself be negated in the long and complex process of achieving an entirely new human form. The relation of abstract to concrete, central to Marxist economic theory, is central too in understanding the gestation and transformation of individuality.

The extension of historical materialism to the concrete human sphere sketched here presents tremendous challenges to the understanding of socialist development, but at the same time it makes this understanding for the first time truly possible. The development of socialism is not based on a simple one time only replacement of property relations; it is a step by step replacement of the blind forces of capitalism with the conscious forces of socialism. A socialism developing in the capitalist era is fraught with basic contradictions. These are not "vestiges" of capitalism, but are integral to the nature of socialism. The understanding of the concrete complexity of human life and consciousness will make it possible to replace the very abstract concepts of productive forces and relations, and "vestiges" with concrete analyses of real contradictions. The mistaking of abstract preconceptions and concepts for real social dynamics is one of the outstanding features of the difficulties currently facing the socialist countries and Marxist thought. As this theory is extended, the full complexity and contradictoriness of socialism will emerge. It is high time for Marxists to overcome their reluctance to delve into this. The question of democracy and human rights provides a good case in point.

III. Democracy and human rights

THIS HISTORICAL THEORY of individuality and the concomitant understanding of the unity of base and superstructure in the life process, leads directly to a new understanding of the role of democracy at this time of history. Democracy is absolutely essential as a social form, for the full development and expression of individuality to take place. This individuality, its consciousness, attitudes, motivations, is essential at this stage of the development of the productive forces. Democracy, then, like psychological life, is not "in" the superstructure any more than economics is "in" the base. For individuals to function fully as such in the productive process requires that they be able to experience and develop their individuality in all spheres of life.

There is a necessary internal relation, in the essential unity of the life process, between democracy and the requirements of production at this time. In this light, previous Marxist formulations about democracy are entirely inadequate. It is not sufficient to speak of democracy for the working class in socialism without considering that the class is made up of living individuals. Nor can the democracy

in the capitalist countries be dismissed as a superficiality, or as an illusion promulgated by the capitalist class. Democratic forms are both real and necessary.

As people come to experience their humanity, their universality and individuality, the struggle for democracy becomes inexorable, and the need for the experience and expression of individuality is at once an historical necessity and a deeply felt personal motivation. The struggle for democracy is essential, yet of course in each social form and situation, in particular class relations, this struggle will assume as variety of forms. A Marxist understanding of this motion, this struggle, must rest neither on liberal ahistorical proclamations of human rights nor on abstract assertions of class democracy; rather, it must analyze each concrete situation in terms of all the factors combining to form the experience and motives of individuality.

THE DRIVE toward democracy must be understood in terms of the developing control, by people, over the conditions of life. This is the beginning of real human history, the emergence from prehistory. This need and desire for control is manifested in all spheres of life. In considering democracy, the entire spectrum of needs must be analyzed in the context of class relations. These needs are not only in the realm of culture and civil society, but in production and disposition too, that is, decisions as to what is produced and how it is produced, distributed and used. These economic needs (shall we call them human rights?), are by definition outside of the realm of possibility in capitalism, and in socialism they will be met only through a gradual developmental process. In capitalism, the real granting of civil rights is of course limited by the need of the capitalist class to stay in power. Maintenance of this power by coercion is only one end of a vast spectrum of ideological, cultural, and psychological manipulations, an area at which the capitalist class has achieved the highest sophistication. The need to allow people to operate as individuals, while serving the needs of the capitalist class is one of the greatest challenges to this ruling class.

In addition to the need for individual expression, there is a need for communality, for connection to the social whole. People's need to experience real community can't be met in capitalism, and this is why the experience of individuality in capitalism, although real, in the end is hollow. The most fully developed individuality must also have access to the human community. The turns to spiritualism and cult groups represent this need under conditions of its material unattainability, yet in the long run they cannot substitute for true community in the material sense of real control over the conditions of life in which we produce ourselves. The struggle for democracy in capitalism must focus not only on the preservation and extension of individual rights, but also on the need for real community and for control of life conditions. The potential of a turn to fascism must be analyzed not

only in economic and political terms, but in terms of the need for community as it takes irrational, distorted forms.

In socialism, similarly, this interplay of individuality and collectivity must be understood scientifically. It is not contradictory, for instance, that while in capitalism, which is only too happy to allow religions and other forms of alienated communality, progressives must struggle for real, empowered forms of communality, at the same time in socialism the right to religious practices must be recognized. Alienated forms of communality must be allowed because the era of alienation has not yet ended, and the development necessary under this form is not yet complete. The analysis of religion is far too complex to enter into here, but suffice it to say that the central role that religion has played in history cannot be abolished all at once. The religious expression of the human need for community, along with other alienated forms, will expire only when the unity of the individual and community is fully achieved. This is a long way in the future. The socialist world must analyze this development honestly, and appreciate the necessity for alienated forms of expression which reflect the real state of development of individuality. In my opinion, the problem of alcoholism, in the socialist world, as elsewhere, is based ultimately on an alienated communality, and Marxists, where alcoholism is a problem, should turn their attention to these issues rather than toward bourgeois theories.

THE ISSUES of collectivization, private property and market forces offer vivid examples of the need for Marxism to develop the tools for a scientific analysis of individuality and communality in their true dialectical development. People, it turns out, are not infinitely malleable, and historical stages in their development cannot be passed over. Exhortations, ideology, education, all failed in patching the gap left by a premature jump to a form of organization that did not correspond to the actual state of individuality in its development. The return to private property, to entrepreneurship, to market forces is not a temporary expediency, but is a deep recognition of the necessity to realign the forms of social organization with the actual state of development of the individual so as to foster the further progress of both this individual and the productive forces. The changes in the economic sphere, civil life, and the new openness and honesty all must be understood in their integral connection in the realignment of society with individual needs, motives and consciousness. Here, the relation of abstract labor to individuality becomes most clear. This expansion of the operation of property and market forces represents a heightening of the abstract in relation to the concrete, a sharpening of the gestalt of individuality through a necessary historical tension that impels individual and historical motion.

I have sketched very briefly the way that the theory of individual-

ity offers the insight that the contradictions within social formations in the modern era are expressed in the sphere of concrete life and cannot be understood outside of this sphere. The understanding of the struggle for democracy and human rights, both in capitalism and socialism takes an entirely new form when based upon the contradictions within individuality understood as an historically created form. The dual need of the individual, for emergence and completion on the one hand, and for communality on the other, is worked out in a myriad of ways in the different cultures and systems, but these needs also have an historical inexorability that underlies the infinitude of forms in which they are manifested.

*Round table discussion;
Factors in the development of modern scientific knowledge
Basis for a Marxist Paradigm*

On Contradiction within Scientific Knowledge*

Lester (Hank) Talkington
Editor, *Science and Nature*

Are the concepts which prevail in the natural sciences only fictions because they by no means always correspond with reality? From the moment we accept the theory of evolution all our concepts of organic life correspond only approximately to reality. Otherwise, there would be no change. On the day when concepts and reality coincide in the organic world, development comes to an end. [Engels 1895]

FOR THOSE WHO WISH TO SEE, it is clear that dialectical contradictions exist within scientific knowledge, but it is not so clear how these contradictions arise in the scientific process nor how the scientist can make use of them.

It is a truism, for instance, that experiments are theory-laden, implying some element of circularity in our supposedly straightforward scientific reasoning. Yet there there seems to be no methodological analysis showing how this comes about. An example of such circularity is quantum mechanics, acknowledged on all sides to be a closed system not subject to basic change. But what is the methodological approach to untying this philosophical Gordian knot? The inner contradictions of sociobiology pose similar problems. It is easy to see, for instance, that bourgeois ideology permeates this theoretical system, as in the prevalent concept of the male "optimizing his investment" of sperm. (But it is more difficult to describe the conceptual process, *within science*, by which external ideology can become so deeply rooted in a natural science paradigm.)

Deep-rooted contradictions such as these, arising within processes of normal science, create the conditions for revolutionary transformations of scientific knowledge itself. While Kuhn [1970] pro-

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vided a historical-based description of the revolutionary process in science, he was notoriously weak in his philosophical analysis (more on this later). There are many questions yet to be resolved concerning the continuities and discontinuities of scientific knowledge, the interaction of relative and absolute truths, and so forth.

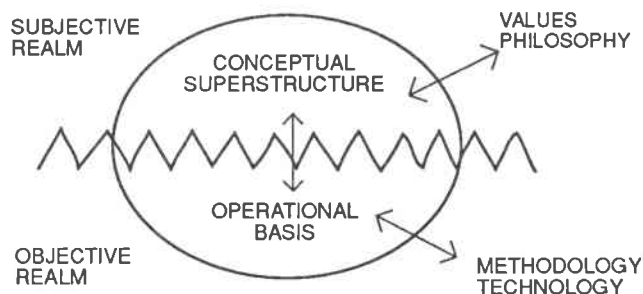
Some of these questions are addressed here in the hope of providing more precise understanding of the contradictions within knowledge and improving the ability of the scientists to make use of them in research.

A base-and-superstructure model

First question. Does scientific knowledge involve an eclectic array of contradictions, or does some single contradiction provide a key, entailing the others? My studies indicate that 1) the primary contradiction is between the *subjective* and the *objective* aspects of knowledge and 2) the historical materialist concept of *base and superstructure* provides an effective analogy for modeling the crucial role of this contradiction in generating scientific knowledge. [A preliminary formulation of this model was given in Talkington 1981.]

Figure 1 presents the fundamental elements of this model: A theoretical system (paradigm), represented as a circle, is surrounded by cultural elements specific to science. The jagged line represents interpenetration of the subjective and objective realms of science.

FIGURE 1.



The *objective realm* of science includes its material aspects: 1) The *methodology* of scientists for assuring objective results: repeatability, experimental controls, statistical analysis, sampling techniques, etc. 2) The *technology* of scientists: the mathematical tools as well as experimental and observational equipment. (While mathematics is a science in itself, it is also a form of technology used by other sciences.)

The *subjective realm*, on the other hand, embraces the ideological aspects of cognition and volition. 1) Scientists have values that are important to the process: standards of conceptual simplicity (elegance), of logical consistency, of integrity, etc. And 2), perhaps more important, is *their philosophy*, individual and collective, since a scien-

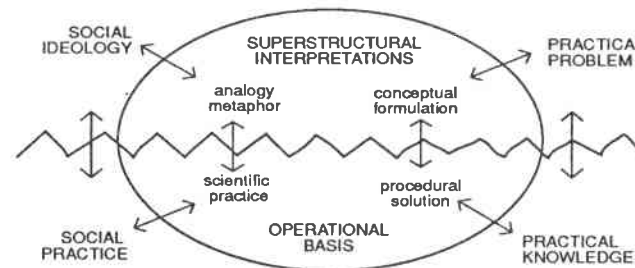
tist is ruled more that he/she knows by a world outlook, by ideas (conscious or unconscious) on the relationship of knowledge to reality, on how development and change occur, etc.

Figure 2 examines the paradigm itself (in circle) as a contradictory unity of the same opposites.

The *operational basis* is the underlying objective component of a theoretical system, comprising the data itself and what Kuhn [1970 p187] called "exemplars," meaning the set of concrete problem-solutions that pretty much define both the general methods and the extent of the phenomena covered by a given discipline. Exemplar elements include procedures for obtaining the material data, plus the mathematical and logical procedures for manipulating the data—essentially the same operations described in any scientific report under "Methods and Procedures" that assure repeatability and empirical reliability of the reported results.

Interacting with this is a *conceptual superstructure* composed of subjective and ideological elements. Here we have the consensual interpretations of a research community—the models, analogies and metaphorical beliefs—that help explain the results obtained, why the operations were performed, what the data really mean.

FIGURE 2.



THE INTERPENETRATION of base and superstructure is not a negligible factor in this system, since it may be literally impossible to find a clear dividing line. For example, a procedure for calculating may be part of the the base yet also part of the interpretation of the data. An instance of this is Ptolemaic astronomy with its interpretive superstructure based on the Pythagorean-Platonic concept of the universe as a set of celestial spheres. Here the objective epicycle procedure for calculations can hardly be separated from either the superstructure or the base, and thus partakes both ways in the contradiction between the spherical concept and the observational data.

Ideally, the conceptual superstructure changes in response to new results obtained in the operational basis by any means, including new technology. And, vice versa, new hypotheses generated in the super-

structure lead to changes in the exemplar methods and procedures and the experimental designs. In actuality, the two aspects tend to be woven together in a tangle of experimental results and interpretive explanations that reflects the historical development of the paradigm and may be resistant to any fundamental change. The prevailing interpretation of quantum mechanics seems to be just such a tangle, one that has defied ordinary historical analysis but may yet yield to analysis in terms of its historically conditioned contradictions. [On the comparable problems of particle physics, see Motz 1986.]

Despite all the tangled interpenetration of base and superstructure, the two opposing tendencies always exist, providing the primary contradiction of the paradigm—the inner force that accounts for a great deal of the restless change observed in any theoretical system developing at the frontiers of science.

Also, since new developments in scientific methodology and technology tend to occur independently of changes in conceptual interpretations, new contradictions between the two aspects keep arising to provide a continuing basis for development and change.

Thus the base-and-superstructure model is in complete accord with the accepted dialectic of theory and experiment as the primary driving force in the development of scientific knowledge. But the more intricate formulation made possible by the proposed model gives it greater explanatory power and heuristic value.

Is the conceptual superstructure necessary?

THERE IS A broad tendency among philosophers, typified by the operationalist school, who maintain that scientists should be concerned only with what I refer to as the operational basis. According to this pragmatic view (related to logical positivism), concepts have no meaning apart from the operations employed in forming and using them. In other words, the conceptual superstructure would be limited to statements generated from the operational base.

What's wrong with that viewpoint? Very simply, it's one-sided. True, operationalism does have its materialist aspect. We can agree that scientists should always carefully analyze the connections between an interpretive model and its underlying operational basis, since the contradictions that reside in these connections provide the basis for motion and development of the theoretical system itself.

But, on the negative side, operationalism tends to leave out the human factor, the fact that science is not done by automatons but by living, feeling, thinking, subjective human beings. History shows that such real scientists cannot "do science" with nothing more than the measurements, the mathematical equations and the logical procedures which operationalists say should be enough. They don't leave room for imagination, for creative speculation about relationships and for the qualitative leap in understanding that can lead to an illu-

minating new interpretive model of the phenomena.

There are two basic reasons why the interpretive component, with its explanatory use of analogy and metaphor, is both normal and necessary to the process of developing a theoretical system.

The first and more basic consideration is that the dialectical mode of thought, inherent to science, requires a search for relationships, for interconnections. Any phenomenon, when viewed without its connections to other natural phenomena, remains essentially inexplicable; attempts to explain such a metaphysical isolate will necessarily tend toward the mystical and irrational. Hence, there is a fundamental need to understand the new in terms of the old, the strange in terms of the familiar, the unknown in terms of the known. This accounts for the widespread use of analogy and metaphoric models when searching for the universal in the particular, for scientific law as a form of the universal.

Secondly, there is the social need for use of interpretive elements to facilitate the communication process that plays such an essential role in science progress. Metaphoric explanations are not only aids to thinking about the research problem but they are also necessary for communicating new concepts to other scientists. They help the scientist remember and communicate an abstract generalization from the concrete empiric data. Interpretation thus gives meaning to a research effort and motivation for others to join it. Without the drive for meaning, there is no science.

Clearly, then, the primary inner forces for the development of a theoretical system derive their potential energy from the contradiction between the objectivity of the system's operational basis and the subjectivity of its conceptual superstructure.

Interaction with the practical world

THE PARADIGM, however, is not an isolated system. Besides its interaction with the ambient scientific community, there is constant and profound interaction with the practical outer world. In terms of influence on the development of scientific knowledge, there are two main channels of interaction between the scientific community and the outside world. They concern 1) the relation between science and practical knowledge or technology, and 2) the relation between scientific ideas and social ideology. Figure 2 deals graphically with these interactive relations.

The outside world presents science with an infinitude of *practical problems*. A practical problem may be known for centuries before science finds a *conceptual formulation* for tackling it; another may become evident only with emergence of a new theoretical system that provides a different way of looking at the practical world. After a problem has been formulated, its *operational solution* will require development of new exemplars using the suitable scientific tools

(mathematical or experimental).

An operational solution to a practical problem immediately becomes a part of mankind's store of *practical knowledge*, the outer world technology or "know-how," which also develops independently of science through the activity of workers and engineers solving practical problems.

For an example of this interaction with the practical world, consider the development of the modern reciprocating steam engine [as seen by Engels 1883, 81]. It began with the concept of German philosopher-mathematician Leibniz [1646-1716] on use of a cylinder and piston; was first implemented (impractically) by French physicist Papin [1647-1712]; then implemented in successively more practical forms (for pumping water out of mines) by English inventors Savery [c.1650-1715], Newcomen [1663-1729] and Watt [1736-1819]. Its theory, however, (as a heat engine) awaited the thermodynamic studies of French physicist Carnot [1796-1832], was essentially completed by German physicist Clausius [1822-1888], Scottish engineer Rankine [1820-1872] and British physicist-mathematician Thomson (Lord Kelvin) [1824-1907].

SOCIAL IDEOLOGY from the "outside world" also provides an important source of *analogy* and *metaphor* for conceptual interpretations in *scientific practice*. Scientists respond not only to the ideas of the scientific community but also to those of the ambient social milieu, which in turn tend to be based upon *social practice*. External social concepts enter most naturally into the thinking of a scientist who is casting about for an interpretive explanation of some newly found empirical relation in natural phenomena. [For more on ideology in natural science, see Talkington 1981.]

The relative effectiveness of an interpretive concept, i.e., the degree of its congruence with the natural relationships of the phenomena to be explained, may well depend on the social outlook (ideology) of the scientist. For instance, Marx [1862] was amused by Darwin's bourgeois interpretation of evolutionary processes in terms of "his English society with its division of labor, competition, opening up of new markets, 'inventions,' and the Malthusian 'struggle for existence.'" Similarly, for today's sociobiologists, conditioned by capitalist ideology, it is quite natural to put a one-sided emphasis on the competitive aspects of the survival process. On the other hand, with a developed socialist view, it is quite natural to seek out the collective aspects that play such important roles in *human survival*.

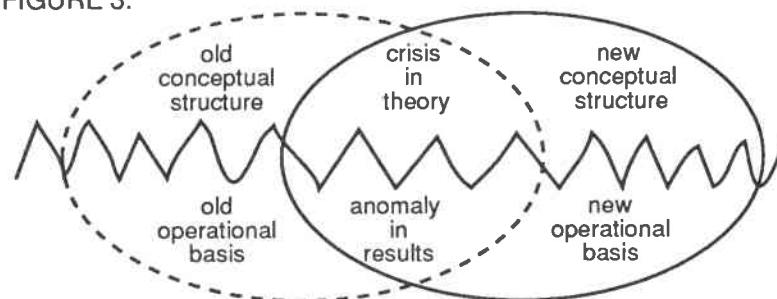
However, the Marxist dialectical approach requires looking at both sides of such a problem and, recognizing that dialectical oppositions tend to characterize causal relations in nature, encourages the search for interpretive formulations that illuminate such relations. Thus, the Marxist world outlook heightens the creative awareness and adaptiveness of the scientist.

Revolution belongs to the process

SO FAR, we have dealt with what Kuhn [1970] terms "normal science"—the developmental phase of a theoretical system in which relatively continuous paradigm articulation and quantitative extension occurs. Now we turn to the revolutionary phase, the phase of discovery, discontinuity and qualitative change in which a new paradigm emerges from the old, replacing it to a greater or lesser extent. Let us see how well the proposed base-and-superstructure model conforms to the actual process of scientific revolution.

Figure 3 indicates the transitional process and the catalytic role of *anomalous result* and *theoretical crisis*, interacting as a unity of opposites to create the conditions for emergence of a new paradigm.

FIGURE 3.



This disruptive process usually begins with the objective discovery of anomaly (some experimental or observational result that seriously contradicts the interpretive superstructure) though it may start with a theoretical crisis brought on by a conceptual discovery (such as a flaw of logic, revealing a fatal contradiction between theoretical interpretation and objective data). In either case, the one gives rise to the other and the two can reinforce one another (like two embers in fireplace keeping each other alive) until some final resolution is found for the new contradiction.

The final resolution, however, may be a long time coming. There is always a tendency to obscure a contradiction by some sort of "fudge factor"—patching up the conceptual explanations in such a way that anomaly is no longer apparent and the threat of crisis is averted. The alternative method of obfuscation is to sweep the anomaly under the rug—e.g., burying it in an obscure footnote and forgetting about it.

Out of this dialectical process a new paradigm eventually emerges to offer a fundamental resolution of the old contradictions. When the new theoretical system matures to the point where its challenge cannot be ignored, the fat is in the fire. The resistance to fundamental change will be more pronounced if the paradigm has become well established so that, from long successful use in practice, a commitment develops in the scientific community that amounts to institu-

tionalizing the theoretical structure, entrenching it as dogma and deepening the contradictions between base and superstructure. In such a case, ousting the old paradigm and installing the new can be a bitter struggle. The analogy with class revolution is obvious.

Sometimes a scientific revolution can even merge with class struggle, through ideological conflict between the progressive scientific concepts of a new paradigm and reactionary external social forces backed by state power. Such was the case in the Copernican revolution where Giordano Bruno and Galileo Galilei were not the only scientists to suffer violence from the state, as we learn from Lawson [1968 p122f]:

Gerardus Mercator, the Flemish map maker whose approach to cartography was revolutionized by the Copernican theory, was arrested for heresy with a number of other intellectuals in Antwerp in 1544. Many of his companions were burned, beheaded or buried alive. But Charles V needed accurate maps for his military campaigns. He secured Mercator's release, and the cartographer expressed his gratitude with an especially designed, and suitably Ptolemaic, map of the universe.

Mercator thus became one of many scientists who over the centuries have been spared ruling class violence on the basis of rendering technological services (from the operational basis) and cringing denial of scientific ideas (from the interpretive superstructure) that clash with the ruling ideology. That's one form of interaction with external ideology.

There's still another and very important way in which the concept of base and superstructure provides an illuminating parallel with historical materialism. In a scientific revolution, just as in social revolution, superstructural elements tend to be swept away while a good deal of the material base may be taken over intact (at least temporarily). For example, the concept of a geocentric universe was wiped out by the revolutionary new Copernican concept, but this in itself brought no basic change in instrumentation or procedures; Copernicus still depended on epicycle calculations (true, his calculations were simplified and some results became more precise, but others became less so).

The two levels of knowledge

EXAMINING the philosophical questions of scientific truth and progress, we find that the base/superstructure model gives rise to two different levels of theoretical knowledge, with two different forms of scientific truth and two different types of progress.

At the operational level of a theoretical system, knowledge has objectivity deriving from the objective procedures by which it is obtained. Hence, this knowledge is objectively and unconditionally true for the limited conditions of its derivation, though its import

cannot be known at this level.

At the ideological level of a theoretical system, however, knowledge derives from subjective and consensual interpretation, and is thereby necessarily hypothetical in nature—always conditional and subject to negation in whole or part. This is the level, however, where the power of scientific generalization appears.

Usually, no sharp boundary can be found between these two integral aspects of scientific truth because accepted conceptual truths influence the choice of procedures while objective procedural results influence the choice of concepts. Only at the time of theoretical crisis are scientists likely to think very deeply about the questions of truth involved here, and the resulting debates tend to be inconclusive because seldom do any participants approach the questions in terms of fundamental contradictions within truth itself. Hence, resolution of a crisis usually comes—without much philosophical clarity—in the form of a victorious new paradigm bringing a fresh set of unknown or only dimly perceived contradictions within its truths.

QUESTIONS about scientific progress also involve the fundamental contradiction of knowledge: there is one type of progress at the conceptual level, another at the procedural level.

Error in procedures or exemplars can be progressively eliminated through the test of practice, so that continuous and absolute progress is possible at this level. Even when overthrow of a paradigm leaves a its procedures stranded by irrelevance to the new theoretical system, its validity is retained fully and it may remain highly useful as the basis for technology. An obvious example is Newtonian mechanics, which still provides the basis for most of physics and engineering practice today though it has been largely supplanted by relativistic mechanics in the theoretical system of modern physics.

At the superstructural level, however, the question of progress is problematic indeed. Error can never be eliminated fully from interpretive concepts (see quote from Engels that opens this essay). In fact, at the conceptual level there is no assurance of progress with a change of paradigm: new interpretive concepts do not always bring an improved congruence with the underlying reality. For example, [Engels, 82, 260], in 17th-century England heat was conceived as "motion of a particular kind" while in the 18th century on the Continent heat came to be seen as "a special substance" (caloric), a conceptual change representing regress according to modern concepts of heat. True, a new interpretive concept, such as the electron of 1897, may be transformed—by sufficient proof in practice—from the status of hypothesis to that of objective knowledge. But much of modern science depends on concepts that are far from achieving this status of objectivity. Kuhn [206f] observed that Newton's mechanics improved on Aristotle's and that Einstein's improved on Newton's "as instruments for puzzle-solving" but, in relation to the question of

progress in science, "Einstein's general theory of relativity is closer to Aristotle's than either of them is to Newton's."

Thus, on the one hand, a paradigm change brings a new conceptual apparatus that characteristically offers an improved heuristic (embodied in its exemplars) to help scientists recognize and solve problems presented by nature. On the other hand, it is clear that 1) the objective content of an interpretive concept depends on its congruence with reality as tested in practice, and 2) scientific truth resides (lives, develops), and scientific progress is registered, in the objective basis where the test of practice prevails.

In praise of the paradigm

Readers who are familiar with Kuhn's [1970] ideas on scientific revolutions may well feel comfortable with the proposed base/superstructure model. Though the dialectical form of this model makes it more systematic and provides new insights, such as a specific mechanism by which social ideology can enter into scientific theory, none of its properties contradict Kuhn's system. The base/superstructure model in fact provides a profound philosophical justification for Kuhn's concepts on paradigm, revolution, etc. This is ironic because original intent of this author was to probe for weaknesses in Kuhn's concepts. Writing this essay revealed how completely Kuhn's ideas are in accord; for every feature of the model, some support from Kuhn could be found.

Kuhn's paradigm concept really needs no such support. Scientists all over find it a helpful way of looking at the scientific process. His influence can be seen throughout the literature; for example, in Lewis Thomas [1982] on today's scientific and technological revolution:

In the fields I know best, among the life sciences, it is required that the most expert and sophisticated minds be capable of changing course — often with a great lurch—every few years. In some branches of biology the mind-changing is occurring with accelerating velocity. Next week's issue of any scientific journal can turn a whole field upside down, shaking out any number of immutable ideas and installing new bodies of dogma. This is an almost everyday event in physics, in chemistry, in materials research, in genetics, in immunology.

The triumph of Kuhn's concepts can be attributed to his considerable knowledge of the historical process in physics, so that his concepts spontaneously if imperfectly reflect the inherent dialectical content of this history. But Kuhn was not adequately equipped philosophically for such dialectical content. He floundered especially on questions of truth and progress. Truth was truth, "a permanent fixed scientific truth" [p173], not a dialectic of the relative and absolute. His paradigm was a (formally) logical system, not one with inner contradictions. Unable to distinguish clearly between the ideological and substantive aspects, Kuhn had to reject the idea that

changes of paradigm carry us "closer and closer to the truth" [p170]. Though Kuhn did conceive of progress in terms of basic procedures ("each stage in the development of scientific knowledge is a better exemplar" [p173]), the irony is that he treated the exemplar as an isolated metaphysical entity, not as an integral but polar aspect in the contradictions of a historically-conditioned paradigm.

A final irony. Kuhn has since backed away from the very concepts that won such wide acclaim from scientists. Presenting to him History of Science Society's Sarton Medal, Frederick L. Holmes [1983] remarked on how "Kuhn himself has qualified and modified his original scheme, and he has attempted, with limited success, either to redefine or withdraw his notorious term "paradigm"; but he has found that his original ideas have become such common property that even he can no longer reshape them at his own will."

Kuhn's evident discomfort today with the concepts he pioneered may reflect their revolutionary implications that extend beyond the laboratory? (Recall that Kuhn [1965 p7] went out of his way to agree with Karl Popper that Marxist historiography is not scientific.)

Is Marxist science a paradigm?

IN CLOSING, I suggest that the base/superstructure model applies not only to the natural sciences but also to the social sciences. In particular, I suggest that Marxist social science is also a paradigm with inner contradictions of its own and thus subject to revolutionary transformation. Specifically, one may see the Marxist paradigm emerging from frustrations suffered by Marx and Engels in their struggles for bourgeois democracy in 18th-century Germany, with a theoretically powerful superstructure centering on the concept of class interest as the motive power for social development but with an as yet poorly developed basis in exemplars of class struggle. I offer an example of how contradiction between procedural basis and interpretive superstructure led to a revolutionary transformation within the Marxist paradigm:

ANOMALY. Marx and Engels predicted social revolution would come first in England because of its advanced capitalism and large working class. But history did not work out that way.

CRISIS. Lenin, foreseeing revolution occurring where capitalism is weakest, developed new procedures of struggle that challenged accepted truths of Marxism. But Plekhanov and other theorists disagreed violently, defending the original Marxist paradigm.

RESOLUTION. After bitter struggle within the Marxist scientific community, a new Marxist-Leninist paradigm emerged, based on changes in practice and a changed interpretation of how the struggle proceeds.

With the hindsight of history, we can see that, for a quarter of a century, Stalin forcibly thrust on the Communist movement an anti-

Leninist paradigm. Now, a quarter-century after Stalin's death, under the leadership of Gorbachev, the paradigm is undergoing another revolutionary transformation, returning to its Leninist roots but at a higher level of development.

VIEWING MARXISM thus as a paradigm, we see how its theory and practice does indeed develop and change through the dialectical self-corrective process that characterizes all science.

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HUMAN SEXUALITY: *The Interpenetrating Opposites*

Marx on man and woman

THE DIRECT, natural, and necessary relation of person to person is the *relation of man to woman*. In this natural species-relationship man's relation to nature is immediately his relation to man, just as his relation to man is immediately his relation to nature—his own natural destination. In this relationship, therefore, is *sensuously manifested*, reduced to an observable fact, the extent to which the human essence has become nature to man, or to which nature to him has become the human essence of man. From this relationship one can therefore judge man's whole level of development.... This relationship also reveals the extent to which man's *need* has become a *human need*; the extent to which, therefore, the *other* person has become for him a need—the extent to which he in his individual existence is at the same time a social being.

—Karl Marx, *Economic and Philosophic Manuscripts of 1844* (Third manuscript, section on private property and communism).

IN ITS ESSENCE, the delight of sexual love, the [genital] spasm, is a sensation of resurrection, of renewing our life in another, for only in others can we renew our life and so perpetuate ourselves.

—Miguel de Unamuno, Spanish writer [1864-1936]

Sexism and the New Woman

CONTRADICTIONS are everywhere visible in the New Woman. Consider one of them, engagingly outlined by a perceptive writer, Susan Brownmiller [*Femininity*. NY: Fawcett 1985]. It is the attire of the "successful woman," the one who is generally thought closest to attaining the ideal of parity of the sexes. If she has climbed to the highest spheres of the corporate world, she covers her trunk with a jacket. It would be a serious hindrance to professional upward mobility to accentuate an all-too-feminine bustline, as with a tight yellow sweater or a revealing décolletage. No woman who aspired to enter the executive room—other than as underling leered at with impunity by her male superiors—ever dared to incur such sartorial indiscretions. Thus, her upper body is covered with a jacket, indistinguishable from the male garment. Below the waist, however, cor-

porate officialdom permits a woman's skirt that terminates above the knee. Here, femaleness is given safe-conduct. The legs are exposed, and their sexual appeal not just left undisturbed but triumphantly, unabashedly enhanced by the silky sheen of stockings and the use of unhealthy, torturing high-heeled shoes designed to accentuate the legs' smooth contour. Such the schizoid split of women's fashion in the exalted executive spheres of the Western world: upper asceticism and lower sensuality, much like the Greek partition of the body into spiritual and animal domains divided by the sheet of the diaphragm, as described in *Timaheus*.

IT IS ONLY the callous and unperceptive who attribute these absurd contradictions to woman's unthinking frivolity or vanity. The truth is that she moves today, as in the past, in an absurd world that racks her with contrary pressures. In her relations with men the New Woman is not exempt of the need to attract and repel, and to constantly toe the precarious line between the desire to entice and the need to repulse. In vain do we tell ourselves that she lives in an era of "new openness," in which all commerce between the sexes can at last take place free of hypocrisy and pretense. In the large urban centers, where this shibboleth passes unquestioned, is precisely where the contradiction is greatest... It is here where the opportunities for male aggression are multiplied, and the occasions for female diffidence increased accordingly. Here, in these nuclei of social progress, in these beachheads of liberality, a woman must be constantly on her guard. She must rid herself of insistent followers and learn to discern a shy suitor from a potential attacker who watches her in ambush. She must avoid a male presence in dark alleys, deserted lots, solitary elevators, or unwatched buildings. She must protect herself from deviant males who press themselves against her in crowded places, trains, or buses, deriving a sickly vicarious pleasure from the anonymous contact. When a disturbing ambiguity of solicitations and potential threats constantly surrounds her, is it a wonder that instead of the vulnerable expressivity of a human face, she prefers the inalterable demeanor of a mask?

- F. Gonzalez-Crussi, *On the Nature of Things Erotic*.
Harcourt Brace Jovanovich 1988 pp 114f.

No, I do not cherish the flaming frenzy of delight
The rapturous sensation of reckless flight,
When with such groans and shrieks the Bacchante girl
Much like a snake in my embrace will twist and whirl,
With passionate caress and taunting kiss, not tender,
She'll rush to push the final moment of surrender!

Oh, how far sweeter you, my gentle one, my meek!
Oh, what tormented bliss when love with you I seek,
When bowing to my eager pleas that long to capture,

You give yourself to me so gentle, yet without rapture.
Modestly, still cold, my ardor does not make you sway;
Hardly responsive, you hear nothing that I say,
And then come alive, more and more, till warily,
You share at last my passion, involuntarily.

- Alexander Pushkin

La Mujer

MAKING A LIVING has always been hard for the people of Northern New Mexico. El dicho "Dicen que hace años que se acabó la depresion; pues aqui no notamos la diferencia entre cuando se comensó o cuando se acabó" was more than an attempt at humor—it was a good description of the economic life de la gente de aqui.

Para la mujer de la Raza, the situation has been doubly hard. La mujer has had to learn to survive in a world that is racist and sexist—a world run by anglos and by men.

The anglos—men and women—see la mujer only when they have need of her services: to clean their house, take care of their children, wait their tables, clerk their shops. They think of la mujer—when they think of her at all—as simple-minded, lacking ambition, dreaming small dreams; docile and subservient. In short, a person of no importance or consequence.

In our own culture, a culture as sexist as any other, there has never been any question of the importance of la mujer. Speak with almost any Raza about life in their communities and it is clear that la mujer has an important and significant role in that life.

In the early 1950s, the women of the northern valleys kept our communities going while the men worked the sheep in Wyoming, or the mines and harvests of Colorado, or factories outside of New Mexico. The tradition of community made their life possible.

Las mujeres — abuelas, madres, hermanas, primas, comadres y vecinas — planted and harvested, canned and dried food together. They inter-bred their farm animals and butchered them together. They patched roofs and mudded walls together. They helped each other harness and hitch the horses and haul wood together. They assisted each other's birthings and dyings. They prayed and laughed and cried together. They repaired the churches and the schools. And, together with the teachers, they ran the schools and instructed their children.

Sexism takes many forms throughout the world. Often, but not always, the form it takes depends on the economic and educational level of a particular group. While las mujeres had a strong community, the effects of sexism were less harsh. A drunk, abusive husband could be subdued by several women; a widowed or deserted woman and her children were cared for by the extended family or the community; certain 'tios or 'manos were never allowed to be alone

with children; fathers who came home to find their daughters pregnant without husbands, were persuaded by the women not to take out their anger on wife and daughter; a jealous husband could not keep his wife from seeing her family.

"Progress" began trickling into Northern New Mexico after WWII. By the late 1950s, the trickle increased. By the late 1960s, the trickle had increased into a steady stream. By the late 1970s, the stream ran like the acequias in the late spring.

And one of the things that 'progress' brought was the dissolving of la comunidad de las mujeres. Daughters moved away with their husbands. Some went to college. Birthings moved from the homes into the hospitals. The dead were tended by funeral homes rather than by families. The schools were centralized and removed from the communities. And many women sought work outside the home.

With 'progress' each family became involved with its own survival; with 'progress' the women retreated from their lives in the community. With 'progress' came conveniences such as washing machines and refrigerators and telephones and automobiles. With 'progress' came isolation para la mujer. And in that isolation, sexism became harsher, each woman dealing with it by herself.

La mujer deals daily with the double burden of racism and sexism. How she deals in her daily life is what *Lo Nuestro* will be presenting in this column. We are going to observe our lives through entrevistas, stories and reports ...

— *Lo Nuestro del Norte* No. 6, (P.O. Box AA, Vales NM 87580).

Understand: we have
grown into one as we slept and
now I can't jump
because I can't let go your hand.

— Marina Tsvetayeva

Freud's unfinished analysis

AS a biographer of Freud, [Peter] Gay has applied Freud's method to the master's life. His analysis of Freud is at odds in some major respects with the official Freud biography by Ernest Jones. Where Jones saw Freud as serene and mature after his famous self-analysis, Mr. Gay sees him as still "tortured," especially about his work. And in Mr. Gay's view, Freud had a lifelong "problematic" relationship with his mother, beginning with his resentment toward her as a child for providing him so many siblings. "Though Freud analyzed carefully his relationship with his father," says Mr. Gay, "he did not do so with his mother. It was a morass for him." This unfinished business in his own analysis, Mr. Gay believes, may do much to explain Freud's theories of women, which have been severely criticized in recent years.

— Daniel Goleman, *NY Times Book Review* 24 April 1988

The fountains mingle with the river
And the rivers with the ocean,
The winds of heaven mix for ever
With a sweet emotion;
Nothing in the world is single;
All things by a law divine
In one spirit meet and mingle,
Why not I with thine?
— Percy Bysshe Shelley

Lady, let our spirits mingle,
I in you and you in me;
Let the two of us be single
Being both together be,
Each to other let's be true!
"Sir, that I will never do.
I am mine, let yours be you."
— Anonymous

Early Christian sex

THE early Fathers were presented with a paradox. While virginity was the most exalted state, the Church approved of marriage, and marriage was on its way to becoming a sacrament. Yet the very process of producing virgins often involved lust and sensuality. Surely, in sanctifying marriage, the Church was not condoning lust. Perhaps the best way to make this distinction clear was to regulate sexual congress so as to clearly categorize it as an inferior by-product of marriage.

In *The Instructor*, written in the third century, the presbyter Clement of Alexandria told married people that the daytime should be devoted to prayer and to reading religious tomes. Accordingly, a couple might lie with each other only after supper. This permission was not intended as a license for coitus, for the act could remain without sin only if voluptuousness were eliminated and control and restraint maintained.

Jerome went much further: a man should not love his wife with passion, but with judgment. In fact, he who loved his wife too ardently was no more than an adulterer. The fourth Council of Carthage, in 398, pronounced that out of reverence for the benediction, newlyweds should abstain from sexual union for the first night. Happily, however, by paying a moderate fee, a dispensation could be obtained to permit cohabitation even on the first night.

— *Love, Sex and Marriage through the Ages*, by Bernard I. Murstein
(New York: Springer 1974) p.98.

AS Christ never knew the love of woman, he had no personal acquaintance with that refining of man's true nature that comes only with the intimate life of man and woman. The intimate sexual union, on which

the preservation of the human race depends, is just as important on that account as the spiritual penetration of the two sexes, or the mutual complement which they bring to each other in the practical wants of daily life as well as in the highest ideal function of the soul.

— Ernst Heinrich Haeckel, German biologist 1834-1919

Vatican vigilance on virginity

ON New Year's Day 1987, Pope John Paul II proclaimed a special year, dedicated to the Virgin Mary, to begin the following June and to be observed by Catholics worldwide. "O Mary," he said, "we want you to shine on the horizon of our age as we prepare for the third millennium of the Christian age." (A Marian year, 1953-54, had celebrated the 100th anniversary of the proclamation of the dogma of the Immaculate Conception.)

Then the Vatican, in a major doctrinal statement, 10 March, declared its moral opposition to virtually all forms of artificial fertilization and embryo transfer, approving medical interference in human procreation only when it assists a married couple who have engaged in a "normal" sexual act. Warning that uncontrolled use of the new biomedical technologies "could lead to unforeseeable and damaging consequence for civil society," the Vatican called for intervention by political authorities and legislators.

Noting the new possibility of procreation through *in vitro* meeting of germ-cells taken previously from the man and woman, the Vatican asserted that

what is technically possible is not for that very reason morally admissible. Rational reflection on the fundamental values of life and of human procreation is therefore indispensable for formulating a moral evaluation of such technological intervention on a human being from the first stages of his (sic) development.

Couples who happen to be infertile are warned that marriage does not bring "the right to have a child," but only the right to perform "natural acts" aimed at procreation. It seems that a child emerging from the less natural process would lack the "proper perfection."

Strong dissent came from theologians (even a cardinal), from medical professionals and from lay people throughout the Catholic world who saw it as another example of "fallible" Vatican teachings. Said one Catholic woman: "Parenting is such a strong urge, I don't think the church can stop it." Many saw the document serving to heighten the existing debates within the church.

Stressing moral issues, the statement disclaimed "any special competence" in science. And there was no sign the Pontifical Academy of Science had been consulted (*Science* 29 March). A *Nature* editorial (19 March) noted prophetically the unrealistic and insensitive approach to modern science in, e.g., the Vatican's effort to prevent embryological "research with, as opposed to therapy on,

living embryos." (Nothing surprising in the abortive White House trial balloon, 6 Sept 88, for a ban on research even with fetal tissue.)

Soon (25 March 1987) John Paul issued an encyclical proclaiming the Virgin Mary a "model" for the Roman Catholic Church and calling on all Christians to accept her as their "common mother" and a source of unity. Since dogmas such as that of the Immaculate Conception are seen by many Protestants as barriers to ecumenical progress, it was not clear how much of this encyclical would contribute toward resolving the acknowledged "considerable discrepancies of doctrine concerning the mystery and ministry of the church and... the role of Mary in the work of salvation." And the Pope's personal view of Mary as a role model seemed to lay a heavy burden on all women (while continuing to deny them an equal role in the church):

In the light of Mary, the church sees in the face of women the reflection of a beauty which mirrors the loftiest sentiments of which the human heart is capable; the strength that is capable of bearing the greatest sorrows; the limitless fidelity and tireless devotion to work; the ability to combine penetrating intuition with words of support and encouragement.

In Spokane, 25 Sept 87, John Paul consented to hear a woman plead that the laity be given a larger voice. "Questioning is not dissent," she said, in a speech submitted to the Vatican in advance.

Christmas Day '87 found the Pope again on the front page, and once more urging mankind not to be tempted to seek salvation in modern technology but to look instead to the message of Christ's birth in a manger in Bethlehem. He was surely harking back to the proposed ban on *in vitro* fertilization as he said:

He who came for us and for our salvation came down from the Father, became flesh in the womb of the Virgin Mary and was made man. He has given this power to us [to become children of God]. Will people know how to make use of such power? ... Never as much as today has man been tempted to believe that he is self-sufficient, capable of building with his own hands his own salvation.

NOW, what is this really all about? Why is the Pope so implacably hostile to a form of technology that humanity in general considers quite benign? Why so rigidly insistent on the "natural" process of procreation? Reviewing the news of the Marian year, I found what seems the incisive question: Is it possible that, in the back of his mind, John Paul sees in vitro fertilization as a threat to Mary's monopoly on the Immaculate Conception industry?

— Lester Talkington, Editor, *Science and Nature*

THE human being, like the immortals, naturally places sexual intercourse far and away above all other joys—yet he has left it out of his heaven. —Mark Twain (Samuel Clemens), *Letters from the Earth*.

Was Jesus Chaste? or did he
Give any Lessons of Chastity?
The morning blush'd fiery red:
Mary was found in Adulterous bed;
Earth groan'd beneath, & Heaven above
Trembled at discovery of Love.

– William Blake

Orgasm as a dialectical communion

THERE is a reason why man and woman must strive after trust, care and respect, mutual responsibility and understanding beyond mere infatuation, so as to create a mental and emotional unit; only such a love can raise sexual communion above the physical, and make it a unique expression of man and woman as one flesh.

Orgasm is certainly associated with a [complex] reflex process..., and is certainly a special type of brain function, but the details are a mystery and will probably always remain so ... Sexual pleasure and ejaculation of semen, rhythmical movements of the uterus, sexual tension and relaxation do not constitute orgasm, although the latter is not possible without them.

Orgasm presupposes an internal readiness to give oneself entirely to the partner, but the will to do this is less significant than the unconscious attitude. The attitude of wanting the partner for oneself, and of wanting to experience a peak of sensation with him and through him (expressed as "I want to find happiness with you") may be as disastrous to orgasm as the almost challenging attitude: "You must be happy with (and through) me, I will make you happy." It is better to adopt the attitude: "I am ready to serve you actively with all my human sexuality" ...

Complete abandon in sexual intercourse is possible through such an attitude and only through it. For a matter of seconds the two existences fuse into one; each has the sensation of being powerless over his own body and momentarily losing himself in an extreme of pleasurable unconsciousness. Man and woman give themselves entirely and achieve what each alone cannot reach, a unique experience of joy involving body, mind and spirit for a few seconds. At the peak of experience, at orgasm, the facial expression is not one of unalloyed pleasure. The experience lies between the death of the ego and the life of a new unity, between egoistical pain at abandonment of one's own personality and the joy of gaining an entirely different ego in the new unity. Thus the facial expression is torn between joy and pain, between life and death.

– *Man and Woman: The Basics of Sex and Marriage*. Karl Wrage, M.D., Tr. from German. Phila.: Fortress Press 1969.

Let loose my hands
and my heart, Oh let me go!
Let my fingers run free
over your body's roads.
Passion—blood, fire, kisses—
burn me with tremulous flames.
You know not what this means.

It is the tempest of my senses
bending the sensitive jungles of my nerves.
How flesh cries out with its ardent tongues!
What fire!
Here you are, woman, like a virgin beam,
while my cindered life flies
toward your body all filled with stars like the night!

Let loose my hands,
and my heart, Oh let me go!

You alone I want, you alone I crave.
It is not love but only desire which burns itself out.
A rain of furies,
a seeking of the impossible,
but there you are
to give your all to me,
for this you were born, to give all to me,
as I was to hold you,
desire you,
receive you!

– Pablo Neruda

TODAY problems with sexual desire is the most common complaint treated by sex therapists. For 31% of couples seeking sex therapy, the problem was a discrepancy between partners in their desire for sex.

Much of the research focuses on the biochemistry of desire, particularly the role of hormones, especially testosterone. Testosterone is often called the male sex hormone because it is more prevalent in men, although it fluctuates in the individual with time, and plays a key role in development of masculine traits.

In a study of men who suffered from extremely low levels of desire as the result of underactive gonads, doses of testosterone increased the men's frequency of sexual fantasies and restored their sexual desire. But the testosterone had no effect on the mechanics of sexual arousal, such as their genital arousal while watching erotic videotapes or fantasizing...

There is less agreement on the relationship between testosterone and desire in women. Studies have found that in many women sexual desire peaks in the middle phase of the menstrual cycle, when testosterone levels are at their highest. But other researchers have failed to duplicate the findings. However, higher-than-normal doses of testosterone are used to treat loss of desire in some women who are post-menopausal or who have had their ovaries removed...

– Abridged from Daniel Goleman, *The NY Times* 18 Oct 1988.

Reality as fiction

WHEN Ella first made love with Paul, during the first few months, what set the seal on the fact she loved him, and made it possible for her to use the word, was that she immediately experienced orgasm. Vaginal orgasm, that is. And she could not have experienced it if she had not loved him. It is the orgasm that is created by the man's need for a woman, and his confidence in that need.

As time went on, he began to use mechanical means. (I look at the word mechanical—a man wouldn't use it.) Paul began to rely on manipulating her externally, on giving Ella clitoral orgasms. Very exciting. Yet there was always a part of her that resented it. Because she felt that the fact he wanted to, was an expression of his instinctive desire not to commit himself to her. She felt that without knowing it or being conscious of it (though perhaps he was conscious of it) he was afraid of the emotion. A vaginal orgasm is emotion and nothing else, felt as emotion and expressed in sensations that are indistinguishable from emotion. The vaginal orgasm is a dissolving in a vague, dark generalized sensation like being swirled in a warm whirlpool.

There are several different sorts of clitoral orgasms, and they are more powerful (that is a male word) than the vaginal orgasm. There can be a thousand thrills, sensations, etc., but there is only one real female orgasm and that is when a man, from the whole of his need and desire takes a woman and wants all her response. Everything else is a substitute and a fake, and the most inexperienced woman feels this instinctively. Ella had never experienced clitoral orgasm before Paul, and she told him so, and he was delighted. "Well, you are a virgin in something, Ella, at least." But when she told him she had never experienced what she insisted on calling "a real orgasm" to anything like the same depth before him, he involuntarily frowned, and remarked: "Do you know that there are eminent physiologists who say women have no physical basis for vaginal orgasm?"

"They don't know much, do they?"

And so, as time went on, the emphasis shifted in their love-making from the real orgasm to the clitoral orgasm, and there came a point when Ella realized (and quickly refused to think about it) that she was no longer having real orgasms. That was just before the end, when Paul left her. In short, she knew emotionally what the truth was when her mind would not admit it.

—Doris Lessing, *The Golden Notebook*. Simon & Schuster 1962.

A MALE PATIENT recently asked: You mean I shouldn't get angry with Jennifer if she doesn't have an orgasm? I don't want her to have sex just to accommodate me, but when she doesn't come, I think that's what she's doing.

TO WHICH Jennifer replied: That's nonsense. Sometimes I come, sometimes I don't. It depends on a lot of things. But I can tell you this, there are times when I don't have a climax but I feel wonderfully close to you. And there are other times when I have an orgasm, but I don't feel so good with you. And I much prefer the first to the latter. So get off my back about coming. An orgasm isn't something you can deliver on command. Stop making the whole issue so important.

—*The G-Spot and Other Recent Discoveries about Human Sexuality*, Alice Kahn Ladas, Beverly Whipple, John D. Perry. Dell 1982.

WHETHER the G spot really exists I'm not qualified to say, but suppose that there is a sensitive region located on the innermost third of the front vaginal wall. What sort of behavior would this encourage? As devotees of the G spot have long been aware, sexual intercourse in the en face, or "missionary," position affords only minimal stimulation to that area, whereas "bestial" intercourse—in the front-to-back position characteristic of the nonhuman mammals—maximizes it. (That position, incidentally, also facilitates clitoral touching.) The argument seems to be ripening toward climax: if there is such a thing as vaginal orgasm, it is perfectly tailored to the activity by which our primate ancestors engendered us.

—Melvin Konner, *Is Orgasm Essential?* *The Sciences* March 1988, 4-7.

A matter of class mores

IN his book on the male, Kinsey contrasts two distinct "systems of mores," two behavioral patterns for sexual intercourse. One of them "depends on prolonged pre-coital play, a considerable variety of techniques, a maximum of stimulation before coital union, and, finally, orgasm which is simultaneous for the male and female." Except for simultaneity of orgasm, this description aptly sums up the goals and therapeutic measures developed in Masters' and Johnson's clinic. And yet, as Kinsey points out, most of this behavior "would be anathema to a large portion of the population, and an outrage to their mores." He asserts that "perhaps a half or more of all persons" are not interested in prolonging a sexual encounter. "This is true, for the most part, of the more poorly educated, although there are not a few upper-level individuals who react similarly."

The second system of mores, consisting of simple and direct coitus, is favored by the lower social level because they consider it more "natural" rather than moral. One may argue that these people are simply unenlightened in matters of sex. On the other hand, they may—as they themselves think—be more in tune with certain biological needs that more sophisticated people tend to neglect. And of course both interpretations may be right. Examining the two systems of behavior, we may find ways in which they can actually complement one another. We may also find that for many persons both

systems are needed in order to benefit from the sensuous as well as the passionate, and from the different types of orgasm.

THIS pluralistic approach seems desirable if only because the sexuality of lower-class, i.e., less-educated, people has been so thoroughly ignored in the professional literature. Leaving aside questions of morality and perversion, it is legitimate to ask whether there may not be advantages to a "complementary" approach which are systematically neglected by adherents of only "intellectual eroticism," as Kinsey calls it, or only the simple-and-direct approach.

In allowing this possibility, one must realize that the simple-and-direct approach involves techniques and sexual response quite different from those of sensuous eroticism. The sensuous approach creates circumstances most conducive to vulval (clitoral) orgasm, while the simple-and-direct approach would seem to orient itself towards uterine orgasms, which require much less sexplay and generally result from a concentration upon coital thrusting. Many women, probably most, find that even under extremely favorable conditions they rarely if ever achieve blended orgasms combining the features of both types.

In some cases, it seems that sensuousness and the vulval orgasm may be only a prelude to the passionate thrusting that a woman really wants. In a recent report a young man said:

If I really want to send a woman up the wall, I give her an orgasm or two and then I get on top and fuck her as hard as I can. This seems to give her a kind of ecstasy unlike anything else. But basically I'm a very sensuous person, and I don't often do this.

Some women report that they are unable to experience either a vaginal or blended orgasm unless it is preceded by vulval orgasm. But there are other "either/or" cases in which there seem to be two mutually exclusive types of feeling or libidinous impulse that determine whether a woman desires clitoral stimulation and a vulval orgasm or passionate coitus and a vaginal orgasm. One woman reported:

Qualitatively the two desires are quite different. Desire for a uterine orgasm is a languishing, yearning kind of feeling which I am sometimes able to communicate merely by looking at my husband in a special way ... There are three or four days quite soon after my menstrual period when I sense this need acutely ... A desire for vulval orgasm, on the other hand takes many forms. I may start out feeling lazy, seductive, and kittenish. Or sometimes it's an aggressive, restless, peevish feeling ... If it is my husband who initiates lovemaking, I can tell which pattern I ought to be following almost at once, because a caress to my breasts or a lingering kiss will bring about a feeling of disagreeable tension and malaise if I am in need of a uterine orgasm. Yet these techniques feel erotically satisfying when I am in the mood for a vulval orgasm ... In foreplay for a uterine orgasm there are usually at least two or three minutes of hugging, nuzzling and deep-pressure caressing. Qualita-

tively this firm caressing is very different from the gentle, light caresses which precede vulval orgasm ... Both partners take part in the hugging and firm caressing, which feels like an effort to weld two organisms into one ... Similarly, I have noticed that if I am "in estrus," I find it very agreeable to have my uterus palpated through the abdomen wall ... Intromission needs to be gentle and slow, but total, so that I can enjoy the sensation of having the uterus being moved by the glans penis ... After the initial gentleness, the momentum of thrusting builds up so that after four or five strokes [I find that I love] the violence of the blows of the penis.

In this report, one discovers a temporal consideration that may be highly relevant to the ambivalence of an "either/or" woman. Note that the impulse to simple-and-direct coitus seems greatest soon after menstruation, in what this woman calls her "estrous" period. The passionate woman who yearns for the quick and forceful penetration of simple-and-direct coitus may be duplicating the instinctive reproductive behavior of infrahuman primates. In some women, this pattern may be the dominant mode of sexuality.

— Abridged from Irving Singer, *The Goals of Human Sexuality* (NY: Norton 1973) pp 105-107 and 114-118.

a curtain of flowers has devoured night's castle
and a dreaming snake slips into your waking

seawinds have lifted the fish
he cuts water's virginal flesh
and his invisible needle gives him an invisible stitch

across wild grasslands embracing
the alliance of arms
the stem of your leg
and the pistil of your breasts
a luminous blade penetrates
into a grotto of passion

vineyards of dawn have marked your heel
that gets lost in my hand
like my sex in yours

the horse of day rears up in the sky
a curtain of flowers has set fire to the forest of love

— *Camourade: Selected Poems*, Paul Laraque (Haitian). Bilingual ed., Rosemary Manno, tr. Willimantic CT: Curbstone Press 1988. The title combines "amour" (love) and "camarade" (comrade).

Empowering Non-Traditional College Students ^[1]

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THIS PAPER briefly examines the social, political, and educational milieu of those who are "outsiders" inside traditional US higher education. We discuss the ideology undergirding various approaches to mathematics education. Here the focus is on responding to the intellectual and affective conditions of non-traditional students and their need to examine critically and act on their milieu. This pedagogical approach aims to prefigure and support transformation of the U.S. society.

Societal, political, and educational contexts

In the United States, as in other nations, large numbers of individuals are prevented from realizing their potential in mathematics [McKnight *et al.* 1987, 111] and in mathematics-related fields. This mathematical disempowerment of individuals and the accompanying alienation that many experience are due, in large part, to the effects of the interactions among the social, political, and economic structures of the U.S. Political economy functions both as a determining factor and as a social filter in the phenomenon of unrealized potential and alienation. In regard to scholastic achievement, for example, attitudes toward race, gender, and class, which are both given birth and reinforced by the political economy of the U.S., restrict the access of ethnic and racial minorities, women, and working-class students to mathematics and mathematics-related fields [2].

1. Revised version of a paper delivered by the authors at Sixth International Congress on Mathematics Education, Budapest, Hungary, July 1988.

2. This is a special case of how sex, gender and class interact to influence the social function of education generally [Apple 1979]. The view that interaction of these variables can account for differential achievement has recently gained currency in the established mathematics-education community [e.g., Reyes and Stanic, 1988].

In the late 1960s, the interplay of two dynamic and contending forces, one economic and the other social and political, contributed to a restructuring of higher education. On the one hand, the economy began to require an increasing proportion of labor to be incorporated into the mass production of information, communication, and finance. On the other hand, the social and political struggle against U.S. involvement in the Vietnam War and the Civil Rights Movement were at their height. Under these pressures, higher educational institutions opened their doors to new kinds of students, ones traditionally considered as "outsiders" [3]. A significant proportion of these outsiders or, as we shall refer to them, "non-traditional" students were not adequately prepared to meet the conventional expectations of post-secondary institutions. This inability was due to both cognitive and psychological constraints engendered in students by social, political, and scholastic biases of the society. These biases produce a stratification of the society educationally and, in turn, determined that many non-traditional students were to be women, ethnic and racial minorities, and working class teenagers and older adults. They comprise the population of students with whom we have been working for several years in colleges.

IN MANY CASES, non-traditional students are in the first generation of their families to attend college, and thus are without a family tradition of post-secondary education to guide and support their scholastic efforts. For many, their previous encounters with educational institutions have diminished significantly their academic self-esteem, in general, and their view of themselves as capable mathematics learners, in particular. In secondary school, many were tracked into non-college-bound curricula and labeled as failures by educational authorities. Too often, non-traditional students enter post-secondary institutions without adequate preparation, academically or psychologically, to meet successfully the challenge of traditional mathematics curricula.

This underdevelopment of non-traditional students is further exacerbated by misconceptions and beliefs about mathematics acquired in their primary- and secondary-school experiences. For instance, they tend to believe that mathematics is an arcane body of knowledge, containing immutable, eternal truths which are external to humans and, therefore, can be discovered only by "gifted," "sagacious" minds. In accord with this belief about the nature of mathematical knowledge, many non-traditional students also hold the misconception that mathematics is learned by completing repetitious exercises and arduously memorizing facts and procedures. Most

3. That these pressures were successful in democratizing access can be understood by examining the strong counter-measures which were implemented. Shor [1986] analyses the various waves of reaction.

insidious, however, is their belief that the mathematics they are expected to master cannot be further developed, at least not by them.

Responding to the large influx of non-traditional students, higher educational institutions have established remedial mathematics courses, but this has been done within a set of existing institutional imperatives. The structuring of remedial courses is constrained by such imperatives as degree requirements, required course load for full-time status, and institutional withholding of degree credits, none of which address the cognitive and other educational needs of non-traditional students. Adding to the structural disjunction, those assigned to teach remedial courses tend to be either part-time faculty, receiving substandard recompense, or full-time faculty considered (and considering themselves) to be at the bottom of the faculty hierarchy. Students become aware of the self-image of faculty as well as the value, or lack thereof, that the institution places on remedial courses and on students who need such courses. The combined effect of these environmental features is a stigma which affects both faculty and students, and negatively influences the effectiveness of remedial courses.

The Ideology of remedial instructional approaches

This stigma contributes to and is reinforced by the poor performance of both dominant instructional methodologies and non-traditional students. To understand this, we need to examine the philosophies behind the instructional approaches under which non-traditional students are taught mathematics. Giroux's [1982] categorization of the ideologies underlying various approaches to native-language literacy is useful in understanding the problematic nature of traditional mathematics pedagogies and the promise of some alternative ones. Giroux [338] views ideology as a "dynamic concept that refers to the way in which meanings and ideas are produced, mediated, and embodied in forms of knowledge, cultural experiences, social practices, and cultural artifacts." He argues that by examining the ideology behind various pedagogies, we can analyze how schools sustain and produce meanings, and how individuals and groups produce, negotiate, modify, or resist those meanings.

Giroux's category of *instrumental ideology* focuses on principles of prediction, efficiency, and technical control. Knowledge is seen as objective and external to the knower. Facts are stripped of the subjectivity of class formations, race, and gender and celebrated for their supposed neutrality. The focus of instruction is on atomized content, the mastery of which constitutes the central problematic. This ideological perspective underlies traditional mathematics pedagogies and has its crudest expression in remedial instructional methods which concentrate on lower-order cognition—mechanical proficiency and rote memorization—omitting any insight into the nature of mathematics as a way of thinking and seeing and the uses of mathe-

tics in understanding the world. At best, this kind of functional "math literacy" results in a fragmented knowledge of discrete mathematical algorithms, without an understanding of how mathematical knowledge is generated or used to examine and transform economic and social realities. At worst, it results in a blind pursuit of value-free scientific knowledge with little tolerance for questions concerning the ethical nature and consequences of the practical application of knowledge. This belief in value-free knowledge produces, for example, nuclear weapons without awareness or questioning of the interests and choices that direct the application of mathematics.

Giroux's category of *interaction ideology* centers on the human dimensions of knowledge, viewing knowledge as a social construction. It regards meaning, as opposed to mastery of content, as the central problematic. This ideology underlies "humanistic" mathematics pedagogies which focus on alleviating "math anxiety" [4], individualizing instruction at the students' own paces, and problem solving with a stress on process over product. In such pedagogies, there are important moments when students can grasp the nature of mathematics and their ability to do mathematics. Though interaction ideology is concerned with cognitive dissonance and moral development, it omits notions of political conflict and power differences among socioeconomic classes and racial, ethnic, and gender groups. That is, "power and freedom collapse into an exaggerated notion of human will as well as a blindness towards those larger social forces that promote economic and cultural disintegration" [Giroux, 348].

INTERACTION AND INSTRUMENTAL IDEOLOGIES are dominant in instructional methods of mathematics and are reproduced, particularly the former, in remedial mathematics courses. The long-term success rate of these methods has proven to be dismal as evidenced by the fact that these students find themselves again and again in need of remediation. For those who do succeed, their increased facility in basic skills tends to be short-lived. These ideologies leave students with little or no insight into the nature of mathematical thinking and certainly without recognition of their ability to generate mathematics; they serve only to confirm students' beliefs that they are incapable of understanding mathematics and to reinforce the logic of existing relations of domination.

While remedial courses have often lacked original and imaginative teaching and learning models and have failed to promote modes of thought and to develop tools with which students can break with the predefined, they have also been places where innovations in mathematics pedagogy and challenges to dominant ideologies have taken root. New approaches and methods, fundamentally different from traditional ones, have developed due to the interplay of theo-

4. A critical approach to this topic can be found in Frankenstein [1984].

retical and concrete influences which are both internal and external to the fields of mathematics and education. These influences have included changes in the theoretical perspectives concerning the nature of mathematics and the learning process and the effects of non-traditional students stimulating instructors to re-examine methods in light of the instructional failure and theoretical collapse of the instrumental paradigm [5].

The interaction of these influences, as we view them, have led to the development of mathematics pedagogies which fall within Giroux's third category, critical ideology. This ideological perspective, which owes much to Freire's [1970, 1973] pedagogy of the oppressed, extends the complex role schools play as institutions that mediate and sustain the logic of the state and the imperatives of capital, to include the important concept of human agency where, in a dialectical process, people both participate in their own oppression and struggle to resist. As Giroux [p.354] says, at the core of Freire's notion of critical literacy is "the insight that culture contains not only a moment of domination but also the possibility for the oppressed to produce, reinvent, and create the ideological and material tools they need to break through the myths and structures that prevent them from transforming an oppressive social reality." Furthermore, critical mathematics pedagogies take the view that the cognitive processes owned by speakers of any language are akin to those involved in thinking mathematically [Gattegno 1963, 1970]; that students require situations to mathematize and only a minimum of givens; and that from these they can generate mathematics both inductively and deductively [Gattegno 1984]. This critical ideology and its pedagogical manifestations are the foundations of the three instructional techniques—reading, articulation, and ethnomathematics—discussed briefly below and elaborated elsewhere [Frankenstein 1987, Hoffman and Powell 1987, Powell 1986a].

Reading and articulation: The construction of meaning in both society and mathematics

To support non-traditional students in their attempts to construct meaning in mathematics and society, reading and articulating are processes to which we attend explicitly. By reading, we restrict our reference here to non-textbook readings related to mathematics and mathematics learning. Students read excerpts from the mathematics education literature and critically reflect on the reported findings and their own mathematics learning in light of these findings. For example, students read excerpts from, "Mathematics in the Street and in

5. More space than we have is required to provide evidence for this conjecture. However, for an analysis of a parallel paradigm shift which occurred in the teaching of composition, see Hairston [1982].

the Schools" [Carragher et al, 1985], a study conducted in Brazil among sons and daughters of street vendors who assist their parents in their businesses. The study found that "performance on mathematical problems embedded in real-life contexts was superior to that on school-type word problems and context-free computational problems involving the same numbers and operations." Students are asked to reflect and comment on the study. Their reflections are made public in small-group and class discussions and through writing. In the above example, the discussions help students to make explicit and recognize the variety of situations in their lives in which they competently use and understand mathematics.

THE SOCIAL CONSTRUCTION OF MEANING in society through mathematics can be an important part of our individual and collective struggles to make our lives more democratic, just, and humane. Students read newspaper articles on topical social, political, and economic issues and the mathematics of these issues are examined. Here the focus is on understanding and interpreting, through discussions and in writing, the statistical information and arguments presented [Frankenstein 1987], [6]. Statistical data can clarify issues and reveal aspects of the underlying structures of the society. Critical mathematics literacy involves the ability to ask basic statistical questions in order to deepen one's appreciation of particular issues and the ability to present data to change people's perceptions of those issues. An understanding of numerical data prompts one to question "taken-for-granted" assumptions about how a society is structured, enabling us to act from a more informed position on societal structures and processes. For example, an analysis of data collected and published by the U.S. government reveals that the U.S. economic system functions as "socialism for the rich" (e.g., in 1975 the maximum Aid for Dependent Children welfare payment to a family of four was \$5000, while the average tax loophole for each of the richest 160,000 taxpayers was \$45,000 [Babson & Brigham 1978]). For another example, the International Association of Machinists uses statistical data in their argument for peace conversion and have documented that, contrary to popular mythology, "as the military budget goes up ... machinists jobs in military industry decline" [Anderson 1979].

Further, critical interpretation and reflection are processes which also can be stimulated and promoted by articulation activities. In such activities, students reflect explicitly on cognitive and effective aspects of their mathematical experiences and articulate these reflections in speech or in writing. Talking about mathematics is facilitated by small-group, collaborative work. The results of these small-group deliberations are publicly heard and debated in class discussions.

6. For a text which teaches basic mathematics through real statistical data about the world, see Frankenstein [1989].

Collectively, but not without dissenting positions, meanings are thus constructed.

Articulation in the context of mathematics can also be facilitated through writing. Students are engaged in exploratory, speculative writing as a vehicle to externalize their reflections and constructions of meanings of mathematics. This type of expressive writing can be a valuable end in itself as well as a starting point in which feedback and revisions are grounded. Revising, then, is a process through which students write more deeply and elaborately about mathematics and their learning. We have used successfully several types of writing activities, including multiple-entry logs [Hoffman and Powell 1988], free writing, and journals (or learning logs) [López and Powell 1989, Countryman 1985, Stempien and Borasi 1985]. For example, students write journals to monitor their learning, to formulate questions, to describe observations, and conjectures; they also write to express their affective responses to the mathematics they are learning and as a way to gain control of anxieties and other emotions which prevent them from doing mathematics well. We provide written responses, which are intended to be non-judgmental, to statements, interpretations, questions, discoveries, and misconceptions in students' journals. Responding in this way establishes a medium for direct, personal "dialogue" between instructor and students; and, students are reassured that their concerns were taken into account. Writing also requires students to take a more active role in determining the content of their learning.

WHEN NON-TRADITIONAL STUDENTS take steps to determine the content of their learning through the independent use of learning tools, it is indicative of their involvement with an empowering process. Writing is an effective reflective tool for students to articulate and explore their evolving understanding of both mathematics and society and themselves in relation to them. Whether writing is empowering can be measured by the extent to which it can be used as an independent learning tool. Evidence that writing is empowering was provided by a student who, beyond the course in which it was introduced, continued to use multiple-entry logs in a mathematics course for which writing is neither required nor monitored. The significance of the example can be appreciated once we briefly describe multiple-entry logs.

One way students create a multiple-entry log is to crease a sheet of loose-leaf paper width-wise into three equal sections. Into the left-hand column, students copy portions of "text" which particularly interests or strikes them. The word "text" is interpreted broadly to mean a selection of prose or mathematical expressions from the textbook, lecture, problem set, or any other course material as well as selections from mathematical discussions in which one engages or, as it were, witnesses. Once a "text" is selected, students write in the

middle column a comment, an evaluation, a summary or any other type of reflection of their "text." Finally, the most crucial and critical aspect of maintaining multiple-entry logs is for students, some period later, to reflect again or "meta-reflect" on previous "text"-reflection entries and, in the right-hand column, to update their reflections. The excerpt in Figure 1 below is from the multiple-entry log of a student who was in the second week of a college algebra course [7].

TEXT	REFLECTION #1	REFLECTION #2
Doug is paid double time for each hour worked over 40 hours in a weeks. Last week he worked 46 hours and earned \$468. What is his normal hourly rate?	He only worked 6 hours overtime. That means only 6 of those hours were double time. I'm not sure how to set up the problem. The \$468 represents the amount he was paid for the regular 40 hrs. plus the 6 hrs. overtime which were double time.	Although the problem doesn't ask how much he earned per week without overtime, I can now answer that question. Also I can answer the question of how much he earned for the 6 hrs. he worked overtime. $40(\$9) = \$360/\text{wk}$ $6(\$18) = \108 for O.T.
	Whatever his hourly rate is, for the 6 hrs. he worked overtime it will be doubled. Let x represent his normal hourly rate. He normally works 40 hrs./wk., so $40x$ represents a typical weekly earning. $6(2x)$ represents the six hrs. worked overtime at double his normal hourly pay.	After reflecting on this problem, I have come to the conclusion that if I can represent an unknown quantity with a variable I could find the other unknown quantities of a problem using that variable.
	$40x + 6(2x) = 468$ $40x + 12x = 468$ $52x = 468$ $x = 9$	
	His normal hourly rate is \$9/hr. For the six hours he earned \$18/hr.	

Figure 1. The multiple-entry log of a student engaged in writing as an independent tool to learn college algebra.

7. Currently, this student and one of the authors are collaborating on a research project to determine whether writing, such as multiple-entry logs, can be used as an independent learning tool.

The above example of a multiple-entry log, produced independent of directions from an instructor, illustrates several interesting aspects of the types of writing students produce using this tool. First, the entries in the middle and right-hand columns are examples of personal or expressive writing which are both reflective and analytical. Second, in the middle column, the student states that he is "not sure how to set up the problem," as if by declaring this, it allows him to go on. Third, he uses the writing to explore his understanding of the problem. Specifically, he seems to wrestle with the significance of Doug having worked 6 hours overtime and the impact this has on the pay he received for the week. Fourth, as the student writes, his understanding of the problem seems to deepen, and he discovers a way to express one of the unknown quantities. He determines that the variable " x " can represent Doug's normal rate of pay and that " $2x$ " would therefore stand for his overtime rate. Then, the student establishes an equation: Doug's "typical weekly earning" plus his overtime earning equals his total earnings for the week.

In the right-hand column, which contains the student's second reflection, he discusses two important insights. The second of these is a generalization of the particular instance in which he became aware that if one unknown quantity could be denoted by a variable, then the same variable can be used to assist in the representation of other unknown quantities in the problem. Later, of course, he will need to specialize to determine the domain for which his insight holds. The point, however, is that the process of generalizing is an important aspect of mathematical thinking, and the act of writing reflectively afforded the student an opportunity to engage in metacognition and to think deeply about mathematics at his level. This is the potential that articulation activities have for empowering non-traditional students.

Ethnomathematics and cultural affirmation

Ethnomathematics, a cultural anthropology of mathematics, is defined by D'Ambrosio [1985] as "the mathematics which is practised among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain age bracket, professional classes, and so on." Further, Fasheh has stated that "ethnomathematics means working hard to understand the logic of other peoples, of other ways of thinking," and Gerdes posits that "mathematics is the union of all ethnomathematics" [8]. Ethnomathematical research focuses on methodological differences in various cultures' mathematics, such as the contrasting uses of the period and comma in mathematical notation, or how learning is affected when notational conventions of

8. These remarks were made by M. Fasheh and P. Gerdes during a panel presentation, "Mathematics Education in the Global Village: What can we expect from ethnomathematics?", at the Sixth International Congress on Mathematics Education, Budapest, Hungary, July 1988.

enumeration of one cultural-linguistic group is uncritically adopted to the cultural-linguistic system of another [Powell 1986b]; it can involve analyzing conceptual differences in various cultures' mathematics, such as the classification structures of other languages, where, for example, in the African language Setswana, things are classified by what they *do*, rather than by what they *are*, as in Indo-European languages [Berry 1985]. Ethnomathematical research has shown that the basic notions of mathematics are similarly developed in all children, regardless of social class, race, and culture [Ginsberg 1982]; that what counts as mathematical knowledge needs reconsideration, since, for example, the geometric knowledge of basket weavers [Gerdes 1986] and the group structure of kinship relations [Ascher and Ascher 1986] have been found to embody complex mathematical structures; and that the contributions of various cultures to mathematics have been distorted and hidden, such as, the false portraits of Euclid, a historically famous mathematician, who lived and died in Egypt, but who is depicted as a "fair Greek," "not even sunburned by the Egyptian sun" when "there is not a shred of evidence to suggest that he was anything other than [an African person of Egypt]" [Lumpkin 1983, Zaslavsky 1983].

AN EXAMPLE of how this research can be used in the curriculum involves a discussion of the following problem:

Many Western anthropologists have claimed that the other cultures they studied were "childlike" and "primitive." Marcia Ascher, a mathematician, and Robert Ascher, an anthropologist, argue that "there is not one instance of a study or a restudy that upon close examination supports the myth of the childlike and primitive." They go on to quote other anthropologists and conclude that "cultural differences in cognition reside more in the situations to which particular cognitive processes are applied than in the existence of a process in one cultural group and its absence in another" [Ascher and Ascher 1983, 131]. A clear example of the kind of distortion or racist misunderstanding that has occurred involves a frequently repeated anecdote in math history books. It tells of an exchange between an African sheep herder and what is variously described as an explorer, trader, or anthropologist. It is intended to show that the herder cannot comprehend the simple arithmetic fact that $2 + 2 = 4$. It describes how the herder agrees to accept two sticks of tobacco for one sheep, but becomes confused and upset when given four sticks of tobacco after a second sheep is selected. Can you think of another interpretation of the sheep herder's confusion?

Through reflection and discussion of this problem, one becomes aware that from the sheep herders perspective, sheep are not standardized mathematical units. When students realize that there is a logic to the sheep herder's reasoning, they develop a greater respect of their own reasoning. Moreover, in turn, they become motivated to search for the logic in how they solve mathematical problems.

At present, we, and others in the International Study Group on

Ethnomathematics [9], are working to expand the ways in which these topics can be incorporated meaningfully into the classroom. We have found five important reasons for integrating an ethnomathematical perspective into curricula. First, the additional examples obtained by considering the mathematics of non-Western peoples provide a rich source for illustrating and applying mathematical concepts and theorems. Second, it gives a more accurate account of the history of mathematics and the contributions of non-Western peoples to it. Third, an ethnomathematical teaching perspective encourages instructors to have students examine their methods and ways of conceptualizing mathematics. Such examinations can be done through class discussions, writing, and student-instructor interviews. Instructors can then build from the mathematical structures understood by their students. Fourth, while students reflect on and reconceptualize their mathematical knowledge, they come to realize that they already know more mathematics than traditional evaluations reveal and develop confidence that they can learn even more mathematics. Fifth, since our students are culturally and racially diverse, they are culturally affirmed by the results of ethnomathematical research. They acquire an appreciation for the contributions of their communities and of other peoples to the history of mathematics. In addition, they gain respect for their own intellectual work, breaking through the view that "the intellectual activity of those without power is always characterized as non-intellectual" [Freire and Macedo 1987, 122].

Conclusion

Both as a sector within the U.S. society and as individuals, non-traditional students are not without power, especially intellectual power. The atmosphere created in mathematics classes can be structured to encourage this realization, and this can best be done when, to use the language of Gattegno, "teaching is subordinated to learning." One implication of this is that the instructor and the content are no longer the focus of attention. To accomplish this aim, one which can lead to the empowerment of non-traditional students, as with any other group of students, instructors must engage students in the use of their powers of perception and action and in dialogue. In this dialogue, students must be considered and treated as equals. This dialogue could include discussions of teaching styles, the nature of mathematics and learning, the constraints and short-comings of the system in which the course exists, and strategies for change. Further, instructors and students could interact as co-researchers to design instruc-

9. The International Study Group on Ethnomathematics organizes panels at various mathematics and mathematics education conferences and publishes a newsletter. For further information and a newsletter subscription, write Gloria Gilmer, 2001 West Vliet St., Milwaukee WI 53205.

tional and learning techniques and assess their effectiveness [López and Powell 1989] as well as to act on ways of effecting institutional change. Together, they can develop ways of overcoming the effects of racism, sexism, and classism on instructional methods and student achievement in mathematics. These efforts, by necessity, will be directed towards structurally transforming the negative educational and societal conditions in which the dialogue exists.

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On the conceptual and social hazards of viewing DNA as a "blueprint"

Genetic Engineering as Metaphysics and Menace*

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MOLECULAR GENETICS, the reigning paradigm in biology, promises to transform the living world through manipulation of the DNA molecule. Genetic engineering of plants and nonhuman animals is already well underway, and proposals for genetic engineering of humans and human embryos for medical purposes are increasingly frequent. Genetic manipulations confined to the body cells of individual persons ("somatic" gene modification), if found to be effective in treating rare, life-threatening diseases, would almost certainly come to be advocated as a therapeutic procedure for more common health-threatening conditions such as obesity and hypertension. And genetic modification of the reproductive cells, or the early embryo, for the purpose of prospectively correcting inherited defects or predispositions to disease ("germ-line" genetic engineering), while not on the short-term medical agenda, is considered by many to be a reasonable prospect because of recent dramatic results along these lines in animal experiments. According to one prominent medical geneticist "the animal studies raise the possibility of future genetic manipulations in humans" [Motulsky 1983].

Given the magnitude of what is being proposed and attempted in the name of molecular genetics, it is reasonable to ask whether this field of science has indeed developed a conceptual framework which is adequate to this program. Scientific and philosophical analysts earlier in this century, particularly in the Soviet Union, were critical of a view of living systems centered totally around the gene [see, for example, Zavadovsky 1931]. Because this critique of idealist and metaphysical trends in genetics eventually became caught up in that debacle of arbitrary state intervention in scientific thought and practice known as Lysenkoism, left-oriented analysis of biological ideas has been scarce during the past 40 years. Suggestions that genetics, in particular, may be encumbered by a class-laden perspective, have

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been virtually taboo. The distorting effect that political expediency can have on the theory and practice of science is a lesson well-learned, but it may have been learned too well. Although the Soviet Union's poor substitute for genetics in the 1930s and 1940s led to ill-conceived policies and wasted effort, it left the biosphere and the biological nature of the human species unaffected. In contrast, the implementation of the new biology by commercial forces in the U.S., Japan and Western Europe, in conjunction with genetic ideas that are in many ways as naive as those of the 1920s, threatens to have profound and permanent effects on the living world. Under these circumstances, it is not farfetched to consider how the most basic thought patterns in the biological sciences may be colored by the agendas of the societies in which they are currently flourishing.

In what follows I will attempt to show that the standard view of the accomplishments and capabilities of molecular biology, held by the general public, as well as by many scientists, is informed by a conceptual framework that is a poor representation of biological reality. As a consequence, justification of the technological application of molecular genetics is increasingly fraught with dogmatism and hype. Such mystification of biological science and technology increases the leverage of the commercializers over the general public, and provides a smokescreen for activities with unexamined hazards and social consequences. In particular, I will discuss the implications of a genetic engineering approach to human biology, given the current level of scientific understanding in this area. Although it is always possible that major theoretical breakthroughs can dramatically enhance our power to intelligently modify living organisms, none of the advocates of the implementation of the new biology has suggested waiting for such new insights. Therefore, it is within the present conceptual framework that practical proposals must be evaluated.

What are genes?

GREGOR MENDEL, whose work laid the foundations for the science of genetics, was interested in certain features of plants and animals that appeared to be transmitted across generational lines with predictable, but not absolute, regularity. In the case of the pea plant, which Mendel studied most carefully, these features included traits such as smooth or wrinkled seeds, white or gray seed coats, yellow or green pods, and long or short stems. Mendel suggested that certain "factors" existed in the peas which were associated with one version or another of these traits, and which were transmitted according to definite laws from parent to offspring. The most important of these laws were that each individual receives an equal number of such factors from each parent, and that each factor can exist in more than one version. These factors later came to be known as "genes," and have since become identified with specific sequences of DNA.

Note that Mendel conceived of his factors as influencing the *choice*

between complex alternatives, not as determining the *nature* of these alternatives. However, a very different view had come into prominence when physicist Erwin Schroedinger [1945] published his influential book *What Is Life?* "The chromosome structures" he wrote, "are instrumental in bringing about the development they foreshadow. They are law-code and executive power—or, to use another simile, they are architect's plan and builder's craft in one". These "chromosome structures," the repositories of an organism's DNA, had taken on a significance in both scientific and popular thought about living organisms that far exceeded the role for which Mendel had proposed the gene concept. Since Schroedinger's statement, the claimed role for DNA has become even more inflated. According to molecular biologist David Baltimore [1984], DNA is the "brain of the cell."

BUT WHEN WE LOOK at how DNA actually functions, it becomes apparent that this substance is no more responsible for a cell's activities or traits than a menu is responsible for a meal. That portion of a cell's DNA whose role is understood (which actually comprises only a few percent of this substance in a complex organism), represents the cell's means of keeping a record of the complement of protein and RNA molecules it is capable of producing. These molecules play a role in the cell analogous to the bricks and beams of a building, and to the tools that can help cut and join them. DNA performs its role not by issuing commands or coordinating functions, but simply by virtue of the fact that certain complex cellular activities make use of a correspondence between the linear sequence of the subunits ("nucleotides") of a portion of the cell's DNA, and the nucleotide and "amino acid" subunits of RNAs and proteins, respectively.

DNA's molecular structure makes it ideally suited to being duplicated by chemical processes in the cell and transmitted in precise copies to the offspring of any dividing cell. This property of DNA, along with its role described above, provides the means for conserving the structure of proteins and RNA molecules across generational lines. The maintenance of a cell's living activities, in turn, is absolutely dependent on its having inherited the capacity to produce proteins and RNAs that coordinate with one another and with the cell's environment. DNA is thus instrumental in the inheritance by cells and organisms of protein and RNA structure.

Insofar as the presence of specific proteins and RNA molecules can be considered "traits" of an organism, DNA serves the role of the Mendelian factors for these traits. This is because changes in some DNA sequences are ultimately reflected in structural changes in the corresponding proteins and RNAs. This satisfies Mendel's stipulation that the factors should influence the choice among different versions of a trait. However, most identifiable traits of an organism, such as size, shape, and behavioral characteristics, are the outcomes of complex interactive development processes involving numerous

proteins and RNA molecules, along with molecules from the environment, such as sugars and ions. Occasionally, there will be a reliable correspondence between a DNA change and a change in the expressed version of one of these traits. Under these rare circumstances a DNA sequence serves as this trait's Mendelian factor. But in most cases there will be no such simple factor for a given trait.

Although Mendel's successors frequently treated the inheritance of any trait, with virtually any sort of regularity, as evidence for the existence of genes "corresponding" to that trait, this is a drastic oversimplification. As noted above, even if a trait, such as seed texture in the pea plant, is inherited in a strictly Mendelian fashion, sequences of DNA do not specify the specific form of the trait. They only influence the *choice* between alternative forms. However, factors that influence the choice between different outcomes in a complex system are not always illuminating clues to the system's underlying processes. For example, a favorably placed rock can shunt a mountain stream from one valley to another, and eventually help determine the patterns of wildlife and human settlements in these regions. But the properties of the rock itself tell us nothing about the laws of water flow or of the ecology and economics of water use. As will be described below, key genes or their products can radically affect an organism's form and function by diverting ongoing dynamical processes; but such genes control the production of particular biological traits no more than the rock in the given example controls the distribution of habitats.

Are there genetic programs?

CONSIDERING the wealth of data available on the cellular role of DNA, it is difficult to understand why the facile metaphor that likens this molecule to a computer program has persisted for so long. Although the cells of multicellular organisms like ourselves contain much more DNA than is required to specify the totality of their proteins, no one has convincingly suggested a function for this molecule beyond its bookkeeping role in RNA and protein synthesis. In effect, it constitutes a list of ingredients, not a recipe for their interactions.

Whereas all somatic cells in a given individual contain the same sequences of DNA, these sequences are not equally used in each differentiated cell type. In a real sense, the "program" for the selective use of DNA resides among other components of the cell and its environment. DNA function is under the control of complex systems within the cell just as much as it determines aspects of the cell's composition. Biological information is therefore not uniquely located in any one structure or molecule.

If a cell's DNA indeed embodied a computer-type program, it should be feasible to decipher the language in which the program is written. I refer here not to the linear relationship between triplets of nucleotides and amino acids, i.e., the "genetic code". Corresponden-

dences of this sort can be used by the cell according to a set of rules, but do not themselves constitute such rules, much less a programming language. This can be made clearer by an example taken from the experimental literature [Hunter 1984]. Mouse connective tissue cells grown in culture were induced to take up one of two types of DNA: either a segment of DNA identical to one the cells already contained, or a form of that segment that contained a single changed nucleotide. The normal DNA segment specifies a protein, known as "*ras*", which adheres to the inner surface of the cell's enclosing membrane. The altered gene specifies copies of this protein that contain one changed amino acid. The result of the experiment was surprising: the uptake of the abnormal DNA turned the normal cell into a cancer cell that had an abnormal shape and growth properties, and failed to stop moving when it encountered neighboring cells. Its progeny eventually overgrew the entire culture.

It is difficult to imagine how such changed cellular properties could have been due to a set of instructions emanating from the mutated DNA molecule; this would imply that information relating to cell shape, responsiveness to the environment, and growth properties are all encoded in one nucleotide. It might be argued that, given the intracellular context, the altered *ras* protein specified by the mutated DNA effectively programmed the cell to be cancerous. But this line of thought, when followed consistently, is equivalent to maintaining that a defective gasket programmed the space shuttle Challenger to explode. When applied to nongenetic processes this viewpoint would be considered eccentric at best.

The experiment with *ras* is representative of the results of numerous studies in which genes are mutated, moved, or increased in number, and the consequences for whole organisms or their cells recorded. These studies show that small genetic changes can have effects on the cell or organismal phenotype that may be extensive or negligible, depending on the particular protein which is altered, or how it is altered, and on the interactions that this protein has with other cellular components. But the consequences of genetic changes clearly do not arise from alterations in a set of rigidly programmed instructions.

THE ONLY SENSE, therefore, in which an organism's DNA sequence might conceivably be considered to be a program is the trivial one of a presumed unique correspondence between the totality of an organism's genes ("genotype") and its structural and functional properties ("phenotype") under a constant environment. But even this is an oversimplification of the relationship between genes and traits. The "environment" of the genome includes not only externally controllable factors like temperature and nutrition, but also numerous maternally-provided proteins present in the egg cell at the time of fertilization. These proteins influence gene activity, and by virtue of

variations in their amounts and spatial distribution in the egg, can cause embryos even of genotypically identical twins to develop in uniquely different ways.

Living systems are built along very different principles from digital computers, or for that matter, other kinds of machines. Constructed of proteins and RNA molecules in interaction with one another, along with lipids (fat-like substances), and ions and fuels from the environment, they are examples of what is known to physical scientists as "dynamical systems": collections of interacting components that exhibit organized behaviors. Such systems are sensitive to inputs from their environments and, unlike machines, for example, can exhibit very different behaviors and take on different forms under slightly different environmental conditions, or even under constant environments. A pendulum is a particularly simple example of such a system (the solar system and a radio transmitter are more complicated ones). But even the simplest dynamical system can behave in unexpected and "non-programmed" ways. The motion of a pendulum, for example, can be negligible, periodic, or even chaotic, depending on external driving forces [Tritton 1986]. Significantly, the beating cells of the heart are found to obey similar rules [Guevara et al. 1981]. Simply specifying a list of ingredients for such a system will not determine exactly how it will behave, or what form it will take. And if the dynamical behavior of a system as simple as a pendulum is not reducible to a description of its composition, the behavior of a cells, which contain tens of thousands of interacting components, can in no fashion be considered to be programmed by sequences of DNA.

Nevertheless the view that DNA acts as the organism's program or blueprint remains fashionable. As molecular biologists Alexander Rich and S.H. Kim [1978] stated:

[I]t is now widely known that the instructions for the assembly and organization of a living system are embodied in the DNA molecules contained within the living cell.

And as incisive an analyst as the physicist Freeman Dyson [1985], from his survey of molecular biology, has somehow concluded:

Hard ware processes information; software embodies information. These two components have their exact analogues in the living cell; protein is hardware and nucleic acid is software.

Is genetic engineering possible?

THE ATTRACTIVE IDEA that organisms are programmed by DNA, and thus can be reprogrammed by manipulating DNA, and that diseases and other infirmities can be treated in a piecemeal genetic fashion, has been seized upon by those who seek to commercialize and profit from biotechnology. Yet it is far from clear whether this idea will yield

concrete results in the form of therapies that actually work.

Even in those rare cases in which the replacement of a single gene might ameliorate a particular disease, introducing new working genes into the tissues of mature individuals has proved to be exceptionally difficult. Consideration of the normal mechanisms of gene expression, insofar as they are understood, shows why this is the case, and casts profound doubt on the idea, touted by some investigators and many commercializers, that organisms are susceptible to reprogramming with predictable results.

The chromosomes of each cell type are generated in sequential steps that occur during embryonic development, including chemical modification of the DNA itself. The result of these steps is that some DNA sequences wind up in functional chromosomal regions and some are packed away into nonfunctional regions. Current techniques cannot select where in a chromosome a particular piece of foreign DNA will be inserted, and thus cannot ensure that it will be active in the cell. Insertions that fortuitously result in an active foreign gene risk disrupting normally active genes or reactivating normally quiescent ones. Furthermore, the specific removal of defective genes is impossible with current or foreseeable technologies.

In the case of gene modification of the cells that constitute the body (i.e., somatic cells) these difficulties could lead to disruption of the patient's physiology by a variety of effects, including overproduction of proteins, desired or undesired, or suppression of normal ones. In the worst case the genetically modified cells could acquire cancerous properties, and eventually kill the patient. This is not to deny that appropriate expression of a desired protein can occasionally be achieved in target cells, or that implantation of such cells into a patient's body might ameliorate the symptoms of a gene-related disability. Such therapy may offer hope in some rare, desperate cases. But scientific principles that would allow one to predict the long-term behavior of bodily tissues that express foreign genes do not at present exist.

THE INTRODUCTION of foreign DNA into the egg or sperm prior to fertilization, or into early embryos, presents an additional set of problems. These procedures are collectively referred to as "germ-line genetic engineering" for the reason that, whatever the intent of their application, they have the probable result that the altered genes will become incorporated into the embryo's own germ-line, or reproductive cell precursors, and thence conveyed to subsequent generations. The success that investigators have achieved in introducing functional genes into the eggs and embryos of experimental animals [Palmiter et al. 1982; Brinster and Palmiter 1986] might appear to be a result of a deeper understanding of the process of gene expression during early development than currently exists for the analogous process in somatic cells. Quite the opposite is true.

Early embryos have long been known to have the capability of enduring major traumas and insults and still develop into normal looking organisms. Embryos of sea urchins, frogs, and even mammals can be experimentally dissociated into their constituent cells; if this is done at an early enough stage, each cell gives rise to a fully formed individual. If two unrelated early mouse embryos are jumbled together into a single aggregate, the constituent cells will readjust their fates to yield a single individual with four parents. Phenomena of this sort, which are more a tribute to biological prodigiousness than to human ingenuity, led the embryologist Hans Driesch to his mystical concepts of goal directedness or "entelechy" when he could not explain them physically. A hundred years later we still do not understand the mechanisms.

Therefore it was not completely unexpected when it was reported that foreign genes injected into fertilized mouse eggs were expressed in the resulting embryos, which then developed into recognizable animals, occasionally with new characteristics, such as increased size [Palmiter et al. 1982]. In some cases the new gene was expressed in the appropriate tissue types, in some cases, not; in still other cases there were unforeseen interactions that influenced the expression of genes different from the one inserted. Moreover, it was evident that certain embryos could incorporate the new genes with absolutely no outward signs [Brinster and Palmiter 1986].

Because of the extraordinary homeostatic capacities of the embryo, phenotypically normal or even "improved" development may occur in embryos that have been rendered genetically abnormal by these procedures. But in such cases the cryptic genetic defect has been known to show up in the phenotypes of subsequent generations. A recent study, for example, found that the normal-looking offspring of one genetically modified mouse developed cancer by the middle of their lives at more than 40 times the rate of the unmodified strain [Leder et al., 1986].

Who needs genetic engineering?

DESPITE THESE POTENTIAL PROBLEMS, the specter of human genetic engineering clearly hovers over the medical industry, and basic research devoted to overcoming the technical obstacles is one of the most glamorous areas of science. The potential constituency for gene correction or replacement therapies, as currently perceived by those developing the procedures, is everyone with a "genetic disease". In the view of David Baltimore [1977], speaking at a National Academy of Sciences forum:

When such therapy becomes possible, there is little doubt that afflicted individuals will seek it. And not to make it available, if it is a feasible scheme, seems inhumane to me. In general, genetic diseases are one of our most serious medical problems, and if gene therapy could be used, many lives could be enriched by better health.

What then, is a *genetic disease*? According to current understanding of genetic mechanisms, polymorphisms, i.e., DNA sequence variants, can occur in thousands of locations in the human genome. Such sequence variants can lead to qualitative functional alterations or variations in the quantitative levels of specific proteins or RNA molecules. The degree of phenotypic divergence between individuals carrying these variants is of course a different question from molecular changes that may be caused in this way. Often, identical changes in a specific cellular component can have radically different effects in different individuals.

Sickle cell anemia, the earliest described disease associated with a single amino acid substitution in a known cellular constituent, hemoglobin, is a case in point. This condition is highly variable in its severity in affected patients. The reason for this is unclear, but an important aspect may be individual differences in the quantity of hemoglobin per red blood cell, which in turn influences the propensity of red blood cells with abnormal hemoglobin to take on a sickled shape (not all of them do so) [Mozzarelli et al. 1987]. The sickled cells clog the body's capillaries, so anything that affects their numbers affects the course of the disease. Contributing conditions, such as the amount of hemoglobin per cell, can be influenced by numerous genetic and nongenetic differences between individuals. Moreover, the possibility exists for drugs to mitigate the condition by acting on parameters, such as cellular hemoglobin concentration, that leave the underlying genetic condition leading to sickle cell anemia unchanged.

Phenylketonuria (PKU), an "inborn error of metabolism" that leads to mental deficiency, is certainly a genetic disease: the enzyme that normally converts one amino acid, phenylalanine, into another, tyrosine, is lacking due to a mutation. However, PKU is also an "environmental disease": the toxic effects of accumulated phenylalanine can be obviated entirely by dietary means.

JUST AS SUFFERERS from some so-called genetic diseases can be successfully treated with drugs or diet, victims of other diseases long thought to result from gene defects, such as Parkinsonism and amyotrophic lateral sclerosis (Lou Gehrig's disease), may in fact have acquired their conditions by ingesting certain unusual toxic substances [Spencer et al. 1987]. Of course, there may be individual genetic variations in susceptibility to such exotic toxins. There is really no inconsistency in considering the same disease as simultaneously genetic and environmental. Many individuals, for instance, are resistant to the cancer-causing properties of tobacco smoke; those who are vulnerable to this environmental carcinogen could correspondingly be considered genetically impaired. Indeed, even such patently infectious agents as the AIDS virus and the *Haemophilus influenzae* bacterium preferentially attack genetically susceptible individuals, and under conditions of widespread exposure can come

to be considered genetic diseases [Diamond 1987].

None of this should be surprising in light of the previous discussion of the highly complex, nonprogrammatic relationship between changes in DNA sequence and changes in an organism's traits. But the virtually tautological presence of a genetic aspect to every healthy or unhealthy condition opens the door to an overemphasis of this aspect by interested parties with genes to sell, in both the commercial and intellectual senses. If a problem is defined as genetic, the implied solution tends to be genetic as well.

Genetic theory and the social order

THOUGH THE GENE-CENTERED VIEW of living systems does not inevitably follow from the relations of production in bourgeois society, this explanatory framework appears natural to most people reared under capitalism. Thus, David Baltimore [1984], commemorating the discovery of DNA structure, termed this molecule the "executive suite" for which the remainder of the cell is the "factory floor", at one stroke reinforcing a pernicious view of the relationship between mental and manual labor, and distorting the role that DNA plays in living processes.

However much the gene-centered view of biology may reflect the social experience of its proponents, like other reductionist paradigms in science it founders on its attempt to exhaustively account for phenomena at a given level of organization by processes at another level. One might equally well consider the molecular basis of business cycles. No one would deny that altering an organism's DNA will often change its characteristics. For this reason, research conducted within the genetic programming paradigm will continue to generate facts and fill research journals. But isolated facts do not add up to a scientific understanding of the laws that govern the construction of organisms, and their susceptibility to dysfunction and disease.

Such an understanding can probably only be approached by research that treats organisms explicitly as dynamical systems, a field that is still in its infancy. Already, however, as in the examples given previously, work along these lines continues to confirm that living systems are indeed not programmed in the computer-like way this term is generally understood, and therefore not susceptible to rational reprogramming (See also Conrad [1983] for a formal analysis of why this is the case).

Of course this conclusion will not be to the liking of the biotechnology advance guard, who wish to take us beyond the cautious prophylactic and therapeutic approach to disease that has characterized medicine in the modern era, into the realm of human genetic engineering. The traditional approach makes use of vaccines, drugs, and natural substances administered to individuals in ways that can usually be stopped if adverse side effects appear. Genetically modified microorganisms, under well-contained conditions, can safely and

cheaply produce many of these agents. This strategy, while not foolproof, is appropriate to the present meager level of understanding of the basis of the qualitative attributes of living systems. (For additional perspective on the limitations of genetic accounts of biological phenomena, see Hubbard [1982], Oyama [1985], Edlin [1987], Fogel [1987] and Newman 1988.)

In contrast, the proponents of human genetic engineering, who include potential commercializers, basic scientists working (for the moment) on animals, and members of government-appointed advisory boards, such as the Recombinant DNA Advisory Council of the U.S. National Institutes of Health, envision procedures in which the human embryo will be the experimental system, and the ultimate goal a novel commodity: customized offspring. This prospect need never be defended publicly. A piecemeal moral perspective, typical of the bourgeois worldview, ensures its realization. Relevant components of this perspective are that, (i) research and development of new manufacturing techniques is an absolute value upon which no countervailing social value may be brought to bear; (ii) everyone has a right to have "perfect" offspring of their own genetic heritage; and (iii), if there is a market for a commodity which is not currently illegal, those who wish to provide it have the right to do so.

EVEN IF MODERN GENETIC THEORY embodied a comprehensive view of living systems, its application to human genetic engineering would be highly problematic. Since the Nazi period, the placement of eugenic policies on the social agenda has been virtually outside the pale of rational discourse, and for good reason. The question of whose genetic values will prevail in a class-ridden society need only be asked for the answer to be obvious. And it must be acknowledged that no existing society, bourgeois or socialist, has developed value systems appropriate to deal with the permanent biological modification of the human gene pool. But the actual primitive state of biological knowledge makes the contemplation of human genetic engineering doubly ill-advised.

Nevertheless, in the U.S. and Western Europe the genetic programming concept, which mystifies the public and flatters those in control of the productive forces that they are also in control of the properties of living systems, goes largely unopposed. Ironically, bad biological science played a similar role during the Lysenkoist period in the Soviet Union. The difference is that the distorted scientific ideas of the present period can cause permanent damage well beyond the socioeconomic sphere. It remains to be seen whether the world's people can become sufficiently informed historically and philosophically to take the necessary political steps for averting biological catastrophe.

The Necessary and the Contingent in the Evolutionary Process

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In the beginning, Hesiod says, there was Chaos, vast and dark. Then appeared Gaea, the deep-breasted earth and finally Eros, "the love which softens hearts," whose fructifying influence would thenceforth preside over the formation of beings and things.

– Greek Mythology, [New Larousse 1959]

It was a time in which all was calm and silent, without movementThe night covered the surface of the sea, but in the deepest waters lived Tepeu and Gucumaz, the Creator and Maker of Forms, respectivelyFirst the gods made a man from putty...but they were not satisfied: the body was too soft.

– From "Popul Vuh" [Gifford 1983]

IN THE MYTHOLOGIES, the evolution of man appears contingent on the whims of the gods. In biology, as the history of polemics over evolutionary mechanisms shows, there has been in the past, and there is in the present actuality, a great confusion about the respective roles of the necessary and the contingent. Indeed, one of the most important ways in which metaphysics has been expressed in evolutionary theory has to do with the antithetical duality "necessity/contingency".

I will argue here that only *dialectical materialism* provides the right approach to understanding the role of these categories in the evolutionary process [2]. As Engels [1954, 217f] said:

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2. On the dialectical materialist approach to the necessary and the contingent see Engels [1954, 209,216,217-221] and the reviews of Rosental and Straks [1960, 124-155] and Pilipenko [1986].

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Another opposition in which metaphysics is entangled is that of chance and necessity..... Common sense, and with it the majority of natural scientists, treats necessity and chance as determinations that exclude each other once for all. A thing, a circumstance, a process is either accidental or necessary, but not both.

For Engels, however, necessity and chance are opposites that become transformed into one another [p. 216], and the first proceeds through contingencies in such a way that behind what seems contingent hides necessity [3]. Also, the contingent is the result of causes, but more remote and indirect [p. 219].

Determinism tries to dispose of chance by denying it altogether. According to this conception only simple, direct necessity prevails in nature [p. 218].

Indeterminacy, however, is more common as a viewpoint in modern evolutionary theory. For example, when Mayr [1982, 57-58] analyses indeterminacy as one of the special characteristics of living organisms, he says:

Temporal predictions are much more rarely possible in the biological sciences No one would have predicted at the beginning of the Cretaceous that the flourishing group of the dinosaurs would become extinct by the end of this era.

Of course, Mayr's assertion is true. If we take into account only the hard prediction of contingent events we must conclude that indeterminacy is a key characteristic of living beings. However, Mayr does not discriminate between necessary and contingent events. As I will argue later in this article, the predictions of more necessary events (such as Engels made) are possible, but first I will examine the foundations in the neo-Darwinist paradigm for such indeterminacy.

Indeterminacy as a key characteristic of organismic changes in neo-Darwinism

MONOD, in *Chance and Necessity* [1971,110], is very explicit on indeterminacy in the evolutionary process. He analyzes random gene mutations as the source of novelties and says:

We say that these events are accidental. And since they constitute the *only* possible source of modifications in the genetic text, itself the *sole* repository of the organism's hereditary structures, it necessarily follows that chance *alone* is at the source of every innovation, of all creation in the biosphere. Pure chance, absolutely free but blind, at the very root of the stupendous edifice of evolution: This central concept of modern biology is no longer one among other possible or even conceivable

3. See: Engels [1954,220]; Letter to W. Borgius, Jan. 25, 1894 [*Marx-Engels Selected Correspondence*. Progress 1975, pp.442f]; and Ludwig Feuerbach and the End of Classical German Philosophy . [Progress 1976, p.382].

hypotheses. It is today the *sole* conceivable hypothesis, the only one compatible with observed and tested fact.

And ending the book he concludes:

Man at last knows that he is alone in the unfeeling immensity of the universe, out of which he emerged only by chance. [p. 167]

The corollary that can be deduced of Monod's view is that anything is possible, that is to say, all conceivable events have the same probability of occurrence and there are no events more or less necessary.

Perhaps an extreme view of "anything goes" is that expressed by Wilson and Bossert [1971,20]:

Evolution can be broadly defined as any change in the genetic constitution of a population. Population genetics has allowed a more precise definition: ANY CHANGE IN GENE FREQUENCY ... it is technically possible to have reversed evolution, at least at the level of sets of alleles.

When Engels [1954,220] analyzed determinism he said that necessity is degraded into chance. Here we could say that chance is elevated into necessity.

Indeed, one of the more frequent attacks made on neo-Darwinism by creationists and Lamarckists is based on chance as the source of order and complex structures. The argument of such attacks goes more or less like this: first we estimate how many mutations would be necessary for the construction of a structure and then we estimate the probability for the joint mutations. The number is so small that the occurrence of the event can be discarded [Futuyma, 1983,135; Steele, 1981,4]. However, the pitfall in this reasoning is that the estimation is for one particular event. The true question would be: How many viable structures could be created? The more necessary event then would be: any of such possibilities [Futuyma, 1983,135].

Futuyma [1983, 136] also replies to creationists that gene mutations are at random, but the second stage of the evolutionary mechanism is the ordering of mutational chaos by natural selection that is non-random.

HOWEVER, neo-Darwinism is reductionist because it does not take into account several levels of organization, considering the gene level as the only source of change in an organism. Thus the creationists are not so wrong when they criticize the randomness of neoDarwinism as the ultimate source of evolution. Indeed, when Monod says that pure chance is at the very root of evolution he is rigorously consequent with the premises of neo-Darwinism. We must answer the question: Is pure chance the only factor at the root of organismic changes, or are there also other more necessary factors? However, we must first review a related aspect in neo-Darwinism: the relation between organism and the environment.

The relation between organism and environment according to neo-Darwinism

IF WE REVIEW the history of ideas and hypotheses about organic evolution it can be seen that the relation between organism and environment has always been conceived as a mechanist relation, a metaphysical duality of "organism/environment". Moreover, regarding the question as to which of these two plays the determinant role in evolution, we can see that it has always been a one-sided overestimation of either the organism or the environment. Then we could state another metaphysical duality: "internal/external". On the one hand, the internal view conceives the evolutionary process as due only to the internal and autonomous forces of the organism. Some examples are Eimer's orthogenesis [Bowler, 1985,179-193] and Vavilov's [1922] Law of Homologous Series. On the other hand, the external view conceives the organism as putty before a molding environment that plays the determinant role. That is to say, there are no internal constraints on the adaptation of the organism to the environment. Examples of this view are Lamarckism, Lysenkoism and neo-Darwinism [4].

In the modern theory of adaptation this external conception of neo-Darwinism has been expressed in several ways, but first we must briefly review two characteristics of neo-Darwinism. First, neo-Darwinism and Darwinism are influenced by the empiricist/positivist tradition that conceives as real only the contingent individuals [Rodríguez, 1988; Webster and Goodwin, 1982]. Second, for neo-Darwinism the organism is constructed by a genome that is autonomous and only varies by random gene mutation (Weissmannism), and the only ordering or necessary agent is natural selection. The result of these characteristics of neo-Darwinism is that the organism is conceived as a contingent aggregate of parts, and as each part has been a result of the natural selection process, the logical conclusion is the "Panglossian Paradigm" [Gould and Lewontin 1979, 256]. According to these authors, this paradigm is based on the near omnipotence of natural selection in forging organic design and fashioning the best among possible worlds. The result would be that all organic form, function and behavior can be ascribed to adaptation.

4. Lamarckism emphasized the adaptation of organisms to environmental circumstances and the inheritance of that acquired characters by descent. See the First and Second Laws in Lamarck's *Zoological Philosophy* [1984, 113].

Lysenko overestimated the possibility of a quick evolution of plants under controlled conditions by an experimenter. He believed both in Darwinism and the inheritance of acquired characteristics by plants as a consequence of modified metabolism (Lamarckism). Indeed, he spoke of some plants as "putty" before the experimenter. [Lysenko, 1941, 53,61,66,104,121,129]

Such a view also leads to tautologies. We presume an existing trait to be advantageous because it has evolved and then, in retrospect, explain its evolution on the basis of some imagined advantage.

On the other hand, the characteristics of neo-Darwinism also lead to the conception of adaptation as "adequacy" for the response to external circumstances. This has been shown in two ways: Adaptation as the fitting to a preexistent form, and adaptation as the tracking of environmental changes. The first implies a preformed physical world to which organisms are fitted [Lewontin 1980, 237]. For the second view, Leigh Van Valen [1973] has made an analogy with the Red Queen (of Lewis Carroll's *Through the Looking Glass and What Alice Found There*) who said: "Now, here you see, it takes all the running you can do, to keep in the same place." For Van Valen, the organisms must be tracking the environmental changes all the time in order to maintain a sufficient adaptation. It is obvious that this view conceives the organism as a passive tracker that only moves by external stimuli.

Another consequence of the neo-Darwinist view is the dilemma of "being adapted/becoming adapted" [Lewontin 1980, 237f] where the alternative to the idea of an ecological niche existing before the organism fills it is

that ecological niches are defined only by the organisms living in them, but this raises serious difficulties for the concept of adaptation. Adaptation cannot be a process of gradual fitting of an organism to the environment if the specific environmental configuration, the ecological niche, does not already exist. If organisms define their own niches, then all species are already adapted and evolution cannot be seen as the process of *becoming* adapted ... the problem is how a species can be at all times both adapting and adapted.

I will call this dilemma the metaphysical dilemma of adaptation theory, and will propose later the dialectical materialist solution.

Underlying all these conceptions on organic adaptation is the assumption that the organism has no constraints limiting its adaptation to environment. However, there is evidence that the organism can be viewed as a system with internal constraints and its own dynamics.

Internal constraint and necessity in organismic dynamics

IN THE FIRST PLACE, the range of potential mutation is limited by the genotype that has evolved. Mayr [1963, 176] says that:

the number of possible mutations at any given locus is severely limited by the other mutational sites of the cistron and indeed by the total epigenotype. The unity of the genotype places well defined limits on the potential for variation.

And Dobzhansky [1970,92-93] says:

The mutational repertoire of the gene is great but not infinite; it is limited by the composition of the gene ... The successive mutational gene changes acquire a direction because natural selection controls the fitness of the resulting phenotypes and thus indirectly imposes a restriction on the randomness of the mutational events.

This idea of limitation due to an advance also occurred to Engels [1954,307]:

Each advance in organic evolution is at the same time a regression, fixing *one-sided* evolution and excluding the possibility of evolution in many other directions.

Also, there is evidence that the organism can be viewed as a "self-organizing" totality, with field properties and its own laws of form and internal constrictions [Webster and Goodwin, 1982a; Goodwin, 1984a, 1984b and 1986; Webster, 1984].

IN THIS VIEW, the organism is not an "expressive totality" due to a genome that works as a "central directing agency" without restrictions for its changes (Weismannism), but:

Species of organisms and their parts appear to comprise systems of transformations as a consequence of "internal" (e.g., genetic) or "external" perturbations. We suggest that these empirical transformations should be understood as transformations in the structuralist sense, i.e., as representative members of a set of potential forms generated by a set of specific laws. In other words, the diversity of forms should not be regarded as irreducible ... with a monistic conceptualization of organisms as self-organizing law-governed structures, the genome ... takes its place as a part of the totality of the constraints on the generative process along with others such as pre-existing organization and environmental factors. A "random" (historical) change in any of these factors will not result in a "random" change of structure, but in an orderly change to another possibility, another member of the system of transformations, and typical form will be conserved ... the picture of "anything goes" is dependent upon and consistent with the conception of the organism as an "expressive totality" since there is no reason to believe that changes in the genome are in any way *biologically* constrained ... the evolutionary process may indeed be the result of "chance" and "necessity" but the chance events enter into a structured system, a system which, because it is law-governed, results in an "a priori" necessary order. [Webster and Goodwin 1982, 112,114-117]

Gould [1982,87] expresses his agreement with this view while Gould and Lewontin [1979] point to architectural constraints as limiting adaptation.

Also, there is some evidence that, irrespective of environment, organisms can be the site of great changes that open new evolutionary possibilities. Such macromutations could lead to "hopeful monsters" due to the hierarchical nature of genetic programs for the embryological development [Gould 1983,196; Goldschmidt 1940,390-

393; Gould 1980a]. This hierarchical characteristic would impose some canalization on the hopeful monster. In fact, Goldschmidt [1940,322] conceived this mechanism as imposing great limitations on the possible directions of evolution:

The selection of the direction in which genetic changes may push the organism is therefore not left to the action of the environment upon the organism, but is controlled by the surroundings of the primordium in ontogeny, by the possibility of changing one ontogenetic process without destroying the whole fabric of development ... Thus what is called in a general way the mechanics of development will decide the direction of possible evolutionary changes. In many cases there will be only one direction. This is orthogenesis without Lamarckism, without mysticism.

Then Goldschmidt could be near an internal view for evolution, but perhaps there is some bit of truth in his assertion.

Also, there is evidence that organisms can experience genetic changes without being controlled by natural selection; see the neutral theory of Kimura [1979].

INDEED, one important question that remains to be answered is: What is the range of viable structural or functional solutions (contingent alternatives) for any given environmental requirement (necessity)?

And finally, perhaps one of the most important ways by which the evolution of organisms is directed is the mechanism proposed by Gould [1982,92] in order to explain trends in evolution: trends would be the product of a higher-order sorting that operates via the differential birth and death of species considered as entities. Under this mechanism a direction by differential death (extinction) of species could happen. Though extinction would be random, a direction also could occur if there is differential speciation [p. 101]. Then, if we view the species as a kind of organic entity, there is a possibility of "direction bias" due to speciation more likely to occur in one direction than in others. This could mean that the organism can have an active role as protagonist in evolution though, of course, environment also plays its part in such differential speciation.

These trends perhaps explain the "excesses of adaptation" [de Beer 1972,10]. That is to say, much adaptation to particular circumstances can be death traps when such circumstances change. Again I recall Engels and his one-sided evolution excluding evolution in other directions.

All these factors discussed—limited mutational repertoires, law-governed changes of form, canalized macromutations that set new canalizations, and differential birth and death of species—can help to explain the direction of evolutionary trajectories if we conceive it as

directional and non-random in the sense that it is the result of the interaction of continually acting forces. [Allen, 1980,49]

Of course, directional change does not imply predetermined change. Nevertheless, if we are to acknowledge the respective roles of organism and environment in evolution, we must approach the relationship with a dialectical materialist outlook.

The dialectical materialist approach

AGAINST THE mechanist approach of metaphysics, we must approach the relation between organism and environment as a dialectical interpenetration of opposites. This approach to the problem has been made by Zavadovsky [1931] who proposed to overcome the duality "biological/physical", by Caudwell, a brilliant British Marxist who proposed to overcome all bourgeois dualities in biology [Sheehan 1985,365-368], and more recently by Levins and Lewontin [1985, 85-108] whose book *The Dialectical Biologist* I hope will open a new style of thought and reasoning among western biologists. However, none of these authors treat both organism and environment as each the site of its own contradictions that arise due to both necessary and contingent processes, contradictions that are both autonomous and mutually conditioned and set the conditions for the contradictions between organism and environment as the driving force for the evolutionary process, a process that by necessity develops in a spasmodic way (non-gradualist).

In this approach the dialectical Law of the *unity and struggle of opposites* [Engels 1954,17,62; Konstantinov, 1976,244-272] and the dialectical categories of *possibility and reality* [Rosental and Straks 1960,230-256] can be very useful for the analysis of the mutual conditioning of the respective contradictions of organism and environment.

The organism transforms its environment (for example, the oxygenation of the atmosphere by photosynthesis and the formation of soil by earthworms and roots of plants), and is transformed by the environment (for example, in the process of natural selection).

In the dialectical materialist view, the internal contradictions of the organism are also a source of necessary novelties and qualitative development in evolution. For neo-Darwinism, as we have seen, such internal and autonomous changes are mere random mutations that must be ordered by the necessity of natural selection. Indeed a typical characteristic of metaphysics is the underrating of internal contradictions of natural systems as a source of qualitative development. For this worldview the change and the movement are due only to the collisions of external forces [Konstantinov, 1976,244-260]. For dialectical materialism, such internal changes and contradictions are both necessary and contingent. For example, one could say that a particular mutation is the result of necessary and contingent factors [Pilipenko, 1986,111,185] but observed from the viewpoint of the repertoire of possible mutations, there was an objective contingency

in that particular mutation. That is to say, the particular event could have happened or not happened. However, the total rate of mutations in the population of alleles is necessary, that is to say, the event must happen in one way or another and necessarily will happen and happen within the limits of such a repertoire. This subtle and intimate nexus between necessity and contingency as opposites that become transformed into one another must be remembered when one analyses them.

A "HOPEFUL MONSTER" would be the result of more necessities (internal constrictions) than a gene mutation, because it was the result of canalization under a hierarchized genome. The organism as a "self-organizing totality" could impose restrictions on the potential changes of form. Also, if we accept a model of several integrative levels of organization for living matter, that is to say, a dialectical materialist approach as proposed by Gould [1982] rather than a reductionist or holist approach [5], then a key question to be answered would be: How influenced are the changes in each level by the lower and higher levels?

On the other hand, to say that between the contradictions of organism and the contradictions of environment there is a mutual conditioning set by the previous history of the contradictory process according to the dialectical categories of *possibility and reality* does not imply that environment elicits changes in the organism for the "good" of the latter. Nevertheless, this Lamarckian possibility could be realized in some cases [Steele, 1981; Steele, Gorczyński and Pollard, 1984].

Also, Marxist biologists must utilize the dialectical categories of necessity and contingency when analyzing the changes of organism and environment. Lewontin [1980, 237] says that

the external world can be divided up in an uncountable infinity of conceivable ecological niches. Unless there is a preferred or correct way in

5. On levels of organization, the metaphysical antithetical duality has been "*reductionism/holism*".

The reductionism takes into account only the more basic levels of organization. For example, neo-Darwinism has taken into account only gene mutations as the source of organismic change.

On the other hand, holism takes into account only the tendencies of wholes without explaining it in a materialist way by internal interactions of parts or by interactions of the whole with other wholes. Then holism is a kind of idealism. Examples are Smuts' [1926] view of the evolutionary process and more recently the Gaia Hypothesis of Lovelock [1979] that conceives of the biosphere as a semiconscious macroorganism.

The dialectical materialist approach avoids both the Scylla of reductionism and the Charybdis of holism. It views systems as integrated wholes with several integrative levels of organization, each with semi-autonomous properties influenced both by lower levels, which are integrated at higher levels, and by the higher levels upon it.

which to partition the world, the idea of an ecological niche without an organism filling it loses all meaning.

IT IS VERY TRUE that one cannot speak of a niche without an organism. However, in the environment there are necessary (inevitable) factors such as the force of gravity, the photoperiod and others, and there are also more contingent factors such as particular predators or foods. Then, there is a preferred way in which to partition the world if we think in necessary and contingent factors.

Also, as we have seen, there is Lewontin's dilemma of "*being adapted/becoming adapted*," but this is a dilemma only in the metaphysical worldview. As Engels [1947,31-32] said:

To the metaphysician, things and their mental reflexes, ideas, are isolated, are to be considered one after the other and apart from each other, are objects of investigation fixed, rigid, given once for all. He thinks in absolutely irreconcilable antithesis. "His communication is 'yea, yea; nay, nay'; for whatsoever is more than these cometh of evil." For him a thing either exists or does not exist; a thing cannot at the same time be itself and something else.

But in the natural world,

every organic being is always itself, and yet something other than itself.

Under a dialectical view of contradictory process between organism and environment, organisms are at the same time adapted and becoming adapted. However, Lewontin states the dilemma without giving the dialectical solution. Indeed Lewontin [p. 238] proposes as one of the possible solutions

that the environment is constantly decaying with respect to the existing organisms, so the organisms must evolve to maintain their state of adaptation. Evolutionary adaptation is then an infinitesimal process in which the organism tracks the ever changing environment, always lagging slightly behind, always adapting to the most recent environment, but always at the mercy of further historical change. Both the occasional sudden increases in abundance and range of a species can be explained in this way ... The simple view that the external environmental changes by some dynamic of its own and is tracked by the organisms takes no account of the effect that organisms have on the environment.

I propose that Marxist biologists be more strict with their speech. The word "tracking" implies the organism is a mere tracker and we have seen that this Red Queen hypothesis is pure metaphysics (external view). Dialectical materialism views adaptation as a state and as a process at the same time – a result of constant dialectical contradiction between organism and its environment [Allen, 1980,49]. Also, to conceive of it as an infinitesimal process is to accept gradualism, another metaphysical view.

Another possible alternative to the dilemma, Lewontin says, is

that the environment remains unchanged but the species by chance acquires a character that enables it to utilize a previously untapped resource is very much less likely. Such favorable mutations or "hopeful monsters" may nevertheless have occurred [p. 238].

Additionally, Soviet biologist Tatarinov [1986,66] says that saltationism confers great relevance to random events.

Again, I think one must be precise. One macromutation may be absolutely random if viewed only from environment. But, if we analyze it from the standpoint of the organism, it is the result of necessary and contingent factors.

On necessary and contingent events in evolutionary trajectories

FOR ENGELS [1954,39,209] the evolutionary events, "life arising from inorganic matter" and "a thinking being arising from a non-thinking being", are necessary events whose contingent conditions would differ depending on circumstances.

In one of his articles Gould [1980b,141] says:

Astrophysicist William A. Fowler argues that the sun will exhaust its central hydrogen fuel after ten to twelve billion years of life. It will then explode and transform to a red giant ... it is an arresting thought ... to recognize that humans have appeared on earth at just about the halfway point of our planet's existence. The earth need never have evolved its complex life. It took three billion years to go beyond the algal mat. It might as well have taken five times as long, if only the earth have endured. In other words, if we could run the experiment again, the most spectacular event in the history of our solar system, the explosive exhaustion of its parent, might just as well have had an algal mat as its highest, mute witness.

This is very true. However, Gould forgets the possibility that in other experiments rational life could be evolved in less time than on earth. It would seem that there is a strong cultural bias to view rational beings as a rare evolutionary event. We know only one experiment. Perhaps in the universe there have been many such experiments. If we could know of them, then we could estimate means and standard deviations for timelapses. Of course, these would be big statistics, but I think Engels was right in his thinking on necessary and contingent events in evolutionary history. We have seen that the conception "anything goes" is based on a metaphysical assumption. The evolutionary process has non-predetermined directions. Eventually some directions give necessary events such as "the transition of some form of life from aquatic to terrestrial life" and "development of some form of rational living beings."

As we have seen, for Monod man was the result of chance. But as Gould [1977,399] says:

Our paedomorphic morphology is a consequence of retarded development; in this sense, we are neotenuous ... our paedomorphic features are a set of adaptations coordinated by their common efficient cause of retarded development. We are not neotenuous only because we possess an impressive set of paedomorphic characters; we are neotenuous because these characters develop within a matrix of retarded development that coordinates their common appearance in human adults ... major human adaptations acted synergistically ... The interacting system of delayed development-upright posture-large brain is such a complex: delayed development has produced a large brain by prolonging fetal growth rates and has supplied a set of cranial proportions adapted to upright posture. Upright posture freed the hands for tool use and set selection pressures for an expanded brain.

Then, man's morphology could be viewed as a necessary consequence of the interacting system—delayed development-upright posture-large brain. The correlated features impressed some direction (necessity) on man's evolution. Again, this necessity does not imply a predetermined direction or result. For dialectical materialism, man's evolution has been the result of both necessary and contingent factors.

For Engels, the freeing of hands was a necessary prerequisite for development of work. After freeing of hands and upright posture, a positive feedback relationship was set between cultural transformation of environment and large brain development [Engels, 1954, 170-183]. We could generalize and say that some kind of interpenetration of opposites (coevolution) between biology (gene) and culture is a necessary evolutionary mechanism for development of some kind of rational life.

IN SUM, only dialectical materialism provides the right approach to the necessary and the contingent in the organic world. In the same way that the gods of the Popul-Vuh were not satisfied with their creations because they were too soft, we must develop a more dialectical evolutionary theory because the present neo-Darwinian paradigm views the organic being as no more than soft putty.

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Essence and Phenomenon in the Evolutionary Theory of Species

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METAPHYSICS, AS ENGELS [1947,31] DEFINED IT, is a world view that conceives things and processes in terms of rigid dualities (antitheses):

To the metaphysician, things and their mental reflexes, ideas, are isolated, are to be considered one after the other and apart from each other, are objects of investigation fixed, rigid, given once for all. He thinks in absolutely irreconcilable antitheses.

Dialectical materialism is an alternative world view that conceives of opposites in terms of their unity and struggle, their interpenetration and mutual transformation [Engels 1947,17,62; Konstantinov et al. 1976,244-272 or 1982,109-117].

One of the persistent metaphysical dualities in biology has been that of *essentialism/empiricism*. Some examples of essentialism are the idealist morphology with its reification of archetypical form [Mayr 1982,458] and in Linnaeus' concept of species [Mayr 1982,167; Pilipenko 1986,45].

Engels [1954] criticized such reifications, as when Louis Agassiz said that the Creator

created not only the actual animals, but also abstract animals, the fish and such! [p 200].

or when Richard Owen said:

The archetypal idea was manifested in the flesh under diverse modifications upon this planet, long prior to the existence of those animal species that actually exemplify it [p 206].

Indeed, Engels knew very well the dangers of reification within dialectical materialism itself:

In every field of science, in natural as in historical science, one must pro-

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ceed from the given facts...therefore in theoretical natural science...the interconnections are not to be built into the facts, but to be discovered in them, and when discovered, to be verified as far as possible by experiment [p 47].

On the other hand, Darwin and Lamarck were influenced by the empiricist positivist tradition [2]. Perhaps this fact helps to explain why these authors, despite their skill in systematics and paleontology [Gould, 1980b,205], were not able to view species as real and discrete entities. In *Origin of the Species*, Darwin [1859,67] said:

I look at the term species as one arbitrarily given, for sake of convenience. [Ch. 2, Variations under Nature.]

Similarly, Lamarck [1809, 35-46] in his *Zoological Philosophy* considered the species as an arbitrary category [Ch. III, Of Species Among Living Bodies and the Idea That We Should Attach to That Word].

More recently, this empiricist approach to species has been well exemplified by Mayr [1963,5] with his extreme replacement of typological thinking by population thinking:

For the typologist, the type (eidos) is real and the variation an illusion, while for the populationist the type (average) is an abstraction and only the variation is real.

PERHAPS ENGELS [1954,28] was very right when he said:

But tradition is a power not only in the Catholic Church but also in natural science.

Mayr [1942,114] asserts that a species is a continually evolving group of individuals without discrete limits in time:

To attempt to define species is to try to establish a fixed stage in the evolutionary stream. If there is evolution in the true sense of the word, as against catastrophism or creation, we should find all kinds of species – incipient species, mature species, and incipient genera, as well as all intermediate conditions. To define the middle stage of this series perfectly, so that every taxonomic unit can be certified with confidence as to whether or not it is a species, is just as impossible as to define the middle stage in the life of man, mature man, so well that every single human male can be identified as boy, mature man, or old man. It is, therefore, obvious that every species definition can only be an approach and should be considered with some tolerance.

2. An important ingredient in the world view that came to be called Darwinism was Lockean epistemology [Greene 1981,133]. Concerning the positivism in Lamarck's world view, see Senent [1971,5-20].

Empiricism and positivism reject the search for underlying essences as pure fantasy, and only deal with the contingent and single individual. See Rosental and Straks [1960,chs 1-2] for review of these epistemologies.

This author also underestimates the morphological concept of species as based on Platonic essentialism [Mayr, 1963,16].

Despite the criticisms that can be made concerning the usefulness of this concept [Mayr 1963,17; Grassé 1969,895], it is still recognized as the simplest and most widely held concept [Mayr 1963,16; Grassé 1969,894], and in paleontology it is obviously the only one available.

On the other hand, there is good evidence that species are real and discrete entities that once created can remain as stable morphogenetic "packages" during their geological lifetime [Eldredge and Gould, 1972; Eldredge, 1985,43-83; Gould, 1980a and 1982]. That is to say, species are real and discrete entities in time.

However, this view of species could not be formulated under Mayr's empiricist viewpoint, with his emphasis on the individual, the contingent, the variability, and his underestimation of the universal, the necessary, the essential.

HERE, THE DIALECTICAL MATERIALIST PHILOSOPHY offers the categories of essence and phenomenon which are viewed as two aspects of an indissoluble unity [Rosental and Straks, 1960,1-82]. The essence is the more internal, necessary and universal aspect of objects and processes, while the phenomenon expresses its own essence and is more contingent, external and single. Dialectical materialism says that to overestimate the phenomenon (empiricism) is as idealistic as to overestimate the essence (platonic essentialism). Though the essence has no corporal sensible existence, it does express the necessary conceptual foundation underlying the contingent and sensible phenomena, and thus expresses the objective reality. Essence is not an illusory concept. Consider here the cogency of Engels [1954, 53] when he said:

An acquaintance with the historical course of evolution of human thought...is required by theoretical natural science...lack of acquaintance with the history of philosophy is fairly frequent and glaringly displayed. Propositions which were advanced in philosophy centuries ago, which often enough have long been disposed of philosophically are frequently put forward by theorizing natural scientists as brand-new wisdom and even become fashionable for a while.

and [p.59]:

The most certain path from natural science to mysticism...is...the shallowest empiricism that spurns all theory and distrusts all thought.

Even Gould, who is well known for his Marxist viewpoint and his erudition in many fields, misses the approach to essence: "Variation is primary, essences are illusory" [Gould, 1985,160]. I do not understand how this author could make such an assertion since he has studied fossil species that remained stable during geological periods. That is to say, species that, notwithstanding some variation, remained stable in their morphological essence.

Often these categories are used in everyday work although in an implicit way. For example, when Grassé [1969,894] analyses the morphological approach to species, he says that some characteristics are absolute and others are relative, that is to say, necessary or essential and contingent or phenomenalist in dialectical terminology.

On the other hand, Webster and Goodwin rescue the "rational morphology" approach and propose that the organism must be viewed as a self-organizing totality, with field properties and its own laws of form and internal constraints [Webster and Goodwin 1982; Webster 1984; Goodwin 1984a, 1984b, 1986]. Gould [1982,87] expresses his agreement with this viewpoint.

However, the danger in this approach is that it treats living beings as structures, determined only by inherent "laws of form," that is to say, without history. For example, the title "Is Biology an Historical Science?" [Goodwin 1986] suggests that organisms have no history at all, but this is an idealistic assumption. Historicity is a key aspect of dialectical materialism [Levins and Lewontin 1985,286]. And within the historical treatment, the dialectical categories of essence and phenomenon can be relevant in studying the transformations of form in the evolutionary process, as an alternative to essentialism.

PLACING THE EMPHASIS ON VARIATION, as against idealist essentialism, has played an important role in the development of a materialist evolutionary theory. However, in order to advance, we must now reject the empiricism that absolutizes variation.

Thus, the development of science requires recognizing and integrating such opposing concepts as essence and phenomenon. Indeed, I suspect that many scientists in their actual thinking resemble Monsieur Jourdain (of Molière's *Le Bourgeois Gentilhomme*) who one day discovered that he spoke in prose. Here, one day they could discover that they have always used the dialectical categories of essence and phenomenon.

This paper is part of a manuscript dealing with several metaphysical dualities in evolutionary theory, titled "Un Enfoque Dialéctico Materialista de la Evolución Orgánica."

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An Open Letter to Mikhail Gorbachev:

Toward Marxist Renewal in Philosophy of Science

DEAR COMRADE GORBACHEV:

For a long time, I had a small nagging worry about the revolutionary content of glasnost and perestroika. But now, since you added the call for a Marxist-Leninist renewal, I have no doubt at all that the Soviet people will really move in the revolutionary direction under your leadership. This open letter represents my effort to help in the great popular Soviet struggle now under way. What I have to offer is the following analysis showing how a corruption of Marxist theory, a bequest to your culture from the Brezhnev era, hinders the much-needed Marxist-Leninist renewal and, no doubt, even hinders perestroika itself.

The philosophical problem addressed here is not a negligible one. As you will see, it is the same problem that led Lenin to write *Materialism and Empirio-Criticism*. Moreover, I see the same urgency in 1988 as in 1908. So far as I can tell, the Soviet leadership in general is not yet sufficiently aware of the social and political costs entailed by the serious concession that was made to "scientific" idealism, one that pervades your culture and produces, for example, the confusion and dissension that persist between natural scientists and dialectical materialists despite long efforts for a rapprochement.

My analysis, which applies a new theoretical model for the role of ideology in natural science, can at the very least help to resolve that particular conflict. In essence, I have a new model of the science process that elaborates a theoretical basis for the argument advanced in 1968 by Ivan T. Frolov that "politics concerns only the philosophical interpretation of science, not the evaluation of science itself" [Graham 1971, 254]. Here I demonstrate why philosophers in general cannot judge what is good or bad science while scientists in general are not good judges on philosophical questions though, through their constructive collaboration, the two groups together may be able to clarify concepts within scientific theory. An example is given of how such clarification might help speed the development of new knowledge and thus contribute toward perestroika.

I write as editor of a journal devoted to showing the usefulness of the Marxist philosophical outlook in the scientific research process. What follows represents a distillation and further elaboration of theoretical work that has appeared in the journal over several years. The

application of this theory to your present situation is based on three weeks of interaction with Soviet philosophers and scientists in Moscow last August when, invited by Frolov, I participated in the World Congress of Logic, Methodology and Philosophy of Science and the affiliated Round Table on "Factors in the Development of Modern Scientific Knowledge" [Talkington 1987].

The background for my model, its details and its implications will unfold in the discussion that follows.

First, about the Brezhnev legacy

THIS DISCUSSION will center on the concept of "statistical causality" as an exemplary sample of some pressing philosophical problems. During the Brezhnev era the concept of "statistical causality" was hailed as "a concept which successfully counters the attempts to interpret quantum mechanical relationships in the spirit of agnosticism" [Fedoseyev 1982]. It is generally agreed that acceptance of this concept required a fundamental revision in the Marxist concept of material causality, a revision that professes to "save" the concepts of causality and determinism by redefining them in terms of a "probabilistic causality" and a "soft determinism" [cf., e.g., Graham 1987, 350],

The actual content of the revision is as follows: In classical physics, as in Marxist social theory, when observation shows a regular pattern of events, it is assumed that some deeper level of cognition will reveal dynamic causal relationships that fully account for the observed statistical regularity. Thus, an underlying deterministic causality applies in the long run whether the events are the interactions between gas molecules or the interactions between members of social classes. In contemporary microphysics, however, certain probabilistic regularities in events at the subatomic level are assumed to reflect an essential indeterminism in nature itself. According to the standard Copenhagen interpretation, these events represent acausal processes while, according to the new "Marxist" interpretation, these events are attributed to "statistical causality." Neither interpretation allows for the possibility of an underlying dynamic causality determined by some physical mechanism as yet unrecognized. Hence, the so-called "Marxist" interpretation violates the fundamental Marxist tenet concerning the knowability of the objective world.

The method by which this revision is accomplished deserves study. Firstly, the revision does not directly attack the concept of causality but subtly redefines it to eliminate the idea that causality necessarily involves dynamics or force. Secondly, the revisionists center their attack on the concept of determinism, seeking to equate it with mechanistic materialism. Thirdly, and most crucial, the concepts of causality, determinism and law are all vulgarized by divorcing them from the concept of levels in material causality. Only thus is it possible to deny that there can be some underlying level

where as yet unknown laws determine the statistical regularities of quantum phenomena. [See Hörz et al., 1980a,b; Talkington 1980.]

In general, the Soviet revisionist trend has succeeded in blurring the concept of causality, not only among scientists and philosophers but also in the popular mind. The effects of this trend can be seen, for example, in the Soviet textbook *Fundamentals of Marxist-Leninist Philosophy* and in the Soviet *Dictionary of Philosophy* where the defense of the principles of causality and determinism is weakened by failure to discuss them in terms of levels of causality as well as by making concessions to the Copenhagen interpretation.

I have campaigned for years against the blurring effect of "statistical causality" which, though originating in the Soviet Union, came to U.S. attention primarily via East Germany [c.f., Hörz et al. 1980a,b]. My editorial focus has been on how this concept tends to hinder the process of scientific discovery by denying the possibility of and diverting attention from the search for an underlying causal mechanism not identified by contemporary microworld physics [Talkington 1980; 1981a; 1982; 1983a,b; 1984; 1986a,b,c].

The political implications of such revisionist blurring of Marxism are of compelling interest. All these years, it has been hard to understand how such a metaphysical concept could be allowed to parade as "Marxist" in the land of socialism. But recently, after thinking over what Soviet comrades told me last year about the abuse of power in the Brezhnev era, it dawned on me that the generalized idea of "statistical causality" (especially with a fake "Marxist" veneer) would be very useful to a bureaucracy that, seeking to evade responsibility for its shortcomings, would need to discourage people from searching for the underlying causal mechanisms.

Consider, for example, the popular works of Soviet mathematician V.V. Nalimov [1981a,b; 1982]. Consistent with the concept of "statistical causality," he identifies humanism with the indeterminism of "a probabilistic world view" and, on the opposing side, tends to identify causality with a rigidly mechanistic world view. While one may sympathize with Nalimov's desire for escape from a mechanistic world view, probably identified with Stalinism, it is easy to see how an erosion of the sense of personal responsibility could result from such an excessive glorification of indeterminist chance in the affairs of society as well as nature. Similar ideas about the probabilistic nature of reality are popularized widely in the capitalist world with essentially the same ideological effect, to discredit the idea of a world that, in the end, is fully determined by material forces, forces that include the self-interest of the masses.

The problem of ideology within science

ONE IMPORTANT ASPECT of this philosophical problem is that the distortion of reality in scientific theory usually originates with scientists themselves (as was the case with the physicist Mach whose

positivist ideas influenced a whole generation). It is well known that the concept of "statistical causality" originated with mathematician V.A. Fock after he was criticized as advocate of the mystifying acausality of the standard Copenhagen interpretation. Fock presented his revised concept of causality as a "Marxist" alternative to a determinism that he considered outmoded. Later he persuaded Nils Bohr, originator of the Copenhagen interpretation, to accept the revised formulation as more "materialist" than acausality [cf. Graham 1987, 337-343]. In reality, the Bohr-Fock concept of "statistical causality" is nothing more than an eclectic compromise that abuses philosophy; in no way does it provide for a dialectical resolution of the antagonistic conflict between materialist causality and idealist acausality.

IT IS NOT UNUSUAL for scientists to adopt a false or mythic interpretation of their findings. Concerning an erroneous concept of heat that held sway in France until the 1840s, Engels [1873-86, 113] said:

this false theory was not one which had been forced upon physicists by some variety of malicious philosophy, but was one concocted by the physicists themselves, by means of their own naturalistic mode of thought...

This comment is noteworthy in several respects. First, it illustrates how the process of consensus by which scientists come to agreement on theory can produce gross error in the interpretation of their objective findings. Second, it is one of many insights by Engels that anticipate Thomas Kuhn's [1970] paradigm concept, expressing the essence of the concept with a dialectical materialist clarity that eluded Kuhn. Third, it indicates why Engels (like Marx and Lenin), while firmly basing dialectical materialism on the scientific method, would never agree to revision of time-tested philosophical principles in order to conform with a fleeting consensual fad such as "statistical causality."

To be sure, such false or mythic ideas, though generated within science, often reflect external social influence. An outstanding example, pointed out by Boris Hessen [1931], concerns how the static form of Newton's cosmology reflects the social formation in which that great scientist lived and worked. Concerning genesis of the acausal Copenhagen interpretation, Max Jammer [1966, 172-6] showed the influence of Bohr's own existentialist philosophy while Paul Forman [1971] showed the relevance of the reactionary intellectual environment of Weimar Germany, where the causality concept itself was widely rejected.

In the particular case of "statistical causality," as the conceptual stepchild of acausality, still another factor must be considered, namely, the internationalist traditions of science. The free flow of information

and ideas across national boundaries, so vital to the science process, means an equally free flow of embedded interpretive and philosophical concepts, the good and the bad together. In the 1920s-30s it was natural that some Soviet physicists, while adopting the useful new quantum theory, would also accept the idealist interpretation of its creators, Bohr and Heisenberg. Later, facing criticism from Soviet philosophers, it was equally natural that a convinced physicist such as Fock would seek to preserve what amounts to the substance of the Copenhagen interpretation while giving it a more acceptable "Marxist" form.

The traffic in concepts is not a one-way street, of course. Since scientists enjoy a respected position and reputed objectivity, their ideas tend to become enormously influential in society at large, whether for constructive ends or the opposite. An elegant example of constructive influence in another day can be seen in the system for institutional checks and balances in the U.S. Constitution, a system that was consciously modeled after Newton's third law (for every action, an equal and opposite reaction). On the destructive side we must count the social influence of a concept such as "statistical causality" which, as pointed out earlier, objectively provided an ideological shield for a bureaucracy failing to promote the welfare of the masses. (In our day, of course, the potential public influence of a scientific idea, negative or positive, is greatly increased if it bears the label of "Marxism." We shall see later what Lenin had to say about idealism that masquerades as Marxist.)

An illuminating new theoretical model

THE QUESTION ARISES of how such ideological distortions can become so firmly attached to objective scientific findings and widely accepted as part of "scientific knowledge." Many important philosophical controversies pivot around this question, which involves the relation of the ideological to the operative in scientific knowledge. A satisfactory answer to this question requires some fine-tuning of our theory of knowledge.

The central premise of the new model presented here is this: *The fundamental dialectic in the development of scientific knowledge arises from the contradiction between the objective and the subjective within scientific knowledge itself* [cf. Talkington 1987]. This dialectical premise is foreshadowed in the definition of theory given by Rosenthal and Yudin [1967, 449]:

Each theory is complex in structure. For example, two parts may be distinguished in physical theories: formal calculations (mathematical equations, logical symbols, rules, etc.) and a "substantive" interpretation (categories, laws, principles). The structure and treatment of this "substantive" part of theory are connected with the scientist's philosophy and with definite methodological principles of approach to reality.

In my new model the dialectical unity of the objective and the subjective are similarly represented by two interacting "parts" of a theoretical system, which may be likened to a materialist base and an ideological superstructure.

Part I: The operative (materialist) base. Consider any typical scientific operation such as experimental design, spectroscopy reading, particle tracking, logical inference, animal preparation, mathematical formulation, chromatography separation, statistical evaluation, etc. Each such operation provides an objective method for obtaining objective data. The data and the method together form the objective basis for the problem/solution exemplars that represent practical truth and the basis for further development of a scientific theory. It is this objective aspect of science that stands outside of philosophy and outside of class politics, forming the materialist base of a theoretical structure. This is the aspect of scientific knowledge that is best known and understood. Too often, however, the materialist base is considered the complete picture, ignoring the ideological aspect which is also integral to a theoretical structure and to the process of developing new knowledge. Considering the complexities of modern science, only the scientists involved may really understand the meaning of the operations, and they tend to discuss these matters in terminology that may be opaque to the philosopher as well as to the layman. This is the prime source of difficulty in communicating between scientist and philosopher.

Part II: The interpretive (ideological) superstructure. When it comes to interpreting the meaning of results obtained by the objective operations of the base, the scientist's philosophical outlook can make an important difference (as pointed out by Rosenthal and Yudin, above). Interpretation is a subjective process involving the feelings, the belief system and the variety of knowledge of the investigator. In conceptualizing a new discovery or constructing a new theory, it is usually necessary to express complicated relations for which existing concepts provide no exact parallel. Here the process of interpretation offers ripe opportunity for importing some alien ideological distortion, some concept that diverts attention away from the reality of the phenomenon itself. When the phenomenon strongly contradicts previously existing theory, the mystifiers and *God-builders* (as Lenin called them) are quick to jump in with their claims that materialist causality no longer works. In any case, this part of theory definitely involves the philosophy of the theorizer and it is therefore a proper subject for philosophical analysis, whether or not the scientists agree.

THE EARLY HISTORY of quantum theory shows that from the very beginning Nils Bohr claimed that the quantum phenomena demanded entirely new explanations, outside of normal physics [cf. Jammer 1966, 80f]. Thus began a whole school of quantum physics

built around metaphysical and mystifying premises that can be traced back to Bohr's youthful indoctrination in Kierkegaard's existentialism [Jammer 1966, 172-76].

The important point here is that the theory of quantum mechanics has two parts, not only a materialist base as a practical operative science yielding beautiful agreement with experimental results within the realm of its applicability, but also an ideological superstructure within which a mystifying interpretation is firmly embedded. Not surprisingly, this reactionary obscurantist superstructure has had a distorting influence on the base, practically insuring there would be no effective research to discover underlying laws. Through long decades of successful experience by scientists in use of the theory's objective operations to solve practical problems, the superstructure has become strongly entrenched as part of a scientific belief system.

When Einstein challenged the Copenhagen interpretation (in the famous 1930s debate over the "EPR" paradox), Bohr and others proved to their satisfaction that quantum mechanics was impervious to such criticism [Jammer 1966, 381f]. This is the majority view today (though most scientists, because of their practical materialism, do not become too deeply committed to the mystifying aspect of an interpretation).

The important influence of philosophy on the form given an original interpretation becomes even more evident when we consider how often a metaphorical model in natural science is later extrapolated to the social realm, as in examples given earlier.

In the light of this history, the concept of "statistical causality" must be seen as just another way of going along with the Copenhagen mystification by disguising it in a pseudo-Marxist garb. Certainly no one has come forward to claim that this concept has led to new discoveries in quantum mechanics. I believe it would never have been accepted as "truth" in the Soviet philosophical environment if it were not for the extreme distortion of Soviet intellectual development under Stalin repression and then Brezhnev stagnation.

The analogy with historical materialism

AS MY NEW MODEL DEMONSTRATES, the essential characteristic of any theoretical system is the dialectical tension that must exist between the objective materialist base and the subjective ideological superstructure. This is far from a simplistic contradiction between theory and experiment. Engels [1895] recognized the essence of the matter:

Are the concepts which prevail in the natural sciences only fictions because they by no means always correspond with reality? From the moment we accept the theory of evolution all our concepts of organic life correspond only approximately to reality. Otherwise, there would be no change. On the day when concepts and reality coincide in the organic world, development comes to an end.

What is Engels saying here? First, he recognizes the fictional or mythic character of what is considered, in my model, the superstructural part of a theory. Second, he recognizes that the dialectical unity of this fiction with reality embodies contradiction that gives rise to development and change. But what is reality in this case? Is it an absolute reality, beyond the comprehension of any investigator? No, this must be a relative reality available through the investigator's objective methods and procedures, the operative base in the model. Even this limited reality always dances just out of reach, receding nimbly with each substantial advance in theoretical concepts, continuing to tantalize the scientist with unanswered questions. But when the scientist thinks that "concepts and reality coincide," then indeed, "development comes to an end." This is what happens whenever scientists accept their current theoretical "fiction" as the full reality of the subject matter. On the other hand, the scientist who keeps in mind the inevitability of contradiction will be able avoid that trap.

Thus, if we accept the analogy of base and superstructure as it is understood in historical materialism, we will also expect that, in the science process, inner contradiction provides a dialectical mechanism for overthrow of an entrenched and outmoded conceptual system and its replacement by a new theory in which base and superstructure are more congruent. In a scientific revolution it is, of course, the superstructural interpretive aspect of knowledge that is overthrown and cast out as untruth. While the objective data and methods of the base may thereby be rendered irrelevant, they remain as true as ever. This differentiation is not only in basic accord with the Marxist concept of relative truth but, in fact, constitutes a significant elaboration of the concept.

HENCE, WHAT I REALLY OFFER is a consistent Marxist model for the revolutionary process in science. But how well does my model fit with the philosophical problems presented by quantum theory? Are there really such contradictions within microphysics as to provide the basis for development and change?

To confront these questions, I start by noting that the Bohr-Heisenberg or Copenhagen interpretation denies any possibility of such inner contradiction. One of its most ardent supporters, John von Neumann, demonstrated with formal logic that the Copenhagen interpretation constitutes a closed system not subject to change and development through the introduction of new concepts (such as "hidden variables") [Jammer 1966, 367-72]. It is thus a purely static conceptual system, metaphysical in the Marx-Engels sense. Since the stepchild Bohr-Fock interpretation shares the same metaphysical defects, it is clear that the petty differences between Bohr-Heisenberg acausality and Bohr-Fock "statistical causality" are purely formal and without content. In fact, the two interpretations can well be subsumed under the single concept of a *Copenhagen superstructure*.

Von Neumann did not demonstrate that quantum mechanics is free of inner contradictions but simply that no contradictions can be recognized from within the formalism of this theoretical system. If we permit ourselves to step outside the quantum theoretical structure and analyze it with normal scientific skepticism, we find that contradictions abound (though, according to the standard interpretation, these are not contradictions but inevitable limitations on our knowledge, dictated by Nature herself).

This proper type of skepticism leads directly to the revolutionary view that any new conceptual system will have to be constructed *de novo* and imposed from outside the Copenhagen interpretation, as pointed out by Einstein [in Schilpp 1949] and by Dirac [1978, 10]. An excellent expression of this (minority) skeptical view is given by Akhiezer and Berestetskii [1965, 853] in their respected treatise on quantum electrodynamics (which is the most useful part of quantum theory).

The successes of quantum electrodynamics have demonstrated the correctness of our basic physical concepts within a definite domain of phenomena. However, these successes are relative. Electrodynamics turns out not to be a logically closed theory, i.e., it cannot be developed absolutely consistently without introducing auxiliary ideas which, so far, are of a semi-empirical nature. Attempts to carry over the methods of quantum electrodynamics to domains of other phenomena have so far not resulted in any serious successes. Apparently, the difficulties of the present theory can be removed only by means of a new change, and, moreover, perhaps a cardinal one, in the basic physical concepts. It is quite probable that even the fundamental space-time concepts of modern physics will undergo a change in this process.

As good dialectical materialists, these two Soviet theorists were concerned with the inner contradictions of the theory and with the possibilities for its revolutionary change and development. I think it is safe to assume that few practicing scientists would quarrel with their formulation. It says a lot about the orientation of officialdom in the Brezhnev era that these practical concerns went unheralded while the misleading concept of "statistical causality" received public acclaim.

What Lenin had to say

WHILE WRITING THIS LETTER, I wondered to myself what Lenin would have said about "statistical causality." This led me to find what Lenin actually did say – about Avenarius, the Machist founder of empirio-criticism, who advocated essentially the same set of ideas espoused later by Fock in slightly different language. Where Avenarius renounced "necessity" and "force," Fock was against "determinism" and "dynamic" causality. Lenin [1908, 158] writes:

[For a] clear statement of the starting-point of Avenarius' philosophy on

this question...we read: "Just as we do not experience force as causing motion, so we do not experience the necessity of any motion... All we experience is that one follows the other." This is the Humean standpoint in its purest form: sensation, experience tell us nothing of any necessity.... "Since the idea of *causality*," we read further, "demands force and necessity or constraint as integral parts of the effect, so it falls together with these latter.... Necessity therefore expresses a particular degree of probability with which the effect is, or may be, expected."

And how does Lenin react to the concept of "probabilistic necessity" that anticipated Fock's formulation? His comment [ibid.] is very much what we should expect:

This is outspoken subjectivism on the question of causality. And if one is to remain at all consistent when not recognizing objective reality as the source of our sensations one cannot come to any other conclusion.

Later Lenin [p 330] makes a more general comment that applies as aptly to the concept of "statistical causality":

An ever subtler falsification of Marxism, an ever subtler presentation of anti-materialist doctrine under the guise of Marxism – this is the characteristic feature of modern revisionism in political economy, in questions of tactics and in philosophy generally, equally in epistemology and in sociology.

If Lenin found it necessary to take off nearly a year, even neglecting the newspaper *Proletary*, in order to expose the ideas of "a reactionary philosophy," can we afford to let the same set of ideas go unchallenged today? The essential ideological threat now is the same that Lenin faced with Bogdanov: Nothing corrupts Communist clarity and coherence so much as idealism masquerading as Marxism.

What's the practical outlook now?

THERE HAVE ALWAYS BEEN a minority of scientists who sided with Einstein and sought without success to develop a more complete theory, though almost inevitably restricting their search within the bounds of the quantum mechanical concepts (which were all they ever learned).

A major conceptual obstacle to progress in microphysics has been the Heisenberg "uncertainty principle" or "principle of indeterminism," which gives rise to the causality problem in the first place. While experiment does show some actual restrictions on the possible accuracy of microphysical measurements, this empiric effect is transformed by the Copenhagen interpretation into a metaphysically absolute "principle" not subject to further investigation. Until recently, few physicists questioned the inevitability of this "standard quantum limit" on what it is possible to know and understand. But that view is changing because of 1) new developments in the technology for measurement at the subatomic level and 2) a great practical

demand for ever smaller and faster information-processing devices which has brought the tremendous research resources of IBM and other big organizations to bear on the problem of quantum measurement theory [cf. Maddox 1988, Talkington 1986a, Greenberger 1986]. These developments clearly indicate how the struggle against the Copenhagen interpretation may have great potential significance for the perestroika process.*

Obviously, the preconditions for a conceptual revolution in micro-physics are coming into being as the contradictions sharpen between the materialist base and the ideological superstructure. Since Bohr-Heisenberg acausality and its stepchild Bohr-Fock "statistical causality" are both closely related to the Heisenberg "uncertainty principle," there is no doubt that they all stand or fall collectively as the "Copenhagen superstructure." The only question is how long it will take before a new conceptual system emerges to replace the old.

IN THE MEANWHILE, there does not seem much point to a direct confrontation with the scientific community on the issue of quantum causality because this has become a matter of deeply ingrained ideology. After all, a scientist has the right to hold mystical beliefs, just the same as a religionist does, though neither of them has the right to falsely parade such views under the banner of Marxism. (The fundamental social value of science lies much more in the useful reproducible knowledge it yields from a materialist base than in the philosophizing of scientists taken from an ideological superstructure that is always subject to change.) A good tactic might be to dramatize the honors waiting for the scientist who makes the breakthrough on the important question of quantum causality, perhaps by offering an annual prize for the best essay on the causal basis for quantum phenomena. The main caution is to recognize that science, because of its effective autonomy in ideological matters, cannot be changed from outside and there must be no semblance of coercion from the State or the Party.

On the other hand, the Party should certainly develop its own educational program aiming toward a renewal of dialectical materialist understanding in natural science generally, and physical science in particular. And it would be very much in order for the Party to give awards and honors to its scientist members for outstanding contributions to philosophical understanding. From what I was told, there are few Soviet scientists who would qualify for an award based on demonstrating a deep understanding of how Marxism applies in the

* NOTE: The Copenhagen interpretation also involves the dualistic "principle of complementarity," which deserves and requires a rigorous philosophical analysis along the same lines that causality and determinism have been treated here, but this is for another time.

research process. Hence, these few people are a precious resource and I wonder if they are being valued highly enough in the confused philosophical environment of physics today.

I have put the emphasis here on philosophical understanding by the scientists themselves because there is simply no substitute for experience in the research process, especially when combined with experience in political struggle, in achieving a good dialectical materialist grasp on problems of scientific cognition. A good grasp in this case means the ability to use the heuristics of dialectical materialism for thinking productively about scientific problems, to spot idealism where it weakens a theoretical formulation, and to communicate such ideas to one's colleagues and to the public.

The renewal of Marxism in the Soviet scientific community may be a long struggle because of the human reaction to errors of the past half century. This was brought home to me when, aboard Aeroflot, a young Soviet biochemist politely refused to discuss with me how the ideas of Engels and Lenin could be useful today in natural science, raising her eyebrows slightly in disbelief when I sought to persist with the subject. Her attitude seemed obviously the result of much indoctrination from the Soviet scientific community. While it is true that in the past there has been gross interference on an ideological basis, it seems that the Soviet scientific community may now be overly protective of its own ideological superstructure.

Where do philosophers fit in?

WHILE IT'S PRETTY CLEAR that no one can dictate to scientists on philosophical matters, I do see an important role for philosophers in the renewal process for natural science. Their task is to teach the scientist how to use Marxist heuristics in the delicate process of developing new knowledge, i.e., how to use the dialectical mode of thought without losing touch with the materialist foundation of the scientific method—and, thus, how to avoid the positivist errors of a Fock who distorted dialectical materialism to make it fit with a preconceived view of what the microworld is like.

For this purpose, the philosopher should seek to understand the objective procedures of science as fully as possible—in fact, to become a scientist as far as possible—just as the scientist should seek to master the philosopher's ability at concept analysis. And, when faced with a conceptual *cul-de-sac* such as the Copenhagen superstructure, both philosopher and scientist need the historian's ability to trace a concept back to its origin and thus reveal its historically conditioned meaning in all the twists and turns of its actual development. (I have commented before [Talkington 1980, 20] on the significant contribution made along this line by Svechnikov [1971]).

Obviously there can be no easy division of labor between scientist as *doer* and philosopher as *thinker*. Only by collaboration in depth can they unravel the interpenetrating tangle of subjective and objective—

the ideological interpretations and the material procedures that constitute a theoretical structure such as quantum mechanics.

In this process, the philosophers will discover why such persistent debates as that between "ontologists" and "epistemologists" are largely meaningless. In my view, most such recurrent Soviet debates can only be resolved by dialectical analysis along the lines of the base/superstructure model for scientific knowledge. I said as much at the Round Table discussion last August [Talkington 1987] where most of the talks were at cross purposes, emphasizing either the objective (base) or the ideological (superstructure) aspects of scientific knowledge—no one recognizing the dialectical unity of the two opposing views nor offering a unified conceptual framework for dealing with these contradictory aspects. Another participant blasted the speakers for making one speech after another without reaching any conclusion. Neither she nor I got any response from other participants. Evidently it will take some time for philosophers as well as scientists to get a working grasp on the dialectics of contradiction within scientific knowledge.

ANOTHER MEASURE for the current state of Soviet philosophy might be the ripple of applause each time I spoke at the Congress sections, as though people were glad to hear Marxism mentioned at last, and the number of young Soviets who came up to say they agreed with me, coupling this with a warning that some people there were Marxists in name only. I can certainly understand why you depend on the young people to carry forward the renewal process.

Now a suggestion. Not all Soviet philosophers were seduced by the revisionist nonsense of "statistical causality," but there are other problematic tendencies among them. Witness the staff member at *Voprosy Filosofii* who, when I criticized a formulation as not Marxist, defended his paper by saying that "Marxism has been changed so much in the Soviet Union that Marx and Engels would not recognize it today." It seems that wide discussion of the base/superstructure model and the particular problem of "statistical causality" might provide a good start toward achieving a militant Marxist-Leninist renewal.

One final thought: Scientific philosophy is just as inherently internationalist as science itself. The concept of a "Soviet" Marxism makes me almost as uncomfortable as the rampant revisionism of so-called "western Marxism." Should it not be a worldwide effort to clean out the philosophical debris of a distorted Marxism which has spilled across your national boundaries to become a problem for Marxists everywhere? The pages of *Science and Nature* are internationalist anyway. Soviet authors are invited to join our discussions and debates on topics such as "statistical causality." Soviet readers should find this journal as interesting as do subscribers in dozens of countries around the globe.

Yours for a world in which our most intense conflicts are confined to debate over questions of political economy and philosophy.

In solidarity,

LESTER (HANK) TALKINGTON

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Statement on Violence

BELIEVING that it is our responsibility to address from our particular disciplines the most dangerous and destructive activities of our species, violence and war; recognizing that science is a human cultural product which cannot be definitive or all-encompassing, and gratefully acknowledging the support of the authorities of Seville and representatives of the Spanish UNESCO; we, the undersigned scholars from around the world and from relevant sciences, have met and arrived at the following Statement on Violence. In it, we challenge a number of alleged biological findings that have been used, even by some in our disciplines, to justify violence and war. Because the alleged findings have contributed to an atmosphere of pessimism in our time, we submit that the open, considered rejection of these mis-statements can contribute significantly to the International Year of Peace.

Misuse of scientific theories and data to justify violence and war is not new but has been made since the advent of modern science. For example, the theory of evolution has been used to justify not only war, but also genocide, colonialism, and suppression of the weak.

We state our position in the form of five propositions. We are aware that there are many other issues about violence and war that could be fruitfully addressed from the standpoint of our disciplines, but we restrict ourselves here to what we consider a most important first step.

IT IS SCIENTIFICALLY INCORRECT to say that we have inherited a tendency to make war from our animal ancestors. Although fighting occurs widely throughout animal species, only a few cases of destructive intra-species fighting between organized groups have ever been reported among naturally living species, and none of these involve the use of tools designed to be weapons. Normal predatory feeding upon other species cannot be equated with intra-species violence. Warfare is a peculiarly human phenomenon and does not occur in other animals.

The fact that warfare has changed so radically over time indicates that it is a product of culture. Its biological connection is primarily through language which makes possible the coordination of groups, the transmission of technology, and the use of tools. War is biologically possible, but it is not inevitable, as evidenced by its variation in

occurrence and nature over time and space. There are cultures which have not engaged in war for centuries, and there are cultures which have engaged in war frequently at some times and not at others.

IT IS SCIENTIFICALLY INCORRECT to say that war or any other violent behavior is genetically programmed into our human nature. While genes are involved at all levels of nervous system function, they provide a developmental potential that can be actualized only in conjunction with the ecological and social environment. While individuals vary in their predispositions to be affected by their experience, it is the interaction between their genetic endowment and conditions of nurturance that determines their personalities. Except for rare pathologies, the genes do not produce individuals necessarily predisposed to violence. Neither do they determine the opposite. While genes are co-involved in establishing our behavioral capacities, they do not by themselves specify the outcome.

IT IS SCIENTIFICALLY INCORRECT to say that in the course of human evolution there has been a selection for aggressive behavior more than for other kinds of behavior. In all well-studied species, status within the group is achieved by the ability to cooperate and to fulfill social functions relevant to the structure of that group. "Dominance" involves social bondings and affiliations; it is not simply a matter of the possession and use of superior physical power, although it does involve aggressive behaviors. Where genetic selection for aggressive behavior has been artificially instituted in animals, it has rapidly succeeded in producing hyper-aggressive individuals; this indicates that aggression was not maximally selected under natural conditions. When such experimentally-created hyper-aggressive animals are present in a social group, they either disrupt its social structure or are driven out. Violence is neither in our evolutionary legacy nor in our genes.

IT IS SCIENTIFICALLY INCORRECT to say that humans have a "violent brain." While we do have the neural apparatus to act violently, it is not automatically activated by internal or external stimuli. Like higher primates and unlike other animals, our higher neural processes filter such stimuli before they can be acted upon. How we act is shaped by how we have been conditioned and socialized. There is nothing in our neurophysiology that compels us to react violently.

IT IS SCIENTIFICALLY INCORRECT to say that war is caused by "instinct" or any single motivation. The emergence of modern warfare has been a journey from the primacy of emotional and motivational factors, sometimes called "instincts," to the primacy of cognitive factors. Modern war involves institutional use of personal characteristics such as obedience, suggestibility, and idealism, social

skills such as language, and rational considerations such as cost-calculation, planning, and information processing. The technology of modern war has exaggerated traits associated with violence both in the training of actual combatants and in the preparation of support for war in the general population. As a result of this exaggeration, such traits are often mistaken to be the causes rather than the consequences of the process.

We conclude that biology does not condemn humanity to war, and that humanity can be freed from the bondage of biological pessimism and empowered with confidence to undertake the transformative tasks needed in this International Year of Peace and in the years to come. Although these tasks are mainly institutional and collective, they also rest upon the consciousness of individual participants for whom pessimism and optimism are crucial factors. Just as "wars begin in the minds of men," peace also begins in our minds. The same species who invented war is capable of inventing peace. The responsibility lies with each of us.

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Our Man in Ethiopia

ONLY 14 YEARS AGO, Ethiopia's countryside emerged from feudal relations with a legacy of illiteracy, ignorance and poverty. Previous agricultural practices had been very backward, with extremely low productivity, seeds and livestock of inferior grade, and disastrous erosion of soil over much of the land. All this had been exacerbated by periodical droughts, for which the Haile Selassie regime did little or nothing. Hungry peasants who could manage it had flocked to the cities seeking a better life, but finding only unemployment there for the most part, had degenerated into a demoralized *Lumpenproletariat*.

Such a background was hardly conducive to a flourishing science. Sporadic scientific explorations—made by Europeans, especially the British, and by Italians during their colonization of Eritrea—were hardly undertaken with the aim of bettering the condition of the Ethiopian people. Basically such investigations were intended to discover raw materials for export to the “mother” countries, or else were part of more extensive studies of the natural history of Africa.

As in other socialist revolutions, many highly educated citizens (engineers, administrators, doctors, etc.) were part of the privileged classes. Some resisted the revolution and were driven out of the country or executed. And many, even some who favored the change in government, emigrated to developed countries where “the grass was greener” and living conditions easier.

Thus the new revolutionary government faced severe problems, made worse by persistent droughts and the need to devote a large proportion of a very limited budget to military action against U.S.-backed invaders from Somalia and against Western-supported secessionists in Eritrea and Tigrai. Nevertheless, extensive plans have been developed to pull the country out of its backward state, first by the Provisional Military Administrative Council (PMAC), and since 1987 by the People's Democratic Republic of Ethiopia (PDRE).

The primary emphasis is on self-sufficiency in agriculture, which involves about 85% of the population directly or indirectly. Because of primitive farming methods, droughts, etc. the production of food does not yet satisfy the needs of the people. In order to modernize, the government and the Worker's Party of Ethiopia (WPE) mounted an

intensive literacy campaign, and are training leaders both at the “grass roots” and in agricultural colleges. The formerly isolated peasant families are encouraged to join newly constructed villages (the “villagization program”) offering schools, clinics and potable water, and rudimentary cooperative activities (sharing oxen, labor-power, tools, etc.) as well as purchasing and producer cooperatives. A few state and collective farms have been formed to demonstrate the advantages of collectivization.

The second governmental emphasis is on development of mining and industry, including hydroelectric projects. To date, most industry remains small and light (textiles, food processing, leather and hides, etc.). There is much very small private industry and handicraft work, such as basket weaving and repair shops. Productivity of labor remains very low, but is improving. Unionization is encouraged, and has a high profile in governmental and party circles. There's a good deal of foreign aid, especially in mining (Soviet help in petroleum exploration, Swedish in geothermal projects, Italian in seeking new mineral resources, etc.). And, building towards the future, a native supply of engineers, geologists, etc. is being produced at the University of Addis Abeba.

Third is the concentration on health. Because of poor sanitary and food conditions, infant mortality is very high, bringing the average life expectancy down to about 43 years. The government cooperates enthusiastically in the WHO program to immunize children for polio, diphtheria, whooping cough, tetanus, TB and measles. Clinics are built in peasant villages and urban subdivisions known as kebeles. Potable water is supplied wherever possible. Two medical schools train doctors: one in Gonder is aided by physician teachers from the DDR, and one at Addis Abeba University has the participation of McGill University (Canada). Primary health care is emphasized in both urban and rural areas, with Canada helping train personnel to organize and instruct local people in sanitation, nutrition, etc.

Unfortunately, achieving the above aims is slowed by existing economic deficiencies and the need to concentrate militarily on survival. But progress is made in all areas, most spectacularly in the fight against illiteracy—up to about 60% literacy from a prerevolutionary 3%. With the growing strength of the Ethiopian government and the apparent easing of international tensions, we can hope for a political solution of the Eritrean problem and more rapid implementation of the progressive plans for Ethiopia's future.

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* The author says that spelling of *Addis Abeba* versus *Addis Ababa* is a matter of transliteration choice. In Amharic, the middle vowel differs from the first, and is more like our *e*, but there is little difference in the sound when the word is pronounced rapidly. The University transliterates the word with an *a* while the official city map uses an *e*. Chuck Davis adds that, as a purist, he prefers *Abeba*. Editor.

On Scientists as Political Activists

Peter J. Kuznick, *Beyond the Laboratory: Scientists as Political Activists in 1930s America*. Chicago: Univ. of Chicago Press 1987
x+363 pages, \$29.95.

PETER KUZNICK's book addresses questions within an increasingly important area of study: How have twentieth-century scientists utilized their unique status in the complex hierarchy of power within industrialized societies? More specifically, to what extent have scientists in the United States taken responsibility for the social consequences of their research, and to what extent have they attempted to exert influence upon the political decisions that direct the development and application of science? Kuznick focuses on the 1930s, a period that has not received as much attention as the more dramatic World War II era. Also, he does not restrict himself to a study of physicists, invariably the most carefully scrutinized members of the scientific community. Instead, he intends to provide a more comprehensive picture of the politically directed activity of American scientists during the 1930s. The result is a highly empirical description of the organizational and politicized activities of scientists just prior to the cataclysmic reassessment demanded by World War II.

Since history does not unfold in pre-packaged decades, it is worth noting that the period Kuznick addresses does lend itself to treatment as a cohesive segment of the broader social history of science. Due to the abrupt economic changes of the Great Depression, a major contribution to the context for Kuznick's book concerns how scientists in the United States assessed the relative merits of capitalism and socialism during a period in which the depressed capitalist economies did not compare favorably to that of the Soviet Union. Furthermore, the decade ended with the ill-fated signing of the Nazi-Soviet Nonaggression Pact. Although Stalin had never elicited favorable reaction from American scientists, the alliance between Hitler and Stalin triggered a particularly explosive destruction of the conditions that had allowed many scientists to combine a condemnation of fascism with an outspoken appreciation for the potentials of the Soviet system.

As might be expected, scientists were not in the forefront of liberal and progressive movements during the early years of the decade. In general, they had achieved a comfortable and well-funded status during the 1920s; it required the more hostile and financially competitive environment of the Depression to provoke scientists from their aloof indifference to the political fray. By the mid-1930s, however,

scientists had become involved in an essential paradox of the decade. On one hand, many were convinced that if the rational and systematic methods of natural science were applied to the problems of social inequity and political inefficiency, significant progress was almost inevitable. Soviet industrial accomplishments and the highly organized integration of Soviet science into a planned economy were particularly impressive; early in the 1930s, extensive first-hand experience in the Soviet Union frequently resulted in glowing reports from American scientists. On the other hand, even according to many scientists themselves, it was not clear that expertise in the solution of scientific problems earned a public hearing for remedies to political or economic problems. This tension, with its origins prior to World War II, would remain unresolved in the coming nuclear age.

A SECOND AMBIGUITY also arose. Initial motivation to be more outspoken about public policy often was generated by concern for proper allocation of research funds and appropriate recognition for scientific contributions to modern society. It was quite possible to pursue these goals without any accompanying interest in the amelioration of social problems or the reform of political and economic institutions. This is particularly important in Kuznick's chapter on the American Association for the Advancement of Science (AAAS). In spite of considerable interaction with more Marxist-oriented members of the British Association for the Advancement of Science, such as J.D. Bernal, the AAAS avoided any official support for what permanent secretariat Moulton feared would be perceived as "criticism of governments or of social orders" [p.88]. Instead, the AAAS restricted itself to a primarily self-serving advocacy of advantages to be harvested from the appropriately well-funded "advancement" of science.

The relatively restrained activities of the AAAS did not satisfy those scientists who felt that important issues were not receiving sufficient attention. Steadfast in his opposition to racism, Franz Boas was particularly influential in the formation of the University Federation for Democracy and Intellectual Freedom (UFDIF) at Columbia in December, 1937. The Federation aided refugees from fascism and supported the republican forces during the Spanish Civil War. Their efforts to persuade President Roosevelt to lift his economic embargo on Spain offer an interesting contrast to the lack of organized scientific opposition to President Reagan's embargo of Nicaragua during the 1980s.

The Federation's energetic opposition to Nazi racism also became a major concern for the American Committee for Democracy and Intellectual Freedom (ACDIF), also founded under the leadership of Boas in 1939. Similarly, in December of 1938 The American Association of Scientific Workers (AASW) was created at the annual meeting of the AAAS. The story of these two new organizations constitute the

most interesting chapters of Kuznick's book. A statement of the problems that inspired the AASW was distributed by the organizing committee headed by a research chemist, K.A.C. Elliott. The committee expressed its concern about the economic insecurity of scientists and the necessity for intellectual freedom. More original was its objection to the "misapplication of scientific discovery" and "a marked tendency to make use of pseudo-scientific ideas to excuse war and to attack reason and democracy" [p.228]. Attention to these issues by both the AASW and the ACDIF resulted in an initially enthusiastic response from the scientific community. Nevertheless, within just two years they had become nearly inoperative.

As discussed by Kuznick in some detail, their status became complicated by the fact that in these closing years of the decade it became increasingly difficult to maintain the same attitude of tolerance toward the Soviet Union as had been advocated by many scientists before the rise of Stalin. Kuznick devotes considerable attention to the effects of the Lysenko affair—the suppression of Soviet genetics obviously had a deleterious effect on perceptions of the Soviet system by American scientists. Opposition to fascism thus became difficult for scientists to separate from anti-communism. The conflation of both Nazis and Communists under the convenient label of "totalitarianism" became a favorite tactic of John Dewey's severely anti-communist Committee for Cultural Freedom (CCF), founded in May, 1939. Although the CCF had few scientific members, it did succeed in acting as a vanguard for the red-baiting that was an important factor in the demoralization of the AASW and the ACDIF.

Of equal importance, however, was the response of the AASW and the ACDIF to the Hitler-Stalin pact of 1939. Both organizations soon circulated petitions that included a call for neutrality on the part of the United States. Over five hundred scientists initially signed the AASW resolution, but anti-communist opposition arose to such an extent that resignations and accusations of Communist subversion soon tore both organizations apart. Assessment of the situation is complicated by the fact that the political agendas of some of the more active members have never been fully spelled out; Kuznick has not completely settled this issue and details remain for other scholars to clarify. In spite of the greater publicity achieved by other scientific organizations after World War II, the AASW survived and maintained affiliation with both the AAAS and the much larger international World Federation of Scientific Workers (WFSW). Under its new title today as the United States Federation of Scholars and Scientists (USFSS), it continues to promote a global perspective for directing scientific knowledge into the service of humanity rather than into exploitation.

THE PRIMARY VALUE of *Beyond the Laboratory* lies in Kuznick's careful sifting and documentation of evidence pertaining to the

efforts of scientists to have political or social impact in the United States during the 1930s. His primary sources include correspondence, public speeches, press releases, articles and books from both the popular and scientific domains, and notes from meetings of relevant organizations. He also provides some rather extensive treatment of particularly important figures such as H.J. Muller and Franz Boas. The political upshot of these efforts is usually passed over very quickly, however, and the reader is left wondering whether any significant results ensued.

Kuznick clearly has restricted himself to a primarily empirical presentation and does not attempt to interpret his findings by applying a sociological model, Marxist or otherwise. Nor has he attempted to link his subject to other periods of scientific activism. Although *Beyond the Laboratory* is certainly a valuable and informative volume, some important and intriguing questions obviously remain unanswered. For example, why was it that scientists in the 1930s for the most part did not direct their research toward the amelioration of human problems rather than the accumulation of profit by a small minority? General approaches to this question in economic or Marxist terms readily come to mind, and had they been assessed, even in a preliminary manner, *Beyond the Laboratory* would have benefited. Similarly, Kuznick does not attempt a psychological or sociological probe of the personalities or social origins of the scientists concerned. Once again, this is perhaps too large a subject for the book at hand. Nevertheless, in light of the theses recently proposed by such authors as Evelyn Fox Keller, it becomes increasingly valuable to investigate the social and psychological influences that motivate a career in science. Research in this domain at least offers the possibility of a fuller understanding of the persistent failure to inspire in scientists an active sense of responsibility for the consequences of their research. In this respect *Beyond the Laboratory* provides a partial description of a problem yet to be solved.

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Biological Insight through Mathematics

Mathematical Essays on Growth and Emergence of Form, Peter L. Antonelli (ed.). Saskatoon, Sask.: University of Alberta, 1985
xxi+332 pp.

THE ESSAYS in this volume show that mathematical biology, though young compared to mathematical physics, has already reached a

high level of sophistication. A variety of advanced mathematical concepts and techniques, grouped under the headings "Mechanics" and "Field Theories," are applied to biological problems. These include ordinary differential equations, partial differential equations, probability theory, the calculus of variations, topological transformation groups, and the differential geometry of manifolds.

Of special interest are the dialectical thinking and underlying philosophical implications that permeate the essays, selected from two symposia on ecology and development biology at the University of Alberta. The many specific examples here can easily be interpreted in terms of two significant lessons: 1) that the concepts of dialectical materialism are indispensable tools of research in this field; and 2) that mathematical techniques exist that take these concepts into account.

In chapter 2, each section deals with a predator-prey relationship, thus exploring a system based on an *internal contradiction*. Chapter 4 studies the implications of the fact that the manner in which a cell differentiates depends on its position and its ancestry. Chapter 5 gives a view of the developing organism as a self-organizing field that rejects reductionism and idealistic holism that assumes a holistic essence; examining division of the fertilized egg, it is noted that such an egg is both organism and cell. Chapter 6 argues that, even in physics (quantum mechanics, for example), there are global properties that cannot be derived from interactions of the parts. Thus, while the reductionist approach of Chapter 1, that derives properties of a *statistical* aggregate from the properties of its parts, is sometimes useful, it is not valid where the whole determines the nature of its parts.

An interesting speculation in Chapter 5 is that the basis of regeneration of organs is the property of analytic functions of a complex variable that the whole can be recovered from a part, that is, that the values of a function at different points are so tightly related to each other that the values in a small region of the plane determine uniquely the values everywhere else in the plane.

Other biological subjects treated include the growth of a coral reef, and the apparent tannin defense of plants against insect attack. There are two chapters of pure mathematics: "Solving Geodesic Equations in Space of Locally Constant Connection," and "On the Mathematical Theory of Volterra-Hamilton Systems." The book ends with two chapters of historical interest: Volterra's 1936 papers on "Principles of Mathematical Biology," and Goethe's diary notes (1830) on the conflicting views of Cuvier and St. Hilaire.

This book should be useful to anyone working in theoretical biology; also to the mathematician or physicist interested in mathematical biology.

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On Humanity's Place In Nature

Lewis Henry Morgan 1986 *The American Beaver* (facsimile edition). Mineola, NY: Dover Publications, vii+330, appendices. Paper, \$9.95.

ONE OF THE INTRIGUING TOPICS of dialectical anthropology is the unity and differences of humanity with the higher orders of mammals. The Darwinians have tended to stress unity, while Engels and the historical materialists have tended to stress the dialectical relationship, the differences within the unity of the primates [cf. Woolfson 1982, 8f]. Today, of course, the sociobiologists absolutize the unity—from the ants up!

Any assessment of such a dialectical relationship of unity and difference depends greatly, of course, on the state of development of the anthropological and ethological sciences. This dependence was made clear by Engels [1884, 97f] in comments concerning the social structure of the sexual life of early humanity, where he pointed out that in the sciences of his day, "appeal is made to the evidence from the rest of the animal world." He mentions the "facts" assembled by such naturalists as Alfred Espinas, Alexis Giraud-Teulon, Charles Letourneau, Henri Saussure, and Edward Westermarck. However, Engels continued, "the only conclusion I can draw from all these facts, so far as man and his primitive conditions are concerned, is that they prove nothing whatever." Engels concluded with an appropriately historicized caution: "For the present, we must reject any conclusion drawn from such completely unreliable reports." And this was a judicious assessment in light of the state of the sciences in the late nineteenth century.

Mind or Instinct

ONE MAJOR CONTRIBUTOR to the development of anthropology and ethology—the American, Lewis Henry Morgan (1818-1881)—would likely have concurred with Engels' cautionary stance. Morgan had grappled with the topic of the unity and differences of humanity and mammals throughout his scientific career.

Soon after graduating in 1840 from Union College (Schenectady, New York), Morgan [1843] published in *The Knickerbocker* an article "Mind or Instinct: An Inquiry Concerning the Manifestation of Mind by the Lower Orders of Animals." Morgan began his inquiry by observing that humanity considers its own intellectual endowments to be constituted of *Mind*. It characterizes—or, perhaps more accurately, disparages—the intellect of other animals as consisting of

Instinct, rather than *Mind* (414f). This prejudice was forcefully put, for instance, by seventeenth century philosopher Rene Descartes [1931, 244]: “plainly the brutes do not possess thought”.

Morgan makes the very important point that intellectual endowment must be distinguished from cultural development. What humans consider to be their superior endowment may in fact be the resultant of their material cultivation and intergenerational transmission—their enculturation—out of the natural state (414). Thus Morgan stresses the *differences within unity*—of humanity and the Animal Kingdom.

In this stance, Morgan opposed the leading naturalists of his (pre-Darwinian) age; for example, Louis Agassiz of Harvard (1807-1873), not only promoted an idealist absolutization of the differences between the species, but used this to justify his profound racism as well. In his definitive statement on this issue, Agassiz [1857, 86] maintained that “all the differences observed among finite beings are ordained by the action of the Supreme Intellect, and not determined by physical causes.” This would include cultural factors: “the differences which exist...among the races of men, are permanent under the most diversified climatic [or similar] influences” [86].

Morgan [1843, 514] went on to address several functions of *Mind*, namely *Memory*, *Abstraction*, *Imagination*, and *Reasoning*, and concluded that since the *Instinct* of animals also “remembers, abstracts, imagines, and reasons,” therefore it too is *Mind*. Among his animal examples (414, 417, 508, etc.), the beaver is a prime favorite [1].

There is, Morgan continues, a gradation of intellect from humanity down to the lowest orders of animals. Thus the *unity*. Further, “the successive steps downward from the man of the highest intellectual range to the man of the lowest, are no farther than from the latter to the most intelligent animal, and from him successively to the lowest in the scale of intelligence” (514). Thus the “scale of intelligence” is tripartitioned:

$$d(H - \underline{H}) = d(\underline{H} - A) = d(A - \underline{A}),$$

where *H* and *A* are the upper intelligence bounds for Human and Animal, respectively, with \underline{H} and \underline{A} representing the lower bounds. For the young Morgan, the unity of this scale incorporates both quantitative and qualitative *differences* within the Animal Kingdom.

1. The beaver has lost none of its attractiveness. For instance, a “*Ms. Beaver*” juvenile fiction series combines feminist and cooperative viewpoints [Rosemary Allison and Ann Powell, *The Travels of Ms. Beaver* 1973, *Ms. Beaver Travels East* 1978, *Ms. Beaver Travels West* 1983—The Women’s Educational Press, Toronto]. Another example is a “*Dam Builders*” board game using the beaver *lebenswelt* to promote ecological and cooperative values [Animal Town Games, P.O.B. 2002, Santa Barbara, CA 93120].

Echoing Morgan’s position, Agassiz [1857, 115f] acknowledged that it was the “psychological individuality” of animals which constituted “the connecting link between them and man.” He stressed by way of example the “psychical faculties,” the “emotions and feelings,” and the memory of the common dog, and then continued: “though all these faculties do not make a philosopher of him [the dog], they certainly place him in that respect upon a level with a considerable proportion of poor humanity.” Here, the contrast with Morgan is again illuminating. While Morgan supposed that a specific distance on the scale of intelligence separated the human of the lowest intellect from the most intelligent animal, and thereby highlighted the unity of differences, Agassiz supposed that the intelligences were equivalent. Thus a contradiction is generated by Agassiz’ idealism: he abstractly absolutizes differences at one point and then abstractly absolutizes unity (i.e. confounds unity with identity) at another point. As stressed by Engels [1873-86, 197f], the *revolutionary* movement of modern natural science was confronted by a *conservative* outlook, especially in the organic sphere. The struggle to advance a dialectical science continued throughout the nineteenth century, with Agassiz as one of the main conservatives.

The American beaver and his works

MORGAN returned to the topic of differences within unity of humanity and the Animal Kingdom in a book published a quarter century later. In the meantime, his legal career had involved him in the construction and operation of a railroad linking iron ore mines to the port at Marquette, Michigan. As a result, from 1855 on, Morgan spent many summers in a highland region south of Lake Superior that was populated by vast numbers of beaver. Morgan confessed he soon gave up the prospect of trout fishing in order to study the beaver. In the early 1860s, he also travelled north to the Red River settlement in Canada, and up the Missouri River to the Rocky Mountains, and thus was able to compare other beaver populations with that of Michigan. After more than a decade of study, his *American Beaver and His Works* was published in 1868 by J.B. Lippincott in Philadelphia. [The reprint under review is “an unabridged and unaltered republication of the work.” All parenthetical page citations that follow are to this work.]

Overall, this is an excellent book, well worth the reprinting, well worth the modest price. It is not only an enduring classic of ethology but gives us a glimpse into the scientific practice of a truly trans-disciplinary researcher.

The book has nine chapters, with three appendices. The first chapter describes the characteristics of the beaver. This large rodent, of Genus *Castor*, was found throughout North America and Europe. The Family *Castoridae* is among the oldest of living mammals on Earth. The beaver is one of the most intelligent of its Order. The beaver’s manual dexterity is notable, as are its architectural “works.”

Morgan points out that the beaver's architectural skill is made possible by its ability to stand erect, thereby freeing his forepaws [cf. also p. 139]. He further comments that "Man's great superiority over the inferior animals is shown in nothing more conspicuously than in the freedom of his hands" [p.27]; he later comments on the role of language [cf. p.281]. This phenomenological insight is significant for what is to follow, as well as more broadly for indicating Morgan's indigenous American historical materialism.

Chapter 2 and Appendix A, contributed by Morgan's friend, Dr. W.W. Ely [cf. p.45], discuss the beaver's anatomy. Chapters 3 and 4 begin the discussion of the beaver's principal architectural "work," the dam. Up to 1000 yards in width, these dams raise the water level in the beaver's pond several feet and stabilize the pond level. This facilitates the beaver's mode of life even when the surface of the ponds freeze in the winter. If a dam is breached by high water, the beavers quickly repair the damage. There are several distinct kinds of dam, each suitable for a particular type of waterway. The beaver's ability to adapt its works to varying circumstances is evidence, for Morgan, of intelligence [p. 104]. He acknowledges, however, that even "a tame beaver shows an irresistible propensity to dam up flowing water" [p.116], a concession that would seem to weaken his argument against instinct.

The fifth chapter discusses the beaver's lodges and burrows. A burrowing animal, the beaver constructs wood and mud "lodges" above ground as well as underground "burrows," always connected by underwater tunnels to the river, lake, or pond. Beavers do not hibernate; near the outlet to burrow or lodge are piles of tree cuttings stored as food for the winter season.

The sixth chapter describes the beavers' mode of subsistence. They are herbivores, their diet consisting largely of the bark of deciduous tree branches. They cut down trees and strip the branches, either eating the bark immediately or storing it for winter. Chapter 7 concerns itself with the environmental impact of the beaver's "works." Morgan notes the existence of "canals" constructed by the beaver, some hundreds of yards long. These are used to float the beaver's cuttings from the forest to the ponds and lodges. A byproduct of the beaver's works is the development of meadows which have a substantial effect on the forest ecosystem.

The eighth chapter discusses the commercial significance of beaver pelts. Trapping diminished the numbers of beavers from uncounted millions in the Seventeenth Century, almost to the point of extinction by 1900. The decline of the fur trade, and conservancy measures, have by now allowed the beaver to reestablish itself in North America. Morgan discloses in this respect more than a little sympathy for the beaver threatened by the steel trap [cf. pp. 112-3 *et seq.*]. But he continues his account of trapping techniques, as distasteful as this may have been to him. Morgan concludes that "the

beaver, with his life, has contributed in no small degree to the colonization and settlement of the British Provinces [i.e., Canada] and the United States"[2].

Animal psychology

IN THE ninth (final) chapter of this book, Morgan returns to his consideration of Animal Psychology[3]. Here his analysis of the unity and differences of humanity and the Animal Kingdom has become more profound over the quarter century under the impress of his beaver studies. In 1843, Morgan had depended upon literary sources, principally the eighteenth century naturalist Buffon (1707-1788); in 1868 he criticized Buffon's credulity and espoused a methodologically more sophisticated approach to field studies [p.133]. But his arguments remain quite similar. He begins by criticizing the "arbitrary term," *Instinct*, which the naturalists use to explain the behavior of animals. Instead, he suggests that they may possess a "thinking self-conscious principle, the same in kind that man possesses, but feebler in degree" [p.249]. Then he repeats and expands his argument of 1843: Mind has certain manifestations such as Self-Consciousness, Memory, Reasoning, Imagination, Will, Passions, and Lunacy. Does an animal manifest these faculties, etc., and, if so, do they differ in kind or degree from those manifested by humans? [p.250]

Of these, the most decisive must be Self-Consciousness. Few will deny that animals are conscious, i.e. sentient, that they remember, are willful, etc. But many doubt that they are self-conscious, i.e. reflexive. This, because reflexivity requires a symbolic medium such as language for its action. Morgan confronts this issue directly if briefly. "When a beaver stands for a moment and looks upon his work, evidently to see whether it is right, and whether anything else is needed, he shows himself capable of holding his thoughts before his beaver mind; in other words, he is conscious of his own mental processes" [p.256]. And that "consciousness-of-self" is precisely *self-consciousness*. Thus the medium of reflexivity for Morgan can apparently be *planful labor*, and not only language.

Morgan reaches three conclusions. The term "instinct" as an explanation of the intelligent acts of animals should be dropped; we should acknowledge their possession of intelligence; and we should recognize that their intellectual endowment differs in degree, not in

2. This theme is elaborated by Harold A. Innis in his anti-imperialist "staple-commodity" theory of North American economic history, as in his *Fur Trade in Canada* [Toronto: University of Toronto Press 1956].

3. Articles by Hearne (1795) and Bennett (1835) make up Appendices B and C, beginning on page 306. Morgan described these as "the best and most authentic" accounts of the beaver, on which subsequent work depended but, he continued, their "brevity and consequent incompleteness induced the publication of this work" [cf. p. 286].

kind, from that of humans [pp.275-277]. But Morgan does not equate human and animal intelligences. Language and cultural transmission are the crucial factors here. Indeed, in 1868 he sees a greater distance between animal and human than he did in 1843 [pp.280-281]. Differences within unity, yes; but unity, too. From his study of the beaver, Morgan draws insight into the unity of the natural order, unity which is threatened by the commercial predations of humanity. This assessment has a strikingly contemporary ring about it, wholly at one with the conclusions of dialectical materialism.

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Putting Chomsky In Scientific Perspective

Vera John-Steiner and Paul Tatter, An Interactionist Model of Language Development. In *The Sociogenesis of Language and Human Conduct*, ed. by Bruce Bain. Plenum 1983. (pp 79-97)

Noam Chomsky's politics are usually crystal clear; when he sounds off, for example, against U.S. imperialism in Central America, one can hear the fine-tuned moral sensibilities of our anarchist comrades. But, as a linguist, he has always seemed a murky puzzle. How is one to account for his mechanistic model in which a child is born with an *a priori* knowledge of a universal grammar which provides the infant with a basis for learning its particular native tongue? It is good then to have John-Steiner and Tatter show us why Chomsky's model had so much influence for awhile, and to assure us it has now given way to a superior new paradigm.

Their historical review of language development studies starts

with the stultifying effect of behaviorism which preferred to study nonverbal subjects more amenable to stimulus-response analysis. In such a conceptual void, Chomsky's 1957 *Syntactic Structures* had a dramatic appeal with its bold hypothesis concerning an innate language acquisition mechanism. The 1960s saw a mushrooming of studies seeking a scientific basis for a universal preprogrammed grammar. By 1970 experimental research had not only revealed deficiencies in the Chomsky theory (for example, a child tends to experiment with syntax at first) but also pointed toward the social basis of language learning:

The nativists had regarded [the sensitively responsive maternal] input language as lacking in distinctiveness and as marred by disfluencies and disruptions, while the behaviorists had regarded it as a form of reinforcement.

Though Chomsky's rationalist view is now a minority position among researchers, it had the beneficial effect of showing how important it is to make clear the philosophical notions (ontological and epistemological) which underlie any study in the development of language. The new interactionist paradigm reflects earlier contributions from American pragmatists and Soviet Marxists as well as recent integrative thinking. For long-neglected pragmatists such as Charles S. Pierce, John Dewey and George Herbert Mead, the symbolic (symbiotic) role of language had its origins and its meanings only as part of the entire social and cultural process of human interaction, yet was based on and continuous with the organic processes of biological activity.

The pragmatic tendency to see social interaction as necessary to give semantic meaning to signs has reappeared in the past decade through the work of Halliday, Bruner, and others. Parallel with the concerns of the pragmatists are found the formulations by Vygotsky and Luria. In a very rich discussion, the authors show how the problems to be overcome include a theoretical tendency to separate nature and culture, and to consider the cognitive and social processes as separate or parallel phenomena with respect to language. Finally, the process of private (internal) speech is shown to function as a prelude to or preparation for social communication, as a necessary component of the higher mental processes, and to play a primary role in both individuation and enculturation.

Overall, it becomes clear that the interactionist model refers at one level to the role of social interactions, esp. of mother and child, in the ontogenetic development of language but that, in a broader philosophical and psychological context, interactionism refers to the unification of nature and culture in the course of this ontogenetic development. This paper accomplishes its own kind of unification for an important field and represents a significant contribution to the origins of human consciousness (a term not used by the authors). And

the volume in which it appears is also overall an important contribution to the subject.

Incidentally, Chomsky himself seems to have learned little during the past 30 years and participated not at all in developing this fruitful new paradigm, as can be seen from a thoughtful review of his latest book *Knowledge of Language*: see Philip T. Smith, A Word to the Wise. *Nature* 120: 493f; 1986. [L.T.]

A Clear View In the Eye of the Storm

James Moffett, *Storm in the Mountains: A Case Study of Censorship, Conflict and Consciousness*. Carbondale: Southern Illinois University Press 1988, xii+265 pp, index.

"Censorship in the United States," writes Moffett [ix], "comes not from a government suppressing ideas but from a corporate industry making money. The most fanatic censors could not wreak damage of this magnitude. Burned books have at least seen the light of day, and other copies can be found elsewhere. But we will never know what worthy books are not published, no more than we will ever know what the books destroyed in Alexandria had to say." [There they were set afire, he notes, by both pagans and Christians.]

His book recounts the history of the trend-setting 1970s textbook suppression that occurred in Kanawha County, West Virginia, as the result of a rebellion of Appalachian fundamentalists against the textbook selections of an enlightened or liberal public school administration. Though the rebellion was able to suppress only a very few books legally, its practical effect was to discourage most teachers from using *any* of the books attacked, and to induce publishers to abandon *all* texts encouraging free thought in students. The book is characterized by a sensitive social perception of the mountain people who had thus destroyed the author's own creative product.

The author makes a careful distinction between religiosity and spiritual values in his finely tuned analysis of *agnosis*, defined as a fear of knowledge, arising in a community threatened by intrusion of new cultural values in a changing world. This book, with its strong plea for cultural pluralism as the necessary basis for U.S. democracy, will be useful to all who seek to combat effectively the creationists and others who manipulate religious thought for right-wing political purposes. [L.T.]

Their View of Human Nature is Perplexing

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A REVIEW ESSAY:

The Dialectical Biologist

by Richard Levins and Richard Lewontin.

Harvard Univ. Pr. 1985, xiv+303, index. \$8.95 paper.

THE DIALECTICAL BIOLOGIST is a useful and provocative collection of essays from the well known Marxist scientists, Richard Levins and Richard Lewontin [2]. Written at various times for various purposes, the essays are loosely grouped together under the titles: On Evolution (3 essays); On Analysis (3 essays); Science as a Social Product and the Social Product of Science (7 essays); plus a concluding essay on Dialectics written specifically for this book.

A detailed review of this book would imply a review of each essay. As an alternative I have chosen to comment on some aspects of several essays and to suggest, for those wishing to read further, some Marxist references not provided in the book. However, I found the Levins and Lewontin essay on human nature very deficient from a Marxist viewpoint and decided to provide the reader with a Marxist approach to this crucial subject, devoting over half of this review to documenting Marx's views.

The first group of papers begins with an essay on *Evolution as Theory and Ideology* that surveys the history of "evolutionism" as a world view which has permeated the natural and social sciences. The acceptance of this world view, involving "change" as an essential characteristic of systems, was an outcome of the European bourgeois revolution that demanded an alteration in legitimating ideology from

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2. Richard Levins is John Rock Professor of Population Sciences, Harvard School of Public Health. Richard Lewontin is Professor of Zoology, Museum of Comparative Zoology, Harvard University. Both have been members of the *Science for the People* movement. Levins has been a scientific consultant to the Cuban government.

one of natural stasis and stability to one of unceasing change. Human beings see the natural world as a reflection of the social organization and a theory of the naturalness of change is congenial only in a revolutionizing society. The authors point also to the bourgeois ideological origin of "optimality theory" and the emphasis on diversity, complexity and stability as the trends in evolution. The arguments put forward are convincing.

THIS KIND OF APPROACH to scientific theories is in the Marxist tradition of the Hesse [1931] study of the social and economic roots of Newton's *Principia*, of Caudwell's "Studies in a Dying Culture" and "Hereditability and Development: A Study in Bourgeois Biology" [cf., Sheehan 1985,365-369], of Prenant [1969] on the social origins of Darwinism, and of Gould's [1979] on the ideology of gradualist dogma. In fact, Engels [1954,307] was the first Marxist to dwell on the ideological nature of some scientific theories. He (and Marx) viewed the Darwinian theory of the struggle for existence as a transference from society to organic nature of the bourgeois economic theory of competition. For a review of the history of Marxist views and polemics on this theme, see Sheehan [1985] and for the role of ideology in natural science, Talkington [1981]. In this kind of approach, Marxists must avoid offering easy *ad hoc* explanations.

The authors also review briefly the origin of Darwinism as an evolutionary theory that rejected Platonic essentialism but they do not point to the empiricist influence that has prevailed since Darwin's time with its many conceptual implications [see Greene 1981 and Rodríguez 1988a,b (this issue)]. Their survey of ideas and problems in evolution fails to mention that during the last decade there has been an explosion of critical works and new ideas affecting many aspects of evolutionary theory, including philosophical issues [see Reid 1985; Ho and Saunders 1984; Sober 1984; Pollard 1984 and the interesting books of Stephen Jay Gould].

The three essays on evolution emphasize and develop in some detail the dialectical interpenetration between organism and environment and this is perhaps the more valuable and important contribution of the book to present evolutionary thought (see, however, my critiques [Rodríguez 1988a,b, this issue]). The authors suggest, for example, the development of new disciplines such as Biometeorology that would characterize the environment from the perspective of the organism confronting it. Implicit throughout is the continuing need—to elaborate a more comprehensive evolutionary theory—that offers a great challenge to Marxist biologists.

The section On *Analysis* starts with an essay on the analysis of variance and the inference of causes in genetical studies. Next, there is gentle spoof of the analytic method by a fictitious person called Isidore Nabi with subtle allusions to several contemporary scientific issues. Then they elaborate a sound critique of holism and Cartesian

reductionism in ecological theory that surely will open new paths for research in ecology.

The third section, on science/society interaction, opens by examining Lysenkoism in terms of its social, political and material context rather than in idiosyncratic terms, analyzing its mistakes from a Marxist dialectical viewpoint. This is the best analysis I have read on this thorny subject. The reader may also refer to Sheehan [1985] on Soviet debates in Lysenko's time, Hubbard [1982] on the ideological basis of modern genetics, and Rodríguez [1988a, this issue] for a critique of Lysenko's view of organisms. They also vigorously champion the importance of Marxist philosophy of science against the "anti-ideological" technocratic ideology that views science as a neutral activity.

In an essay on the commoditization of science, they analyze the ideological and social characteristics of modern science in developed countries. Marx also foresaw, in *Manuscripts, Grundrisse, Capital*, the character of science under capitalism [cf. Rose and Rose 1976, 6-9]. In an essay on applied biology in the Third World, they criticize the pragmatic and developmentalist views in underdeveloped countries that seek to copy the models of science and technology of developed capitalist countries. "But," they aptly comment, "if European and North American science is already a caricature of the 'science' seen by its enthusiastic advocates, it comes to the third world as a caricature of that caricature" [p.226]. Other essays provide Marxist analyses of agricultural research, the pesticide system, and research needs for Latin American health.

IN THE ESSAY ON HUMAN NATURE, they show how the reductionist or biological determinist view is that of an absolute continuity between prehuman and human evolution while the dialectical view emphasizes the emergence of evolutionary novelty. This statement is in agreement with dialectical materialism which tells us that every form of movement has new properties that cannot be reduced to its constituent forms of movement [Engels 1954,248]. Biological determinists pretend to reduce the complex social human life to biological characteristics.

However, they go too far in this direction when they contend [pp.257-8] that:

The trouble with the question of human nature is that it is the wrong question. Partly the question...carries a vestige of Platonic idealism. The evident fact about human life is the incredible diversity in individual life histories and in social organization across space and time... A dialectical point of view...accepts as primary the heterogeneity of individual life histories and of social developments. Far from seeing the variations as obscuring or even illuminating the underlying uniform ideal...the heterogeneity itself becomes the proper object of study.

They go on to analyze several examples (sex, feeding) that show the

transformation of physiological function under diverse social conditions.

In contradiction to their view, I agree with the more rounded view of Fedoseyev [1979,58-59] who says that Marxism rejects both the biologization of social phenomena and the other extreme, the ultra-sociological assertion that man is merely a concentrate of the economy or the socium and is completely devoid of everything biological, organic or natural in general.

I SUGGEST THAT MARXISTS should avoid the two extremes of the metaphysical antithetical duality: *essentialism/empiricism*. That is to say, we must avoid both the Scylla of Platonic essentialism and the Charybdis of empiricism. Empiricism and positivism reject the search for underlying essences as pure fantasy and only deal with the contingent and the single individual. Dialectical materialism tells us that essence and phenomenon are the two aspects of an indissoluble unity. The essence is the more internal, necessary and universal aspect of objects and processes, while the phenomenon expresses its own essence and is more contingent, external and single. Dialectical materialism states that to overestimate the phenomenon (empiricism) is as idealistic as to overestimate the essence (Platonic essentialism). Though the essence has no corporal sensible existence, it does, however, express the necessary foundation underlying the contingent and sensible phenomena, and thus it expresses objective reality [cf. Rosental y Straks 1960,1-82].

We must not let ourselves become bewildered by the incredible phenomenological diversity (heterogeneity) of individual life histories and social development. In our capitalist environment, for example, we can identify some essential characteristics that allow us to state that, despite contingent differences across space and time, many social developments are capitalist developments. We can similarly identify some essential characteristics of human nature as will be explained below.

Moreover, Levins and Lewontin also contend [p.256] that another difficulty with the Marxist view of human nature is that

even if true, it is not very informative. It cannot be used to project any actual feature of human social organization, nor to say how that organization may or may not change. That is, it seems to confront the issue of human nature and promises to tell us what that nature is, only to provide a picture of human nature that is politically irrelevant! .

I confess I was really perplexed when I read this paragraph. I cannot agree. While it is true that in classic Marxist works human nature is not analyzed in a systematic way, Marx does, in fact, take a definite and substantial position on this ontological subsystem of society and history—i.e., human nature—and we can consider this position as constituting an elementary factor in the structure of his

world view. A good survey of Marx's views on human nature is provided by McMurtry [1978,19-53]. The following argument is based on McMurtry's line of reasoning.

It is first worth noting that Marx implies an underlying factor of human nature by his very concept of the forces of production which involve developed labor-power abilities and are by definition capable of making material use-values. But labor-power abilities and material use values themselves presuppose, respectively, definite capacities and needs of man himself out of which they are developed and to which they are useful. Forces of production therefore presuppose such capacities and needs, and a notion of human nature in these respects is implicit in Marx's theory from the start. Hence, he says, "Man develops his slumbering powers" [1965,177], and "no production without needs"[1973,92]. These capacities and needs constitute the substance of his explicit concept of human nature.

IN A RARELY NOTED PASSAGE of *Capital*, Marx [1965,609] says:

To know what is useful for a dog one must study dog nature... Applying this to man, he that would criticize all human acts, movements, relations, etc., by the principle of utility must first deal with human nature in general, and then with human nature as modified in each historical epoch.

What is of special interest to us in this passage is that Marx clearly accepts the legitimacy of the notion of human nature.

Marx [1964,593] also asserts that "One of the most vital principles of communism" is its "empiric view, based upon a knowledge of man's nature." That is, Marx requires a concept of man's nature as necessary to his own system of thought.

It is important to clarify the distinction between "human nature in general" and "human nature as modified in each historical epoch." The former refers to the properties of man conceived generally and independently of particular historical forms whereas the latter refers to the same properties conceived in a definite historical context. When he talks about man as a species, Marx pursues the traditional philosophical strategy of distinguishing him from the animal. In one well-known passage from *The German Ideology* [1964,31], he tells us that man actually raises himself above the animals only when he starts to produce his own means of staying alive: "They [men] distinguish themselves from animals as soon as they begin to produce their means of subsistence." Since for Marx the *differentia specifica* of human behavior is that man alone produces his means of life, it follows that what he construes as the special capacity enabling such productiveness is for him the *differentia specifica* of man's nature. In a discussion in *Capital* on the labor process Marx [1965,179] clearly states that man's creative intelligence is this special capacity. McMurtry [1978,23] calls this special property of human nature the capacity of

"projective consciousness" which, in brief, is the essence of human nature underlying man's positive freedom and achieves its truly human expression for Marx in the activity of creative art. For it is in "composition" that he sees the inventive and implemental aspects of this natural capacity most freely and integrally expressed [1973,611]. In such creative art (Marx's example is the "composition" of the writer), both the project and its execution are unconstrained by extrinsic dictate and united in the same productive agent, unlike the antagonist and unfree forms of almost all historical production.

THE ULTIMATE END of posthistorical communist society is thus, Marx emphasizes here and elsewhere, to provide those technical and economic conditions whereby all men's activity can achieve precisely this status of creative art, whereby all men's projective consciousness or "creative dispositions" can seek "absolute elaboration" [1964b, 84-85]. For Marx, then, Man the Producer is, in the end, Man the Artist.

However, Marx's position by no means rules out the possibility of collective plans or projects. The operation of such collective projective consciousness can take either of two extremes for Marx: production where the "head" and the "hand" of the social organism altogether "part company" (extreme division of labor) and become "deadly foes" [1965,508] or production where the collective laborer is communist and the plans and execution are performed together. The former of these forms occupies all previous, class-divided history and the latter constitutes the "realm of freedom" [1954,821], the classless utopia in which the "heads" and "hands" of all unite in thoroughly cooperative and non-antagonistic integrated production.

This concept of man's projective consciousness persists throughout Marx's work [see 1961,75-76; 1964,315; 1965,202; 1973,706]. Marx's great emphasis on the influence of specific material conditions upon men and his correspondingly great scorn for wholly "abstract" conceptions easily but mistakenly leads to the conclusion that he rejected general conceptions of man, conceptions of human nature, altogether.

Marx's famous sixth thesis on Feuerbach is a standard source for the claim that he rejected altogether the idea of an intrinsic human nature:

The human essence is no abstraction inherent in each single individual. In its reality, it is the ensemble of social relations."

However, all that Marx is claiming here is what he claims throughout his subsequent work, that is, the "base," the "structure," the "form," the "anatomy," or (as here) the "essence" of human affairs is the totality of social relations.

He is not opposing a notion of human nature as such, but an "abstract" version of it. And he is not depriving inherent human properties of explanatory status, but is saying that in reality, in

practice, the "human essence" is social rather than atomistic.

Marx's concept of human nature—its "species character" of projective consciousness—underlies his indignation at the reduction of human work to a dictated and "mindless detail task"; his preoccupation with the profit imperative of the capitalist system "blindly" governing human productive activity, and so on. For Marx to call something "inhuman" presumes, of necessity, an idea of what is "human" and it is difficult to miss Marx's tendency to employ the term "inhuman" whenever he sees external circumstances as having robbed men of the exercise of their creative intelligence. But Marx construes the nature of man as characterized not only by an essential capacity to conceive a project and bring it to reality but by a corresponding essential need to do so. Hence we find such phrases as man's "need for his own realization" [1961,112] and statements indicating that men are driven to liberate themselves from oppressive social conditions by a definite need to achieve the freedom for material self-realization [1964,331].

Marx also makes numerous fleeting references to species needs for food, clothing, habitation [1964,39], sexual relationship [1961,101], fresh air and sunlight [1965,265,426,465], adequate living and working space [1965,482,657-691], cleanliness of person and surroundings [1965,232,381], rest from exertion [1965,232;527], variation of activity [1965,341,360,440,484,488], aesthetic stimulation [1954b,392;1965,232], and play [1964,459]. In *The German Ideology*, Marx says "life involves before everything else eating and drinking, a habitation, clothing and many other things. The first historical act is thus the production of the means to satisfy these needs." Marx explicitly identifies the needs for "many other things" as ontologically prior to man's "first historical act."

In the projectively and executively unconstrained production of the "realm of freedom," human activity of material self-realization permits the "reappropriation of the human essence" [1961,102]. In sum, Marx's concept of man, as his great emphasis on production, on revolution and on the epistemology of praxis suggest, is above all activist. Man for him can no more relinquish his innate drive for material self-realization than he can cease to be man.

BUT FOR MARX human nature is modified in each historical epoch: "By thus acting on the external world and changing it man at the same time changes his own nature" [1965,177]; and "All history is nothing but the transformation of human nature" [1966,128]. However, this transformation is not conceived by him as alteration of man's general nature. As with human nature in general, human nature as modified in each historical epoch is considered in terms of capacities and needs, primarily through the influence of the forces of production. But the essential capacity and essential need remains the projective consciousness. Marx's overall concept of man gives the clue to the moral

content of all his work and his major ethical premise: Men ought to materially realize themselves.

Thus, Marx's view of human nature is far from irrelevant in political economy.

IN THE CONCLUDING ESSAY on *Dialectics*, Levins and Lewontin provide a valuable and useful analysis, especially for natural scientists trained under Cartesian reductionism.

Overall, *The Dialectical Biologist* provides an obligatory read for the Marxist scientist and surely will provoke many interesting polemics. For me, the essays on evolution and on ecology suggested many questions for dialectical analysis.

The author wishes to express appreciation to Professor Armando Contreras for his review of my English and to the Consejo de Desarrollo Científico y Humanístico de la Universidad de los Andes (CDCH-ULA) for financial support.

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Our Man in the History Department

HOW WONDERFUL to receive the new *S&N* 7/8 issue. I can't wait to drop it around my department to see what happens. (Last time, some idiot threw it out.) It's not so much the mild taboo on Marxism around here as it is the taboo on *all* philosophy of science. Surprising how much hostility both scientists and historians of science show towards philosophy, though in a myriad of ways.

The practicing scientists think they are rejecting *all* philosophy of science, while they gleefully preach whatever philosophy was rejected by the philosophical community exactly ten years previously. For example, all scientists now seem to be Popperians or, if ever so progressive, Kuhnians. A few years ago they were all positivists. (I can't wait until they discover Feyerabend!)

The older historians of science are considered to be Whigs, a term of insult used by younger members of the department: "These terrible Whigs look at history through the eyes of the present, as some sort of inevitable progress toward the truth." For example, a Whig would look at Aristotle *only* as a precursor to Galileo, the latter *only* as a precursor to Newton, etc. This is supposed to be a very bad thing. (Call me a Whig but I think that realism requires an analysis in terms of progress toward truth.)

The younger historians are, of course, all irrationalist Kuhnians or Feyerabendians; science is an irrational act (and/or put there to exploit us). Such stupidity.

So you see the uphill struggle that faces us here. The magazine does come in handy. And this issue should be very helpful. I'm amazed how much is in it. However, I must be honest: when I first glanced at that Althusserian stuff on geology, I said to myself that this is the kind of thing we don't need. Then I found you had written a reply. Good!! The exchange of views proved to be very healthy. But I join with you in the Marxist-Leninist viewpoint that's worlds apart from Althusser's.

Keep up the great work.

Undergrad

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MARILYN FRANKENSTEIN & ARTHUR B. POWELL
Empowering Non-Traditional College Students 100

STUART A. NEWMAN, on DNA as a "blueprint"
**Genetic Engineering as
Metaphysics and Menace** 113

ERNESTO RODRIGUEZ
**The Necessary and the Contingent
In the Evolutionary Process** 125

ERNESTO RODRIGUEZ
**Essence and Phenomenon in the
Evolutionary Theory of Species** 139

LESTER TALKINGTON
An Open Letter to Mikhail Gorbachev 145

SCIENTISTS against war
Seville Statement on Violence 160

CHARLES C. DAVIS reports on
Our Man in Ethiopia 164

*A Nuggets
Collage*

**Human Sexuality:
The Interpenetrating Opposites** 87

*Book
Reviews*

JAMES R. HOFMANN reviews Peter J. Kuznick
On Scientists as Political Activists 166

IRVING ADLER reviews Antonelli
Biological Insight through Mathematics 169

GORDON WELTY reviews Lewis Henry Morgan
On Humanity's Place In Nature 171

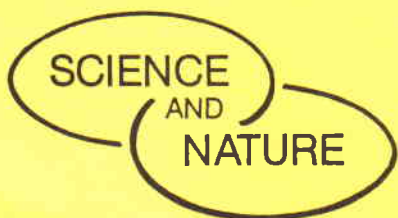
LESTER TALKINGTON reviews John-Steiner & Tatter
Putting Chomsky In Scientific Perspective 176

LESTER TALKINGTON reviews James Moffett
A Clear View in the Eye of the Storm 178

ERNESTO RODRIGUEZ reviews Levins & Lewontin
Their View of Human Nature is Perplexing 179

*Reader
Feedback*

Letters to the Editor 188



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