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Between soul and precision : Ernst Mach's biological empiricism and the social democratic philosophy of science

Author
Charak, Gregory Scott

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Between Soul and Precision: Ernst Mach's Biological Empiricism and the Social Democratic Philosophy of Science

A Dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy

in

Philosophy

by

Gregory Scott Charak

Committee in Charge:

Professor Nancy Cartwright, Chair
Professor Paul Churchland
Professor David Luft
Professor Tracy B. Strong
Professor Eric Watkins

2007

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Chair

University of California, San Diego

2007

DEDICATION

To Nancy Cartwright

For introducing me, soulfully, to Precision

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CURRICULUM VITAE

Areas of Specialization
Philosophy of Science, Nineteenth-Century Philosophy

Areas of Competence
Political Philosophy

Education
University of California, San Diego
Department of Philosophy

2007	Ph.D.
2006	M.A.

Boston University
Department of Philosophy

2002	B.A.

Dissertation

"Between Soul and Precision: Ernst Mach's Biological Empiricism and the Social Democratic Philosophy of Science"
Committee: Nancy Cartwright (chair), Paul Churchland, Eric Watkins, David Luft (history), Tracy B. Strong (political science)

Papers and Symposia

"From the Urban Horizon to Logical Space: Notes on Contemporary Pedagogical Philosophy" presented at the Junior Fellows Conference of the Institute for the Human Sciences, Vienna, May, 2005

Honors and Awards

Dissertation Fellowship, UC San Diego	2006-2007
Fulbright Fellowship, Vienna, Austria	2004-2005
Boston University College Prize for Philosophy	2002

Courses

As teaching assistant
Ethics and Society
Metaphysics
The 14th Amendment

Logic
Diversity and Culture

References

Professor Nancy Cartwright (ncartwright@ucsd.edu)
Professor Eric Watkins (ewatkins@ucsd.edu)
Professor Pam Wright (pwright@ucsd.edu)

ABSTRACT OF THE DISSERTATION

Between Soul and Precision: Ernst Mach's Biological Empiricism and the Social Democratic Philosophy of Science

by

Gregory Scott Charak

Doctor of Philosophy in Philosophy

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Professor Nancy Cartwright, Chair

This dissertation has three primary aims. The first is to offer a new perspective on the philosophical worldview of Ernst Mach, and in particular on his well-known doctrine of elements. This is achieved primarily within a historical context, specifically by exposing two misrepresentations of Mach's thought framed by two of his most famous detractors, Vladimir Lenin and Max Planck. Contrary to their claims that Mach was either a reactionary idealist or a solipsistic positivist, I argue that Mach's philosophical standpoint is best described as a *biological empiricism*. This re-constructed position is developed throughout the text as the one that best captures the variety of roles actually played by the doctrine of elements within Mach's philosophy.

The second aim of the dissertation is to explore the relevance of Mach's standpoint in the philosophy of science to questions of politics and justice. In order to do so, however, an additional standpoint, one linked to Mach's both historically and conceptually, must be developed. This is the standpoint of *technological empiricism*, which I re-construct from the works of Alexander Bogdanov, Otto Neurath, and Nancy Cartwright. Like Mach, these thinkers are dedicated to the priority of human experience in gathering and deploying scientific knowledge. Their focus, however, is not on the psychological, but on the technical, social, and physical aspect of that experience.

Once the relevant similarities and differences are developed, I explore the political aspects of biological and technological empiricism, identifying a series of both shared and independent commitments to the freedom of thought, psychological development, economic planning, and social solidarity. These ideas are synthesized into a common standpoint that moreover views science as a tool of human adaptation, capable of making contributions to both welfare and justice. I conceptualize this standpoint as the *social democratic philosophy of science*.

The third aim of the dissertation is to revisit the polemics of Lenin and Planck in order to expose the shared ethical concerns that lie behind their caricatured attacks on Mach's 'positivism.' The goal is to lend an additional voice to the claim that the opposition between sobriety and resolve is one-sided and untenable.

Introduction

The first aim of this dissertation is to offer a new perspective on the philosophical worldview of Ernst Mach, and in particular on his well-known doctrine of elements. This is achieved primarily within a historical context, specifically by exposing two misrepresentations of Mach's thought framed by two of his most famous detractors, Vladimir Lenin and Max Planck. The anti-Mach polemics of both Lenin and Planck have to this day been influential in shaping Mach's reputation, both scholarly and popular, and by exposing them as inaccurate caricatures we challenge, on the one hand, charges that Mach's thought was reactionary or solipsistic, and on the other, descriptions of his standpoint as one of "subjective idealism" or "logical positivism."

But if Mach was neither an idealist nor a positivist, as is commonly suggested, then how can we interpret his 'standpoint' and what does his concept of neutral elements contribute to it? With respect to the former question, it will be argued that Mach's philosophical standpoint is consistent generally with what might be called a pluralist philosophy of science, and that given his particular constructive concerns, his own work from this standpoint should be described as a 'biological empiricism.'[1] With respect to the second

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[1] The concept of biological empiricism will be developed extensively throughout the following chapters. With respect to the meaning of a "pluralist" philosophy of science, this more general description will be applied both to Mach's biological empiricism and to the "technological empiricism" attributed to Bogdanov, Neurath, and Cartwright. It is meant to capture certain shared commitments of these two standpoints, including the rejection of reductionism and fundamentalism, which will also be defined and developed at length.

question, it will be argued that Mach's doctrine of elements in fact plays a *variety of roles* in expressing the key features of this standpoint.[2]

Mach is as famous for disavowing systematicity as Kant is for claiming it, describing himself on one occasion as "merely an unprejudiced rambler, endowed with original ideas in various fields of knowledge."[3] As such, Mach never proclaims for himself a unified standpoint, either inherited or innovated. Two consequences follow from this:

On the one hand, any study that attempts to decisively capture Mach's philosophical worldview is going to have to engage in a significant amount of interpretation, prioritization, and re-construction of ideas. Such choices require justification, including comparison with other leading accounts, so as not to appear arbitrary. Our re-construction of Mach's thought as 'biological empiricism' is no exception, and we will compare it both to the characterizations offered by Lenin and Planck as well as to those of a number of leading contemporary commentators.

On the other hand, Mach's lack of systematicity should be viewed neither as a glaring omission nor as an impediment to accurate interpretation. On the contrary, it will be argued that a provisional and flexible attitude is itself a key component of any 'pluralist' philosophy of science. Indeed, a major

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[2] These roles include (1) the promotion of a non-reductive psycho-physiology, (2) the emphasis on a 'phenomenalist confirmation base'(Cohen) in physics, (3) the epistemological claim of psychic familiarity as the ultimate aim of all scientific knowledge, (4) a general preference for the "customary sensory world" over specialized, theoretical abstractions (including any notion of an independent, metaphysical world), and (5) a semi-speculative/ethical standpoint advocating sympathy and sensual unity, especially through the claim that "the ego cannot be saved." All of these roles will be developed throughout the following chapters.

[3] Ratliff, *On Mach's Contribution to the Analysis of Sensations*, in {{30 Cohen,R.S. 1970; }} p. 23

justification for using Lenin and Planck as interlocutors here is that this enables us to distinguish Mach's position not only from these thinkers' own 'realism,' especially as formulated in their polemical writings, but moreover from the epistemological traditions to which they inaccurately ascribe Mach's thought. The latter task quickly reveals Mach's philosophy of science as one uniquely concerned with providing an analysis of cognitions as opposed to propositions, scientific practice and experimentation as opposed to 'pure theory,' and, generally, of *experience*, though not it's 'logical structure.'

Indeed, Mach's standpoint has no fundamental basis in considerations of logic (neither formal, transcendental, nor symbolic) and his philosophical ideas are thereby expressed by and large in the ordinary language. His "epistemological sketches," for example, track the history, practice and purpose of the positive sciences with famous candor. They include both descriptive and prescriptive features, sometimes combining these motivations in key regulative principles such as the "economy of thought" and the "complete parallelism of the physical and the psychical."

It will be argued that these principles, and indeed Mach's philosophical project as a whole, is held together, albeit loosely, and that his standpoint is best expressed, through the many roles played by his doctrine of elements. Some scholars have been reluctant to allow for or engage in a multi-faceted interpretation of Mach's elements. As a result, they have either focused on a single, technical interpretation of the elements, as in Banks' treatment of their meaning for physics and sense physiology, or, more commonly, have associated Mach's doctrine with one or another standpoint of radical empiricism, i.e. with a *reduction* of the world to "sense data." Still others, like Cohen, who provides an excellent introduction to the philosophical meaning of the elements in his "Physics, Perception, and Philosophy of Science," have seemed to finally give up in the face of Mach's disparate and developing usages, concluding that Mach's is a "phenomemology of an uncommitted sort, still open to several interpretations."[4]

In the end, Cohen cannot help but attribute to Mach certain paradoxical, if not contradictory, beliefs and principles. This thesis aims to demonstrate how these beliefs and principles can peacefully co-exist within a framework of a pluralist philosophy of science, and more specifically, a biological empiricism. One might object that the 'pluralism' involved here is beginning to sound like a synonym for 'anything goes,' and yet half of this investigation will be dedicated to the critical aims of Mach's philosophy of science, in particular his rejection of reductionism, theory fundamentalism, and pseudo-intelligibility. In general, the struggle against these trends and forces waged from a standpoint that values the richness of experience and the transparency of expression is discussed as Mach's own version of 'anti-metaphysics.'[5]

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[4] {{30 Cohen,R.S. 1970; }} p. 151

[5] "Anti-metaphysics" is a loaded slogan advanced by a great number of (very different) historical thinkers and movements. This thesis will not delve into these differences. The goal is to focus on Mach's own justifications for opposing metaphysics (which he famously equated with promoting "enlightenment") as well as on his understanding of what "metaphysics" includes. Ultimately, we find Mach engaging in a flexible yet thoroughgoing critique of both the disproportionate influence of specialized concepts on everyday life, as well as of uncompromising descriptions of a single "real"

The concerns of this type of anti-metaphysics are shared by all pluralist philosophies of science, and Mach's doctrine of elements, whether as an impediment to materialist reduction in psychology or as a "phenomenalist confirmation base" in physics, plays a number of key roles in expressing them.[6] It is precisely the flexibility of the elements that reflects the unique nature of this type of philosophy of science, which is sparse when it comes to formal structures and a priori assumptions, and instead dedicates itself to developing *mutual understanding and collaboration* at the borders of the individual sciences as well as at the borders between science and society. It will thus be the basic thesis of this study that Mach's doctrine of elements is valuable as a conceptual tool where philosophical concerns about science and philosophical concerns about ethics and politics, about *justice,* meet. 'Justice' is understood here broadly, but before we say more about it, it is important to note that this contribution to concerns about justice involves not only the critical components of a pluralist philosophy of science but its constructive aims as well.

It is in the pursuit of these constructive aims that it will become necessary to introduce a number of new figures into our discussion, along with their common standpoint, which we will call 'technological empiricism.' It

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world existing independently of consciousness, couched, for example, in the language of mathematical physics. Both types of criticism express a preference for what Mach called our "customary, sensible world," and insofar as Mach's "anti-metaphysics" thus challenges both fundamentalism and reductionism, it comes very close in meaning to what we are calling "pluralism" in the philosophy of science. The latter term is often preferred in this thesis, since it avoids associations with the more rigid and formalized versions of "anti-metaphysics" that became influential in the decades following Mach's death, and which have a focus and style that is very different from Mach's work.

[6] Ibid, 132

will be argued that there is a division of labor amongst pluralist philosophies of science, and that technological empiricism represents both the conceptual and historical counterpart to Mach's biological empiricism. While the latter is most concerned with the border between physics, psychology, and physiology, the former concentrates on those between physics and economics, and physics and sociology. Although in all cases we find a commitment to 'anti-metaphysics' and thus a preference for claims about experience to those about a 'real world' beyond or behind it, we will find that Mach's work nevertheless tends towards the psychological aspect of that experience, while the others concentrate on physical and technological considerations. This difference is relevant both to epistemological and ethical-political views.[7]

Technological empiricism will be represented in this thesis by the work of Alexander Bogdanov, Otto Neurath and Nancy Cartwright. The former two thinkers were directly and significantly influenced by Mach, and these connections will be discussed. In general, the justification for including their work, as well as their standpoint in this study, is that these represent a sophisticated and essential extension of themes and concerns already present in Mach. The latter is aware of the need of certain sciences to reference a realm of 'independent' objects and their relations, and yet his discussions of these issues often remain unsatisfying, overly tinged with psychology. A division of labor that reserves the advanced philosophical

[7] The latter will be expressed, for example, when we consider, on the one hand, Mach's association with Buddhism, and on the other, the influence of Karl Marx on the technological empiricists.[7]

analysis of this aspect of experience, as well as the *methods of explanation and experimentation* used to investigate it, for a separate group of thinkers allows each to more fully develop their constructive concepts and research agendas. We will see that these concepts include, for Mach, those of familiarity, "sensible ideas" and *plasticity*, and for the others those of technical mastery, "capacities," and *engineering*. We will thus find that Mach's work concentrated on promoting the significance of the 'new' physiological psychology, while Bogdanov, Neurath and Cartwright's constructive interests are best captured by the former's vision of a "tektology," or a study of the arrangement and organization of capacities into machines. We will ultimately find that these constructive concerns lead to a number of diverse paths towards a 'unity of science'- on the one hand, a unanimous call for transparency and interdisciplinary collaboration, and on the other, a slightly more particular and speculative focus on either the sensual or organizational 'whole.'

It is through this combination of a flexible, pluralistic form of anti-metaphysics with the constructive concepts of plasticity and engineering that we will evaluate the contribution of Mach's doctrine of elements (and the standpoints of biological and technological empiricism generally) to the intersection of the philosophy of science with concerns about justice. The final key concept introduced here will be that of a *social democratic philosophy of science*, and we will present this standpoint as the political aspect of Mach et al.'s pluralist philosophy of science. This will include a review of its main commitments, including to freedom of thought, psychological development, economic planning and social solidarity, as well as an account of how these relate to the tenants of either biological or technological empiricism. In general, we will find that a social democratic philosophy of science focuses attention away from a long-dominant worldview built up around mathematical, mechanistic physics, and instead urges us to concentrate on scientific representations of and interventions within the sphere of the organic and the socio-economic sphere.

Furthermore, with respect to justice, we will identify the doctrine of elements with certain ethical virtues, including those of tolerance, sobriety, sympathy and collaboration. The pluralist philosophy of science is one that everywhere favors familiarity over aura and accessibility to the occult. This general emphasis on *candor* is one with ancient epistemological roots in the Greek concept of *sophrosyne*, and often re-appears in the modern German tradition as *Sachlichkeit*. This emphasis, along with that of technological empiricism on organization and *solidarity* will, in the final chapter of this dissertation, help to more firmly establish the historical and conceptual link between social democratic philosophy of science and the movement for socio-economic enlightenment.

This focus on ethics, politics, and the border between philosophy of science and justice, will bring us full circle to Lenin and Planck. Indeed, one of the most interesting and understudied aspects of the anti-Mach polemics of these thinkers is their overtly ethical and political focus. We will thus examine how both critics reveal, as the concern behind their attacks on Mach's metaphysics and epistemology (his 'idealism' and 'positivism') their belief that such views are a source of ethical and political *frivolousness*. In both cases, a stance of metaphysical recognition ("there is a world existing independently of our experience") is argued for as a precondition for the development of ethical or political *resolve*. As such, by studying the rejection of Mach by the "true communist" and the father of "modern physics," as Blackmore puts it, we are able to re-examine the longstanding ethical and political 'opposition' between candor and resolve from the perspective of the philosophy of science at the turn of the 20th Century.[8] More specifically, we are interested in the influence here of one-sided metaphysical and epistemological oppositions framed by 'realists' as an assault on (Machean) 'positivists.' Given space constraints, we will focus on Mach's influence on the public, political side of this debate, i.e. on various aspects of the struggle over 'revisionism' within the socialist movement. (A study of this opposition with respect to private morality and ethical-aesthetic themes, e.g. one opposing Mach's Epicureanism to the aristocratic ethics of a thinker like Nietzsche, could also have been very interesting) In any case, we hope to contribute a new perspective to the ongoing conversation about the nature and future of 'enlightenment,' especially as the quest for popular emancipation.

[8] The supposed tension traces as far back as to Plato's discussion of the 'distinct' nature of courage vs. mere *sophrosyne* in the *Protagoras*, and continues into the 20th Century 'parting of the ways' {{80 Friedman,Michael 2000; }} between *Sachlichkeit* and *Sorge* in the German tradition.

With respect to the structure of the work, Chapter I (The New Philosophy of Science) provides an introduction and overview of the key concepts of Mach's philosophical thought, including the doctrine of the elements and the principle of the "economy of thought." Several provisional interpretations of each of these concepts are considered, and the insights of a variety of Mach scholars, e.g. Banks, Blackmore, Stadler, Cohen, and Musil, are incorporated and evaluated. For the purposes of introduction, the language traditionally applied to the "anti-metaphysical positive paradigm" (Stadler), i.e. 'anti-metaphysics' and 'unity of science' is used to explore Mach's philosophy of science. The latter reveals itself to be directly concerned, on the one hand, with tolerance and transparency, and on the other, with biological themes of adaptation and psychological themes of recognition. The introduction to these concepts, through both secondary interpretations and Mach' s own writings, are meant to provide a groundwork for the subsequent discussion of the variety of roles played by the elements within Mach's 'biological empiricism.'

Chapter II (Empirio-criticism and Materialism) introduces and develops the key features of this standpoint of 'biological empiricism' through an analysis of Lenin's infamous critique of Mach in his *Materialism and Empiriocriticism* (1909). Lenin claims that Mach is a subjective idealist in the tradition of Berkeley (and by extension, a solipsist), and that his concept of neutral elements is a "purely verbal" invention that does nothing to reconcile the (in fact) irreconcilable, permanently opposed philosophical trends of idealism and materialism. We find that Lenin's arguments for materialism (and thus against idealism), particularly those related to mind and brain, are completely misapplied to the case of Mach. Exposing this misguided attack opens up the door for a deeper consideration of Mach's views on the physiological aspect of psychology. We find that Mach was completely committed to the study of the sense organs and the brain in order to "unravel the subjective conditions of a finding." Indeed, these 'findings' included for Mach not only basic sensations but also more advanced instances of thought, behavior, and deliberation.

Ultimately, we find Mach, the alleged disciple of Berkeley, expressing such a strong enthusiasm for what we call 'developmental psycho-physiology' that he seems to himself come suspiciously close to a materialist standpoint. It is here that Mach's doctrine of elements is crucial, for it rejects the reduction of psychology to physics and physiology and promotes a significant and enduring role for sensations and conscious experience in psychological research. Mach is not a materialist but a methodological pluralist, and we review some of his arguments for the role of sensations and conscious experience in the study of human nature, in particular with respect to his early advocacy of what is now called evolutionary psychology, as well as his ideas about the effect of culture on psychological development.

In general, it is neither idealism nor materialism which interest Mach, but rather a thorough investigation into human *plasticity*. This is an idea about which Mach is enthusiastic, believing it to represent Darwin's revolutionary contribution to science alongside Galileo's own in *measurement*. In general, it is Mach's focus on physiological and evolutionary themes, including "adaptation" and the "organic sphere," alongside his methodological pluralism and rejection of reductionism, that lead us to characterize his position as a 'biological empiricism.'

Chapter II has one final task, which is to address Lenin's own, actual position as well as the ethical and political concerns that led him to attack Mach in *Materialism and Empirio-Criticism*. The former investigation allows us to introduce the 'materialism' of Karl Marx, which again blurs the traditional, metaphysical lines, and the latter introduces another of Lenin's rigid oppositions, that of materialism vs. "fideism," a description that he applies equally to medieval theology and to Mach's philosophy. Lenin rejects fideistic frivolousness and associates the capacity for resolve with a stance of metaphysical recognition (one affirming that there exists a "world independent of our experience.") Our preliminary discussion of these issues in Chapter II lay a groundwork for a discussion in Chapter IV of pluralism, positivism, and "revisionism" in the context of the socialist movement at the turn of the 20th Century.

Chapter III (Economy and Elegance) examines the Mach-Planck polemics and introduces the standpoint of technological empiricism. Planck made his first attack at almost the exact time that Lenin published M&EC, and the two share several important characteristics. The main differences are that now the focus in on physics and physical theory, and that Planck is accusing

Mach not of bring an idealist, but rather a 'logical positivist.' The latter charge is alleged to have unacceptable consequences, both epistemologically and ethically, which include, unsurprisingly, solipsism and frivolousness. In addition, with respect to epistemology and physics, Planck suggests that Mach's standpoint is completely averse to theoretical constructs and activities, regarding each as an "unwanted intrusion on the scene." With respect to ethics Planck, like Lenin, claims that a stance of metaphysical recognition is a pre-condition for the cultivation of resolve, and in particular warn that Mach's positivism will "lame leading minds" and stunt creativity amongst physical scientists. These ideas lead us to make a few remarks about the relationship between ethics and metaphysical recognition that will again be relevant in the fourth and final chapter on "(Anti)Metaphysics and Popular Emancipation."

With respect to Planck's characterizations of Mach's attitude towards physical theory, we expose these as misrepresentations. Far from being theory-averse, we find that Mach included in his philosophical writings sophisticated ideas about the theory-ladenness of observation, the role of idealization, abstraction, and hypothesis in physical experiment, and the contribution of abstract mathematical concepts and constructs to physical theory. Where Mach's standpoint does differ from Planck's self-described 'realism' is in its focus on the elements as part of what we will call a 'critical phenomenalism.' This standpoint includes (1) Mach's anti-fundamentalism, (2) his rejection of the mechanistic worldview, (3) his objection to the domination of the scientific disciplines by physics, and (4) in general his preference for the qualitative, rich and abundant elements of the biosphere to the still quite shoddy and too often imperious “element of the universal,” i.e. the theoretical constructs of the specialized sciences.

Mach, while promoting the development of the individual, specialized sciences, at the same time claims that “the perceptions or our present natural senses will undoubtedly remain the basic elements of our mental and physical world…” The purpose of such a claim is articulated most clearly in *Knowledge and Error*, where Mach writes that “my arguments are never aimed against physical working hypotheses, but only against epistemological absurdities.” The latter result from a fundamentalism about theories, and Mach offers in its place the “artificial simplemindedness” associated with a periodic return to the elements. This (in fact quite sophisticated, according to Mach) position keeps the investigator of nature sober, humble, and eager to apply his knowledge to the needs and concerns of the day. It is in this context that Planck’s battle cry for a “unified world picture” seem to Mach “premature and almost comical.”

Indeed, we find that it is not a unified picture that Mach sees as the goal of science but a collection of “instructions” or “recipes” for producing and predicting particular experiences across a spectrum of different types of phenomena. In this way Mach approaches the principles and concerns of a technological empiricism. However, we ultimately find that Mach’s primary interest is not in manipulation but in *recognition*, and it is thus through the category of the “sensible idea” (and not the “capacity”) that his articulates his vision of the reconciliation of observation and theory, sensation and concept. The “sensible idea” is a complex amalgam of sensation, memory, association, reflection, and habit, and it is consistent with Mach’s paradigm of plasticity as well as his understanding of “familiarity” as the goal of scientific knowledge. Where such a standpoint falls short, however, is in its treatment of the alignment of causal powers involved in the construction of technical machines.

And so after reviewing the ways in which Planck’s actual epistemological views on idealization, hypothesis, etc. are in fact quite similar to Mach’s, we look to the work of Cartwright to break a stalemate that had become fixated on the stagnant questions of the existence of an “independent world,” the fundamentality of a “world picture,” the claim of universal determinism, and the source of ethical resolve and scientific creativity. By turning to the question of how all three thinkers interpret the role and meaning of constants in science, we establish the main aspects of what we call Cartwright’s ‘technological empiricism’ as the best middle ground between Mach and Planck. We find that Cartwright’s view shares many concerns with Mach’s critical phemomenalism, and yet her own position, which we call ‘constructive phenomenalism’ includes a realism about both causality and theoretical entities that allows her to more accurately depict contemporary physical and technological practice. Moreover, technological empiricism calls for collaboration in the search for new, interdisciplinary methods, and points out the deliberation involved in the *engineering* of many familiar regularities. As such, solidarity, which is preferable to the individualistic and somewhat fetishistic concept of resolve, becomes its ethical paradigm. By introducing technological empiricism in Chapter III, we have identified the world of capacities alongside the world of elements as the other main focus of a pluralist philosophy of science.

Chapter IV (Anti-Metaphysics and Popular Emancipation) attempts to work out the relevance of the polemics discussed in Chapters II and III for the campaign for socio-economic enlightenment, especially for the internal struggles that took place over the question of the "true elements" of the socialist movement at the beginning of the 20th Century. Once again, a framed opposition orients the discussion, except now it is Lenin's concept of "revisionism" that is the central focus. In terms of exposing the characterization as a misrepresentation, we find that Lenin's opposition of socialist theory to practice is dubious, and that his rejection of pluralism and "free criticism" is extremely precarious.

But in order to get to these conclusions we first need to shed light on the actual positions involved. The influence and contribution of both biological and technological empiricism to the socialist movement is discussed, the former with respect to a pluralist approach to social reform that includes cultural and pedagogical components, and the latter with respect to the technologist's emphasis on planning and solidarity. These contributions are synthesized into the concept of a *social democratic philosophy of science*.

The figures of Alexander Bogdanov and Otto Neurath are (re)introduced here as key links between Mach and European socialism in the first half of the 20th Century. (re-introduced because Bogdanov already appears in Chapter II as the main "Russian Machist" targeted by Lenin in M&EC, and Neurath in Chapter III as the "hero of [Cartwright's] *The Dappled World*.")

Through these discussions it becomes clear that Lenin's charge of revisionism is vague and misguided. The chapter ends with two sections that attempt to survey, within a limited scope, some of the consequences of the one-sided opposition framed by Lenin. The first looks at Lenin's rejection of "free criticism" and, ultimately, his repression of free expression after the Bolsheviks came to power in the October Revolution. We examine criticisms of Lenin's oppressive tactics written by Bertrand Russell and Maxim Gorky, the former widely considered as the other forefather of 20th Century positivism, and the latter an intimate of both Lenin and Bogdanov who for many years sided with the latter's vision of creating a better society through the proliferation of "freedom and culture." The final section evaluates the legacy of an opposition between socialist theory and praxis, like Lenin's, within the intellectual debate on these issues taking place some distance away from the Revolution. As such, following the work of Thomas Uebel, we "revisit" the dispute between Horkheimer and Neurath, between "critical theory" and "physicalist sociology," tracing the path from original agreement into spurious opposition, isolation, and finally, one-sided irrelevance. The hope is to make a suggestion concerning similar, fruitless divisions still prevalent today.

Chapter I

The New Philosophy of Science

1.1 Overview

One of the many aphorisms found in the notebooks of Ernst Mach reads as follows: "Wo mehrere Wege, sollen sie gezeigt werden."[9] ("Wherever more ways exist, they ought to be shown.") In this chapter, we will explore the key concepts that Mach used to articulate his "philosophy of science," concepts that promote a vision of scientific activity consistent with this motto of pluralism and transparency.

In particular, any thorough study of Mach must include a discussion of his neutral monism, his principle of economy, and his use of the historical-critical method for studying the sciences and their progress. It will be suggested that the first of these positions occupies the central role within Mach's overall program. This view is supported by Robert Cohen, who has called the doctrine of neutral elements Mach's "primary entry to his philosophical achievement."[10]

Much has been written on Mach's "monism," his view that the world, in both its physical and psychological aspects, can be addressed in terms of the same basic, neutral elements, most notably "colors, sounds, spaces, times, pressures," etc. In interpreting this idea, we will focus both on Mach's texts

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[9] {{60 Stadler, Friedrich 1988; }}
[10] {{30 Cohen,R.S. 1970; }}p.128

themselves, as well as on the array of excellent secondary sources that have appeared in the last few decades as interest in Mach's thought, as well as that of the 'Vienna Circle,' has undergone a significant renaissance.[11] In this way a rich interpretation of Mach's central positions will begin to emerge, one that challenges certain conventional descriptions of Mach's philosophy as idealist, solipsistic, dogmatically reductionist, or reactionary. These types of charges and their significance will then be more fully treated in Chapters II and III, whose topics will be, respectively, the anti-Mach polemics of Vladimir Lenin and Max Planck.

Those discussions will have two goals. First, to expose two historically influential, though grossly caricatured misrepresentations of Machean "positivism," and second, to develop a more accurate picture of Mach's actual thought, which we will eventually call his *biological empiricism*. For the purposes of this introductory chapter, however, we will approach Mach's ideas in a more conventional language, the language of the philosophical tradition with which he is most often identified.

Friedrich Stadler has aptly dubbed this tradition the "anti-metaphysical, positive paradigm," and we can briefly point out the fact that Mach's thought occupies a unique position between Kant's transcendental philosophy and certain neo-Kantian versions of logical positivism. Mach, like Kant, surely sought to "limit knowledge," and like Carnap

[11] {{58 Stadler,Friedrich 2001;34 p.117 Banks,Erik C. 2003; p.15 }}

we can say that one of his aims was to “build up” scientific knowledge from the sole basis of experience. At the same time, however, Mach completely rejected the former’s concept of the “noumenal,” the “thing-in-itself,” and the logical formalism of the latter’s work seems alien to Mach’s more practical, biological, and historical investigations. Finally, Mach too offered an account of the foundations of scientific knowledge, but it was, as we will see, one based on theoretical economy, provisional description, and perpetual verification.

More important than these types of comparisons, however, will be our attempt to provisionally map out Mach’s understanding of the two conceptual pillars of modern European positivism, namely its “anti-metaphysics” and its campaign for the “unity of science.” We will see that Mach’s strong commitment to the empirical control of theoretical constructs is crucial with respect to his vision of both of these projects, and that his doctrine of elements is meant to play a key role here, offering not a dogmatic *reduction* to colors, tones, pressures, etc. but rather the occasion for tolerant and collaborative *translation*. With ‘translation,’ we will hope to broadly express *both* Mach’s methodological pluralism and his commitment to overcoming falsely rigid boundaries, be they between the scientific disciplines, ego and world, mind and body, or within the human community.

In general, this chapter will seek to provisionally cast Mach’s “new philosophy of science,” with its rejection of absolutism and pseudo-necessity, and its commitments to sobriety, candor, and social sympathy, as a philosophy of enlightenment with special relevance at the borders of epistemology and justice.[12] This claim will then be filled out in the remaining chapters, at first by exchanging the general concepts of anti-metaphysics and translation for the specific features of Mach's biological empiricism. Once this has been achieved, we will supplement Mach's position by laying out the main features of the *technological empiricism* that is shown to be its natural counterpart, both historically and conceptually. These two standpoints form the basis of what we will call the pluralist philosophy of science.

By the end of this chapter, however, it need only be clear that Mach's was a vision of a science "deeply rooted in the life of humanity," an imperfect, humble, and helpful tool,[13] and that his philosophy of science, hardly a one-sided attempt at a foundationalist epistemology of "the given," was meant rather as a critical and pedagogical check on all theoretical excess.[14] In a world rife with zealous claims to absolute truth and mechanistic necessity,

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[12] The relevant conception of "enlightenment" will hopefully become clear throughout the remainder of this investigation. For the time being, we note that it is meant not as a reference to a specific historical time period, but rather to characterize a certain intellectual, political, and spiritual attitude. Mach's philosophy of science is characterized as "new" based on comments he made in an 1882 lecture entitled "The Economical Nature of Physical Inquiry" in which he calls on science to engage in "a careful study of its character," to allow the "*new* tasks" faced by researchers to dictate a scientific self-understanding beyond the reductionist, mechanistic view that had prevailed for well over a century. {{39 Mach,Ernst 1898; }}

[13] {{5 Mach,Ernst 1960; }}

[14] see for example *Knowledge and Error* {{2 Mach,Ernst 1976; p.12}} where the significance of the "resolution into elememts" is attributed to its ability to overcome "sham philosophical problems" and not as a necessary starting point for, for example, "physics and chemistry which may face quite different problems or different aspects of the same question." Nevertheless, Mach adds that in the end "nothing can become the object of experience or science unless it can someway enter consciousness," and so the doctrine of elements is meant at least as a "negative rule for scientific research." Relevant here as well will be Mach's concept of achieving an "artificial simplemindedness," one which encounters the phenomena *both* relatively free from prejudice *and* with access to the theoretical successes of the past. It is thus that Mach characterizes the doctrine of elements as actually rather sophisticated and requiring an already "fairly high level of thought."

Mach's sobering call for a determined agnosticism served as a beacon of tolerance for many young thinkers at the turn of the century. Mach, like Voltaire, was committed to combating all of those dogmas and ideologies that allow human beings to plague one another with references to the unknowable. It is thus no wonder that Mach was such an ardent admirer of the author of *Candide*, nor is it surprising that Richard von Mises described Mach as "the most influential and, for our times, the most characteristic enlightenment philosopher."[15]

1.2 Provisionally Relevant Biographical Data

Much is known about the life of Ernst Mach. What is included in this section is included not based on any grand design, but merely to provide some contextualization for the ideas and arguments that will follow. No attempt will be made to reduce Mach's thought to his cultural-historical experience, however it does not seem at all prudent to ignore the broad features of that experience.

Mach was born in Moravia in 1838. He was educated for a time at home by his father, and subsequently attended the Piaristen Gymnasium in Kremsier and studied physics at the University of Vienna. Most commentators on Mach are quick to cite the liberal and open-minded spirit of both his home and his "nation" throughout much of his life. Of the former,

[15] Von Mises, 6, in {{30 Cohen,R.S. 1970; }}

Stadler cites the “liberal mentality of his family,” and Blueh mentions Mach’s “upbringing in a liberal and humane” milieu.[16]

Of the latter, it is important to realize that Mach was ten at the time that the nationalist revolutions of 1848 swept Central Europe. And although the Hungarian movement for independence from the Hapsburg monarchy failed, it brought in its wake the abolition of serfdom and the increasing recognition of the linguistic identity and self-determination of the various ethnic groups which composed the Austro-Hungarian empire.[17] Szasz characterizes the period between 1848 and the First World War in Central Europe as one of “widespread belief in the stability and security of the government and the state, coupled with a belief that forces promoting slow but steady changes towards better social conditions were constantly at work.” It was furthermore, he claims, a time of “very encouraging growth in the arts and the sciences.”[18]

Mach was no passive observer to these developments. While his epistemological and scientific efforts and achievements will be addressed in the subsequent sections, it is instructive to cite here his strong views and significant deeds with respect to social welfare, and in particular to popular education. Throughout his life, Mach was a “promoter of general education” and according to Stadler, “his commitment to social and educational reform,

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[16] {{30 Cohen,R.S. 1970; }}
[17] Szasz, ed. vi. in {{8 Mach,Ernst 1959; }}
[18] Ibid. vii. This description is undoubtedly a gross simplification of a dynamic period. Szasz himself attributes this sort of view primarily to the „middle, upper, and still higher classes of this society.” For more detailed treatments of the Austrio-Hungarian empire in the second half of the 19th Century, see {{21 Luft, David S. 1980; }} esp. 9-13, or {{81 Schorske,Carl E. 1979; }}

adult education, the women's movement and pacifism must figure as pioneering even today."[19]

Two anecdotes from Mach's life illustrate this claim especially well. On account of his distinguished work in the sciences, upon retirement Mach was made a member of the Austrian House of Peers, the *Herrenhaus*. Although Mach, in typical fashion, did not accept the honorary title of nobility that accompanied the appointment, he did exercise his right to vote on legislation at least twice. Despite the severe physical impairments that resulted from the stroke which he suffered in 1897 (the condition which had in fact forced his retirement) Mach ordered an ambulance to shuttle him to the Parliament once in 1901 so that he could vote in favor of the nine hour working day, and again in 1907 in the name of the universal franchise.[20] Mach's last will and testament, written in 1899, also provides insight into his character and social commitments. Mach left instructions that his funeral was to cost "as little as possible," and that out of his savings fifty gulden each were to be donated to the Vienna Association of Adult Education and the Worker's Paper.[21]

It is in this context that we must introduce the figure of Josef Popper-Lynkeus if we are going to achieve an adequate understanding of Mach. Popper-Lynkeus was a scientist, inventor, ethical thinker, and social reformer, as well as one of Mach's closest friends. He was deeply admired by Neurath and Einstein among many others, and was determined in his work to help

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[19] {{58 Stadler,Friedrich 2001; }} p. 123
[20] Ibid. p. 120
[21] Ibid. p. 120

solve the "social question" of poverty. In his books, Popper-Lynkeus combined a pragmatic and comprehensive approach to utilitarian social planning with an unwavering commitment to the inviolable dignity of every human being. These characteristics can be seen in the titles of two of his major works, "Universal Alimentation Service" and "The Individual and the Value of Human Life."

Mach and Popper-Lynkeus were of a common opinion when it came to many of these and other issues. Otto Blueh puts it this way: "It was this constant human and social interest which gave motivation to the whole of Mach's activity, the understanding that he shared with his friend Popper-Lynkeus, of placing modest expectations on the moral integrity of the individual man, but of expecting everything for human society from the establishment of workable and just institutions."[22] Popper-Lynkeus also possessed a great sympathy for Mach's epistemological view and its implications, and we may foreshadow a bit by quoting his assessment of the spirit of Mach's ideas: "Philosophy must not go beyond experience. The rest is silence. 'Learning to tolerate incomplete world-views' is how Mach once explained it to me very fittingly. One could also put it like this: shut up and go on living."[23]

Politically, Mach's epistemology was actually the centerpiece of a debate throughout central Europe and Russia with respect to the fate of

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[22] Blueh, 20 in {{30 Cohen,R.S. 1970; }}
[23] {{58 Stadler,Friedrich 2001; }}

Marxism and its philosophical doctrine of materialism. While many of the historical and some of the political details of the debate unfortunately lie outside of the scope of this investigation, the philosophical aspect will actually be of great concern, for Lenin himself was one of the most significant opponents to Mach's epistemology, laying out his arguments in the famous *Materialism and Empirio-Criticism*. These arguments will be discussed in Chapter II. In terms of the political response, suffice here to note that in contrast to Lenin, many leading Austro-Marxists, among them Otto Bauer and Friedrich Adler, were great admirers of Mach's, the former describing Mach's historical-critical approach as essential for "the socio-economic explanation of scientific development," and the latter concluding that "Mach's is the conception of nature which corresponds to Marx's conception of history."[24]

If space and theme permitted, it would be quite interesting to discuss Mach's influence on and participation in the broader cultural life of fin-de-siecle Vienna. One finds that his famous statement from the *Analysis of Sensations* that the "ego cannot be saved" was adopted as a motto by the poets of the "Jung Wien" literary circle, that the great philosopher-novelist Robert Musil wrote his doctoral dissertation on Mach's epistemology, and that many of Mach's ideas resonated with those of the great satirist Karl Kraus and the architect Adolf Loos.[25] We mention these connections in passing if only to allude to the atmosphere of inter-disciplinary communication and

[24] Ibid. 136
[25] Ibid. 130

mutual influence in which Mach lived and worked. We will shortly see that it was the respect for and commitment to this type of translation and understanding between the individual arts and sciences that played such a large role in motivating Mach's thought.

One should also mention the importance of the pedagogical reforms that characterized Mach's age. Both Banks and Stadler discuss the influence of the Exner-Bonitz reforms of the 1850's on Mach, and in particular the pedagogical theories of Johann Herbart, including his views on the economy of learning, seem to have had a great effect on Mach's view of the nature and purpose of school education. Some of these views include his wish to "cut down considerably the number of school hours and the amount of work done outside the school," especially in the name of preserving "vital energy" and "sound powerful judgment," and we will later look at Mach's educational theories and activities in greater detail.

Finally, with respect to the scientific context that Mach encountered as a young experimenter and theorist, many of the key issues will emerge as we begin to discuss his core philosophical views. In general, the mechanistic world conception, which had dominated physical thinking for so long, was beginning to give way under the pressure of new discoveries. Moreover, science in general was provoking more and more doubt and skepticism, with attacks aimed directly at the core concepts of its world picture, a situation so passionately described some years later by the French philosopher Abel Rey in his *Physical Theory According to Contemporary Physicists (1907)*. These issues will become more meaningful as we now move on to examine Mach's doctrine of elements.

1.3 Introduction to the Elements

Mach famously claimed that the sole task of science is to neatly and succinctly describe "the connections between the elements."[26] On the one hand, this assertion is derived from Mach's "principle of economy," his idea that science is a tool for saving mental energy and efficiently communicating acquired stores of knowledge about the relations between phenomena. This view is supposed to suggest a humble agnosticism on the part of the investigator of nature with respect to the "causes of the data," an attitude presumably in accordance with Newton's *hypothesis non fingo*.[27] This principle, primarily as it appears in Mach's "Science of Mechanics" as well as in "The Economical Nature of Physical Inquiry," will be the topic of a subsequent section. In Chapter III, moreover, we will examine the concerns of the principle's most significant opponent, the eminent German physicist Max Planck.

However, before we interpret the claim about the *connections between* elements, we will first ask what 'elements' in fact are according to Mach. This order of approach is not the only one possible.[28] However, unless we are

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[26] {{8 Mach,Ernst 1959; }} p. 14
[27] {{5 Mach,Ernst 1960; }} and {{57 Musil,Robert 1982; }} p.32
[28] When Robert Musil, the great Austrian philosophical novelist, wrote his doctoral dissertation "On Mach's Theories (1908)," he began with an account of "The Cognitive-Psychological and Economic

clear about the nature and function of Mach's 'reduction to the elements,' his accounts of science generally are likely to appear as one-sided skepticism.[29]

So what are the "elements?" Mach's most well-known and comprehensive discussion of this question occurs in the introduction to his *Analysis of Sensations*, written in 1897, and suggestively entitled "Anti-metaphysics." The introduction asks the question of how scientific knowledge is able to make sense of and bring order to the flux of experience with which we are continually faced.[30] This is the point of departure into the doctrine of elements that Mach takes in the second section of the introduction.[31]

In accounting for the flux of experience, Mach begins with some examples of the contents that make it up. He writes, "colors, sounds, temperatures, pressures, spaces, times, and so forth, are connected with one another in manifold ways; and with them are associated dispositions of minds, feelings, and volition."[32] These are examples then of what Mach labels "elements." Mach then goes on to give an account of how out of this "fabric" of elements, we arrive at the common sense notions both of "bodies" and of

Approach," then moved on to Mach on mechanism and causality, and only dealt explicitly with the "Theory of Elements" in the fifth and final chapter.{{57 Musil,Robert 1982; }}

[29] It is instructive to note the outcome of Musil's analysis, which is fixated upon Mach's denial of "natural necessity."

[30] Compare with the original, working title of Carnap's *Aufbau*, "Vom Chaos zum Wirklichkeit" ("From Chaos to Reality")

[31] Before we begin to reconstruct his position, however, it is worth noting that the *first* section of the introduction is concerned with an apparently distinct matter, namely the *limitations of physics*, i.e. the inability of that discipline to "exhaust all the subject matter" of the "*larger* collective body of knowledge."{{8 Mach,Ernst 1959; }} We will later see how these topics are in fact deeply related for Mach.

[32] {{8 Mach,Ernst 1959; }} p. 2

selves, or “egos.” This account becomes a theme of the introduction and is formulated several times in varying manners.

With respect to “bodies,” Mach cites that amidst the flux of experience, “relatively greater permanency is exhibited, first, by certain complexes of colors, sounds, pressures, and so forth, functionally connected in time and space.”[33] These complexes, in virtue of their relative permanence, are called “bodies,” and their ability to endure through certain changes, for example by remaining “my table” despite a cracked surface or “my friend” despite an angry mood, draws us into a more intimate relation with them and “impels us to the partly instinctive, partly voluntary and conscious economy of mental presentation and designation, as expressed in ordinary thought and speech.” In other words, they receive “a single name.”[34] Despite this unifying designation, however, Mach is quick to remind us that “absolutely permanent such complexes are not.” (One must delay the impulse to abandon Mach as a simple reincarnation of either Berkeley or Hume. These issues will be discussed.)

The situation is, according to Mach, quite similar with respect to our common sense notion of the “I” or the “ego.” A relatively fixed “complex of memories, moods, and feelings, joined to a particular body (the human body),” the ultimate groundwork of this construct is “its continuity,” or in other words “the many thoughts and plans of yesterday that are continued

[33] Ibid. p. 2
[34] Ibid. p. 3

today…and the little habits that are unconsciously and involuntarily kept up for long periods of time."[35] The fact that the ego is at the same time finite and undergoing constant change is repeated several times by Mach, all leading up to his famous declaration that the "ego must be given up."[36] He cites that "that which we dread in death, the annihilation of our permanency, actually occurs in life in abundant measure," and repeatedly reminds us that "the ego is not a definite, unalterable, sharply-bounded unity."[37] Mach reflects on the many philosophical attempts to derive the "unity of consciousness" from the necessity of an 'I' corresponding to any and all psychic content, but he qualifies this apparently decisive result by reminding us of the "many different degrees" and directions of focus that the ego-consciousness may assume.

The provisional conclusions of these analyses, repeated throughout Mach's presentation, are that "common elements make up all the different complexes," and that "there is nothing apart from the combinations of elements."[38] Drawing from Mach's own text, we will now offer a preliminary account of the significance and consequences of this doctrine of elements.

As far as the negative conclusion of Mach's doctrine is concerned, that "there is nothing apart from the combinations of elements," this is clearly meant as an attack upon the prevalent philosophical notion of the "thing-in-itself." Mach pursues this consequence eagerly. He admits sympathetically that the relevant permanence of "bodies," the fact that a complex may endure

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[35] Ibid. p.3
[36] Ibid. p.24 More literally, "the ego cannot be saved"
[37] Ibid. p. 6, 24
[38] Ibid. p. 5

the individual removal "of any constituent part without destroying the capacity of the image to stand for the totality and to be recognized again," does at times seem to suggest that it should be possible to "subtract *all* the parts and to have something still remaining." However, he quickly objects that the resulting philosophical notion of a "thing-in-itself," of a "substance" existing 'behind' the phenomena, although at first impressive, is "subsequently recognized as monstrous."[39]

Mach fills out this charge with an assault on several forms of dualism. There is no real, *scientific* "antithesis between ego and world, between sensation (appearance) and thing" writes Mach, regardless of the practical utility and habitual force of such oppositions. Mach defends his claim through a series of examples meant to make us rethink the sharp boundaries between (1) the human mind, (2) the human body, and (3) 'physical objects' in the 'external world.' Neatly represented as complexes αβγ, KLM, and ABC, respectively, Mach probes our ordinary tendencies to either oppose the complex αβγ-KLM as ego with the external, "physical" object ABC, or to sometimes view αβγ alone as ego, and count KLM as included with ABC in "the world of physical objects."[40]

Mach challenges these habitual tendencies at their alleged boundaries. He cites the ways in which αβγ and ABC often directly affect one another ("as, for example, when powerful ideas burst forth into acts, or when our

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[39] Ibid. p. 6
[40] Ibid. p. 9

environment induces noticeable changes in our bodies") and he discusses at length the ways in which KLM significantly determines the other two complex types: "A cube when seen close at hand, looks large; when seen at a distance, small; its appearance to the right eye differs from its appearance to the left; sometimes it appears double; with eyes closed it is invisible."[41]

These reflections bear a striking resemblance to those that occupied Descartes in his first meditation, except that for Mach the above experiences are neither a worry nor an obstacle, and certainly not a series of "sensory illusions" meant to be overcome by "reason." Mach explicitly states that to speak in these cases, (or, for example, of that of a pencil seen as crooked in water) "of an 'appearance' [as opposed to 'reality'] may have a practical meaning, but cannot have a scientific meaning."[42] The only thing one can legitimately say is that under different circumstances, we are confronted with "facts which present us with different combinations of the elements."[43] Indeed, perhaps with Descartes actually in mind, Mach next states that "the question whether the world is real or whether we merely dream it, is also devoid of all scientific meaning."[44]

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[41] Ibid. p. 8
[42] Ibid. p. 11
[43] see also *Knowledge and Error* {{2 Mach,Ernst 1976; }} p.7 "What in ordinary thought leads to the opposition between illusion and reality, between appearance and object, is the confusion between findings under the most various conditions with findings under very definite and specific conditions."
[44] Compare with Schopenhauer: "Life and dreams are leaves of one and the same book. The systematic reading is real life, but when the actual reading hour (the day) has come to an end, and we have the period of recreation, we often continue idly to thumb over the leaves, and turn to a page here and there without method or connection. We sometimes turn up a page we have already read, at others one still unknown to us, but always from the same book." {{82 Schopenhauer,Arthur 1966; }} As has been noted elsewhere, Mach, who at times references Schopenhauer, shares much in common with the latter philosophically. We will continue to cite such overlap when it seems relevant.

If we now ask about Mach's intentions, several preliminary answers come to mind. With his doctrine of elements, Mach is interested in (1) disturbing the traditional manner in which individuals think about and confront the "world," (2) combating the excesses of all types of metaphysical realism, and (3) promoting the unity and cooperation of the scientific disciplines (quite a reasonable agenda for a critical epistemology). We will now briefly treat each of these on its own.

Mach's doctrine, and indeed his thought as a whole, bears a complex relationship to the 'average,' to the intellectual tendencies and habitual modes of everyday life. On the one hand, Mach has a great respect for the "naïve realism" with which we ordinarily approach the world, which has "arisen in the process of immeasurable time without the intentional assistance of man," and which is accordingly "a product of nature, and preserved by nature."[45] Compared to this stable evolutionary adaptation, Mach observes, "everything that philosophy has accomplished…is but an insignificant and ephemeral product of art."

On the other hand, Mach, like any good theoretical philosopher, also wishes to challenge habitual patterns of thought and behavior. He reflects that "the task which we have set ourselves is simply to show why and for what purpose we hold that [ordinary] standpoint during most of our lives, and why and for what purpose we are provisionally obliged to abandon it."[46]

[45] {{8 Mach,Ernst 1959; }} p. 37
[46] Ibid. p. 37

Throughout his comments Mach is critical of “our habit of always following the same path,” and our “habitual stereotyped conceptions,” which “tend greatly to confuse the field of survey.”[47] Mach contrasts the “average view” and its “high practical importance” with the “special cases in which practical ends are not concerned, but where knowledge is an end in itself.” In these cases, Mach concludes, the practical forms of delimitation “may prove to be insufficient, obtrusive, and untenable.”[48] In particular, we will find that it is not the veracity of the ordinary standpoint that Mach attacks, as would, for example, a thinker who claims that the ‘real world’ lies behind the mere appearances of sensual experience. Rather, it is some of the rigid *boundaries* of the naïve standpoint that Mach believes to give way in the presence of philosophical reflection.

In general, Mach is concerned with the role that theoretical philosophy can play not only in epistemology but also with respect to moderating practical conduct. Robert Cohen has called this Mach’s “hardly noticed, though conspicuous…impersonal, serene philosophy.”[49] Revolving around the claim that the “ego cannot be saved,” Mach sees himself as proposing a “freer and more enlightened view of life, which will preclude the disregard of

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[47] Ibid. pp. 15, 17
[48] Ibid. p. 23
[49] {{30 Cohen,R.S. 1970; }}, p. 127 Unfortunately for Mach, Cohen sternly concludes that his ethical vision is “timid, retrogressive, and metaphysical,” representing a will-negating morality that denies both death *and life*, offering only the mystical escape into the “fluid of ocean and womb.” p.156 This thesis cannot go deeply into the question of individual morality, but subsequent sections will hopefully speak against Cohen’s hasty and exaggerated judgments.

other egos and the overestimation of our own."[50] The nature of the connection between Mach's (anti)metaphysics and these types of ethical claims will hopefully become clearer as our discussion continues.

With respect to Mach's interest in combating metaphysical realism, we have already encountered his general critique of the notion of a "thing-in-itself," which he considers nonsensical and potentially dangerous. Mach freely admits that the worldview of everyday life often produces "presentations and concepts" which are "less exact" than scientific knowledge demands. However, they have the simultaneous advantage of being "preserved from the monstrosities which easily result from a one-sided and impassioned pursuit of a scientific or philosophical point of view."[51] Within the context of an introduction entitled "anti-metaphysics," such an advantage has added significance.

Finally, the unification of the sciences is a fundamental positive goal of Mach's work. He begins his introduction to the *Analysis of Sensations* not only with a note on the limitations of physics, but also with a promise to use the remaining portion of the text to "illustrate the relation" between physics and the physiology of the senses.[52] Mach thus alternates his focus back and forth from the alleged *metaphysical* divide between matter and spirit, body and soul, etc. to the "great gulf in research" existing between the various positive sciences. By exposing the illusory nature of the former, he hopes to

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[50] {{8 Mach,Ernst 1959; }} p. 25
[51] Ibid. p. 33
[52] Ibid. p. 1

promote the bridging of the latter, for he believes that "ultimately all must form a whole."[53]

Mach believes that his doctrine of elements is most capable of bringing together the individual disciplines, and of thus anticipating "what future research will do for the connection of the physical and the psychical."[54] It achieves this by demonstrating that between domains, it is "not the subject matter, but the direction of our investigation," that differs.[55] Mach thus reduces a problem of metaphysical domain to one of methodological focus. The physicist, *qua* physicist, can and will continue to use the notion of independent "bodies" in a productive way that achieves "a real facilitation of view," just as we in our practical lives will often hold on to the notion of a rigid and independent ego. However, upon deeper reflection, all of us will recall that each mode of inquiry or conduct is addressing itself to different aspects of one and the same "infinitely rich and manifold reality."[56] The oneness of the world proposed by the system of elements highlights the common basis of experience (and thus the pervasive possibility of communication) at the foundation of all scientific inquiry.

Before moving on to a more detailed analysis of Mach's "achievement," it is important to note that Mach repeatedly describes his doctrine (as he does

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[53] Ibid. p. 18

[54] Ibid. p. 26 Scholars often use the term "neutral monism," one coined by Bertrand Russell in 1914, to describe Mach's doctrine of elements. Mach did indeed come to refer to his elements as "neutral," i.e. as only taking on a psychical or physical nature depending on the standpoint from which they are considered. The metaphysical baggage and tenability of such a view (sometimes associated with a 'double aspect theory') will be addressed in the next section.

[55] Ibid. p. 18

[56] {{5 Mach,Ernst 1960; }}

all doctrines and points of view) as provisional. "For us," he writes, "colors, sounds, spaces, times…are provisionally the ultimate elements whose given connection it is our business to investigate."[57] Likewise, when he touts the advantages of an elemental monism over "various atomic and monadistic theories" for solving the problem of mutual adaptation between physics and psychology, he adds that his solution has no "pretension to being a philosophy for all eternity," and that "it is also ever ready, upon subsequent extensions of the field of experience, to give way before a better conception."[58]

1.3.2 'Metaphysical' Elements?

Having completed this sketch of Mach's doctrine of elements, we will now pursue several interpretations of its significance in greater depth. What does it mean for Mach to claim that everything is composed of "common elements," and that these elements consist of entities such as colors, sounds, temperatures, pressures, spaces, and times? One possible interpretation is the 'metaphysical' one. According to this view, Mach is making a strong claim about what ultimately exists, what makes up the building blocks of reality, and is submitting his elements as the provisionally best candidate.

Scholars are divided on their treatment of Mach as a metaphysician. This seems reasonable, for as noted above, Mach was one his era's most

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[57] {{8 Mach,Ernst 1959; }} 30

[58] Ibid. p. 32- It would be interesting to consider the works of Cartwright, Dupré, and others as contemporary adherents of Mach's general standpoint, however adapted to the micro-structural revolutions in physics, chemistry, and biology that took place in the 20th Century

outspoken proponents of an anti-metaphysical program. Moreover, with the exception of Berkeley's metaphysics, which rest upon theological foundations, it is quite difficult to ascribe "metaphysical" convictions to a position that focuses so intently on experience.[59] Cohen admits that there is a received view of Mach's position that might fit the description, a "simple cliché" declaring that "the world consists of sensations, for the scientist and for the common man," but this sounds like an epistemological claim.[60] Cohen himself, moreover, prefers to deal with Mach as a critical epistemologist and reformer of science, and so we turn to Banks for an extended presentation of Mach as interested in "getting at the nature of the elements" themselves, and not just "the way one talked about them."[61]

We will use Banks' excellent discussion, on the one hand, to introduce the most speculative side of Mach's philosophy, one that was strongly influenced by Gustav Fechner and his reflections on the "inner side of nature."[62] On the other hand, since it is not Mach's metaphysics but his anti-metaphysics that most interests us (and since Mach was often in conflict with himself about nearing the "metaphysical abyss, where there is no experiential

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[59] Indeed, this is how Mach responds to those commentators who identify his standpoint with Berkeley's (or Kant's) noting that Berkeley "regards the 'elements' as conditioned by an unknown cause external to them (God)," whereas Kant, "in order to appear as a sober realist," bracketed this unknown and invents the "thing-in-itself." Mach regards his view, for which "the dependence of the elements on one another is theoretically and practically all that is required," as distinct from both. {{8 Mach,Ernst 1959; }} p. 362n

[60] {{30 Cohen,R.S. 1970; }}p. 126

[61] {{34 Banks,Erik C. 2003; }}p.11

[62] for a thorough discussion of Fechner's philosophical standpoint, see "Nature From Within: Gustav Fechner and His Psychophysical Worldview" {{37 Heidelberger, Michael 2004; }}

foundation"[63]) we will show how Mach's 'metaphysical' monism can be interpreted as a critical assault on traditional metaphysics, and thus as the abandonment of all such speculations in favor of a rich and common experience. We will finally show how in light of this assault, Mach's own speculation can safely re-emerge both in the form of the constructive promotion of psycho-physiological research and as an addition to his ethical worldview.

Banks situates his presentation in its historical context, citing some of the attempts of Mach's friends and commentators to grapple with the question of what it would mean for 'reality itself' to be composed of elements that one normally understands as mere sensations. In 1893, Paul Carus wrote about a meeting in which he had expressed to Mach his conception of "sensation" as an "abstract term presenting one feature of reality only and excluding other features," a view to which Mach objected, "saying that he understands by sensation reality itself." Banks also cites Kleinpeter, who wrote of Mach that the latter possessed a strange sort of "realism," one distinct both from the idealism of Berkeley and from traditional philosophical realism, one that "saw…in sensations the material of the actual world."[64]

How are these ideas to be interpreted? We first of all recall from our discussion of the *Analysis of Sensations* that for Mach, the "world" can be seen as a perpetual flux of elements. Cohen reports that from Mach's point of

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[63] {{34 Banks,Erik C. 2003; }} p. 7
[64] {{34 Banks,Erik C. 2003; }} p.107

view on the nature of observables "all is flux," and Mach himself writes in *Knowledge and Error* that "everything exists in a primordial cosmic stream." At the same time, however, we have also encountered Mach's attention to 'unity,' his position that "all must form a whole." Indeed, Mach often writes about the "interconnection of the whole world," and Banks describes Mach as beginning always with the "unlimited All." And so one reaches the central question of a metaphysical interpretation of Mach's doctrine of elements: What does it mean to speak of an interconnected whole made up of fluxing, sensation-like elements? There are two initial approaches to answering this question, which correspond well to Mach's treatment of the notions of "ego" and "body" described above This may seem reasonable, for one may regard rigid notions of self and world, of subject and object, as the main obstacles to a consistent metaphysical monism.[65]

With respect to the fate of the ego, Banks cites Mach's attempt to provide in his philosophy a "biography of human experience," one paying particular attention to the earliest stages of that story. As part of his epistemology, Mach is keen on achieving a "naïve view" of the world that avoids all distinctions and assumptions that might be mere by-products of the demands of practical life, scientific postulate, or cultural influence, and he thus looks to early childhood as a source of a purer experience.[66] Indeed,

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[65] see for example, *Knowledge and Error*, {{2 Mach,Ernst 1976; }} p.12 "for our purpose of eliminating philosophical sham problems reduction to these elements seems the best way." Mach had previously defined those sham problems as the "unfathomable thing" and the "equally unexplorable ego."

[66] {{34 Banks,Erik C. 2003; }} p.111

there are sections in the *Science of Mechanics* (to which we will return in our discussion of the "economy of thought") in which Mach speaks of our pre-verbal, infantile experience as offering a "vast treasure store" of instinctual knowledge of the world, knowledge "free from subjectivity" and thus of "a high value," a value which is only later articulated, provisionally, in thought and principle.[67]

Banks cites several of Mach's letters in which he writes of the importance of analyzing the experience of the child for our understanding of the world. In a letter to Gabriele Rabel he writes, "we arrive at it [the kernel of Mach's exposition] by observing children and by putting ourselves back into our early childhoods, as we were just learning to differentiate our bodies from the environment," and to Friedrich Adler, "The point of my natural world view when I wrote the *Analysis of Sensations* was more primitive. I placed myself artificially back in the position of a child, who had just begun to separate his body from the environment."[68]

In both statements Mach directs us back to an undifferentiated *origin* of experience, a primordial soup consisting of the now familiar world elements. Mach is well aware that in time a relatively fixed ego emerges with respect to the phenomena, and yet he is presenting this step as a derivative one, a "simple primitive inference" of immense practical value, and yet also capable of supporting the subsequent, dualistic philosophical excess of an absolute,

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[67] *The Science of Mechanics* {{5 Mach,Ernst 1960; }}One could perhaps make a fruitful comparison between Mach's account of this process and Plato's doctrine of recollection.
[68] {{34 Banks,Erik C. 2003; }} p.110

rigid ego posited at an insurmountable distance from the "physical world."[69] This is precisely the conception which Mach believes must be overcome, along with the metaphysical and epistemological paradoxes associated with it, including all notions of personal immortality.

Thus Mach associates his statement that "the ego cannot be saved" with the hope that "the hard dividing wall between man and the world will gradually disappear," or as he puts it in *Knowledge and Error*: "if the ego is not a monad isolated from the rest of the world but a part of it, in the midst of a cosmic stream from which it has emerged and into which it is ready to dissolve back again, then we shall no longer be inclined to regard the world as an unknowable something. We are then close enough to ourselves and in sufficient affinity to other parts of the world to hope for real knowledge."[70] Mach associates these epistemological insights of his monism, which are based on the primacy of experience and the goal of *familiarity*, with related ethical advances, namely the hope that "human beings will not only confront each other, but also the entire organic and so-called lifeless world, with less selfishness and with livelier sympathy."[71] It is most likely on account of such ideas that Mach has been described as the "Buddha of science."[72]

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[69] Ibid. p.110
[70] *Knowledge and Error* {{2 Mach,Ernst 1976; }} p.361
[71] *The Economical Nature of Physical Inquiry*, in {{39 Mach,Ernst 1898; }} p.213
[72] see *Ernst Mach, The Scientist as a Buddhist* by Ursula Baatz in {{32 Blackmore, John T. 1992; }} It is clear that the consequences of Mach's monism for his conception of the ego is open to criticism from an ethical point of view. But again, for now we must leave open the question of whether it is 'will-negating,' whether Cohen is right in asserting that although Mach leaves no room for death, he "does so at the enormous cost of denying life itself…thus returning humanity to pre-existence or to lifelessness."[72]

Returning now to metaphysics, it seems that even a circumspective biography of human experience, one that recalls early childhood in order to blur the borders of stable memory and rigid identity, never itself goes beyond that experience. So what could it mean for the world 'itself,' i.e. independent of the human mind, to be composed of the Machian elements, elements that once again seem inextricably linked to consciousness and sensation? We are perhaps approaching here upon some fairly dense metaphysical territory, namely the dispute between idealists and materialists over the meaning of "world." More specifically, it is the debate over the question of the dependence of the existence of the world on the existence of an "I," or more precisely, of the first eye.[73]

We will encounter this issue again in Chapter II when we review how Lenin accused Mach of avoiding the question of whether "matter or sensation is primary."[74] In that context, we will argue that Mach's biological empiricism goes beyond such vague and one-sided questions. For now, however, we can take a brief look, with the help of Banks, at how Mach might deal with the question of his metaphysical monism in a more speculative way, in particular

[73] See for example the positions of Schopenhauer and Feuerbach: Schopenhauer: "The existence of this whole world remains forever dependent on that first eye that opened, were it even that of an insect." Feuerbach would object that before man, indeed before all consciousness "nature was an absolutely non-human entity." Schopenhauer readily admits that "animals existed before men, fish before land animals, plants before fish, and the inorganic before the organic," and that consequently, "the original mass had to go through a long series of changes before the first eye could be opened." And yet he still insists that "such an eye necessarily brings about knowledge, for which and in which alone the whole world is, and without which it is not even conceivable."{{82 Schopenhauer,Arthur 1966; }}{{83 Lenin,Vladimir 1964; }}

[74] Materialism and Empiriocriticism {{83 Lenin,Vladimir Ilich 1964; }}

through the concepts of "nonhuman sensations" and even "unobservable elements."[75]

Mach often writes about the elements in a way similar to certain idealists who claim that the world is a 'representation.' Specifically, Mach does claim that all the elements necessarily belong to a "complex" of elements. However, he denies the necessary association of this complex with a stable, knowing ego. It need not be a complex of "a wakeful human ego," Mach writes, for he cites the cases of dreams, ecstasy, and animal consciousness as also consisting of complexes of elements.

Mach pushes his view even further, towards "nonhuman sensations," and indeed beyond even those of animals. Banks points here to Mach's affinity with Fechner and the latter's supposition of the existence of an "inner side" to nature in addition to its "quantitatively described exterior properties."[76] For Mach, following Fechner, this inner side is analogous to sensation, and thus in 1863 when Mach asked at what point we must cease the process of extending the possession of a soul by analogy, first to other men, then to higher animals, then lower, and so on, his answer was "nowhere!"[77] Thus the broad hypothesis of Mach's more speculative metaphysics is that of "sensation in matter," and although Mach speculates that "the psychical life of plants must be very different than that of animals," he nonetheless is

[75] {{34 Banks,Erik C. 2003; }} pp. 6, 8
[76] Ibid. p.5
[77] Ibid. p.5

committed to the view that there is indeed "everywhere an inner side."[78] This "inner side" thus represents the possibility of "observer independent elements," what Banks calls Mach's "world elements," and these are meant to answer our original question of "what it could mean for the world itself…to be composed of elements that seem inextricable linked to consciousness and sensation?"

This then is the briefest possible survey of the "genuine metaphysical reality" that one critic of Mach's supposed him to be advancing.[79] Banks is quick and correct to point out, however, that Mach was not a metaphysician by temperament, that he was indeed displeased with all idle speculation. And so Banks suggests that Mach offered his metaphysical vision primarily as a possible *future finding* of the new physiological psychology that he was so eager to promote throughout his career. In the *Economical Nature of Physical Inquiry*, Mach writes that "Physiology, in a word, will reveal to us the true real elements of the world," and that furthermore the "results that shall spring from the union" of natural science and psychology will "far outstrip those of modern mechanical physics."[80] Banks quotes Mach's letter to Rabel in which he envisions the day in which "the Tunnel between the physical and the psychical is completed through or almost through," thus giving investigators access to "how animals sense," and, according to Banks,

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[78] Ibid. p.6 see also, in the *Science of Mechanics*: "we shall then discover that hunger is not so essentially different from the tendency of sulfuric acid for zinc, and our will not so different from the pressure of a stone as it now appears…" {{5 Mach,Ernst 1960; }} Banks concludes that Mach, insofar as he held "pansychist views" adopted these directly from Fechner {{34 Banks,Erik C. 2003; }}
[79] {{34 Banks,Erik C. 2003; }} p.7
[80] *The Economical Nature of Physical Inquiry*, in {{39 Mach,Ernst 1898; }} p. 212

beyond this into *observer independent elements*, into the interior sensations in matter, the aforementioned "cosmic stream" of world elements in itself.[81]

This transition from metaphysics to positive research is one more in keeping with our interpretation of Mach's standpoint, and Banks himself quotes a letter to Friedrich Adler in which Mach leaves the fate of his speculations in the hands of "healthy biological research," which will reveal whether his "hypothesis has any worth."[82] There will be much more to say on Mach's relationship to and understanding of psycho-physiology (and not just its ultimate aim) in the next chapter. For now, it is instructive to remember that for Mach the *Analysis of Sensations*, far from a metaphysical work, was a book addressed "primarily to biologists."[83]

We can now move from a metaphysical interpretation of Mach's doctrine of elements to a critical one, one which describes the doctrine both as a challenge to reductionism and a check on "the misuse of auxiliary hypotheses."[84] It is important to point out that these latter goals are already somewhat present in the former. Indeed, it will be argued in the next section that Mach's elemental 'monism' is meant as a critical dismissal of traditional metaphysical oppositions and speculations in favor of experience. In this way, we will find that Mach's *monism*, oddly enough, paves the way for his

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[81] {{34 Banks,Erik C. 2003; }} p.115
[82] Ibid. p. 7
[83] Ibid. p. 104
[84] Frank, "The Importance of Ernst Mach's Philosophy of Science for Our Times" in {{30 Cohen,R.S. 1970; }}

methodological *pluralism*, and that the doctrine of elements plays a key role in Mach's challenge to reductionism and his promotion of theoretical sobriety.

The focus on the critical aspect of the elements makes even more sense given Mach's context, i.e. the "rampant materialism of the period that dominated in Vienna," and the resulting "physico-mechanicalism" that Mach saw emerging as a "new mythology" for modernity, replacing the animism of old.[85] The doctrine of elements, both as 'metaphysics' and as critical epistemology, was to serve in part as a remedy for an intellectual atmosphere mired by fundamentalism and reductionism. These included for Mach the exuberant and widespread posing of pseudo-questions (e.g. how exactly the "paths of atoms in the brain will one day explain all sensations, ideas, and behaviors?"[86]) as well as the relegation of lived experience to the domain of illusion, secondary attribute, or merely emergent phenomenon.[87] More directly, Mach was perpetually concerned with the domination of the scientific disciplines by physics, and as we will see his work aimed at promoting those psychological and biological aspects and interpretations of the phenomena that precluded such domination.

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[85] see the *Economical Nature of Physical Inquiry*, where Mach already describes this worldview as that which "determines the ideals and character of our times" {{39 Mach,Ernst 1898; }}

[86] {{39 Mach,Ernst 1898; }} p.208 This example appears more than once in Mach's writing, and it seems to have been a question genuinely posed to him by one of his colleagues in physics

[87] Of the latter concern Mach worries that we will one day "wonder how colors and tones which were such innermost parts of us could suddenly get lost in our physical world of atoms," and advises that we should not "resolve ourselves into a nebulous and mystical mass of molecules." {{2 Mach,Ernst 1976; }}

1.3.3 Elements III- Methodological Pluralism and Anti-Metaphysics

There is a statement of Edwin Schroedinger's uncovered by Cohen that closely approximates the metaphysical interpretation of Mach's doctrine of elements described above, namely that "the external world and consciousness are one and the same thing, insofar as both are constituted by the same primitive elements."[88] Despite the possible association of such sentiments with traditional idealism, we how Mach himself came to regard them as the possible future findings of psycho-physiological research. With the help of Phillip Frank, we will now explore some other good reasons to suspect that Mach held no such broad speculative convictions, perhaps first and foremost the fact that in the *Analysis of Sensations* he described himself as "innocent of all -isms."[89]

Phillip Frank agrees wholeheartedly with Mach's self-assessment. In "Ernst Mach and the Unity of Science," Frank asserts that the chief reason that people have trouble interpreting Mach is that "philosophers, and sometimes scientists too, endeavor to discuss Mach's doctrines in the language of traditional philosophy," for example as "idealism, spiritualism, materialism…" This, according to Frank, is impossible, precisely because Mach possessed "what one might call the instinctive aversion of a genuine scientist to the use of vague terms like 'idealism' or 'materialism.'"[90] We recall the oft-quoted passage from the *Analysis of Sensations* in which Mach

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[88] {{30 Cohen,R.S. 1970; }}, p.154
[89] {{8 Mach,Ernst 1959; }} p.48, see also {{2 Mach,Ernst 1976; }} p.12 "My task is not philosophical but methodological."
[90] Frank, in {{30 Cohen,R.S. 1970; }} pp.235, 240

disavows any goals of attaining metaphysical or even philosophical truth, instead stating that his only aim was "to adopt in physics a point of view that need not be changed the moment our glance is carried over into the domain of another science."[91] Indeed, with respect to the grander metaphysical issues, Frank claims that Mach was "quite unconcerned with such problems as whether the world consists of perceptions or of matter."[92]

Then what was his fundamental concern? As we begin to probe this question we start to see Mach's fundamental position not as a metaphysical monism, but as a methodological pluralism, or more precisely, we see the way in which the former facilitates the latter. Indeed, in the *Analysis of Sensations*, when characterizing the tension between physics and psychology, Mach dismisses the big question of whether "the Physis or the Psyche" is the "really mysterious thing," choosing instead to cite the fundamental fact of experience that "the elements A B C… are immediately and indubitably given," and that therefore "they can never afterwards be volatized away by considerations which ultimately are always based on their existence."[93] Similarly, when challenging the metaphysical oppositions of ego and world and of sensation and thing, Mach attributes their origin to an "only partially appropriate and imperfect expression."[94] Rather than declaring the priority of nature or spirit, or citing an unbridgeable divide between self and world, Mach's 'monism' focuses us on a single, common basis of

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[91] {{8 Mach,Ernst 1959; }} p.30
[92] Frank, in {{30 Cohen,R.S. 1970; }} p.238
[93] {{8 Mach,Ernst 1959; }}, p.45
[94] {{8 Mach,Ernst 1959; }}, p.14

experience.[95] Mach then goes on to argue both for a plurality of possible and fruitful ways in which to study the reality offered by our experience, and that this experience should be used to constrain our exuberance for abstract theoretical constructs and systems. And so we will now briefly look at Mach's methodological pluralism and his anti-metaphysics.

1.3.3.2 Methodological Pluralism

One of the most important moments in Mach's introduction to the *Analysis of Sensations* comes when he states that "man is pre-eminently endowed with the power of voluntarily and consciously determining his own point of view."[96] We had noted above that a methodological pluralism regards the change that takes place as we move between disciplines not as one of metaphysical domain but of the "direction of investigation." For Mach, there are many such directions, and in the very first section of the *Analysis of Sensations* he asserts that "physical ways of thinking and physical modes of procedure" have access only to "a portion of a *larger* collective body of knowledge," and that therefore the "limited intellectual implements" of physics, "created for limited and special purposes," are unable to "exhaust all the subject matter in question." This seems a reasonable conclusion for Mach, who describes the reality that we encounter in experience as "infinitely rich

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[95] see *Knowledge and Error*, where Mach explains that the main focus of the doctrine of elements is to overcome "philosophical sham problems." {{2 Mach,Ernst 1976; }}
[96] {{8 Mach,Ernst 1959; }}

and inexhaustibly manifold."[97] Mach's methodological pluralism challenges the domination (though not the contribution) of the scientific disciplines, especially psychology, by physics. Instead of the domination of a single standpoint or method, it aims to limit presuppositions and to advocate an approach to reality of perpetual and plural experimentation, of "freshness and open-mindedness," as Mach puts it.[98] "Where there are more ways, they ought to be shown" he writes, and in the next chapter we will pursue the role of Mach's elements in his rejection of reductionism in greater depth.

Mach's pluralism informed his vision for a "unity of science." Unification was to be achieved neither by inter-theoretic reduction nor the arrangement of the sciences into a hierarchical pyramid, but rather through conceptual translation and cooperative activity between individual disciplines arranged non-hierarchically, each investigating unique aspects of the single "infinitely rich and inexhaustible manifold reality." Mach's doctrine of elements can make a positive contribution here by recalling the basis of each and every science in experience, thus facilitating the use of a common language of perceptions at disciplinary boundaries.[99] This does not, however, lead Mach to the kind of dogmatic formalism sometimes associated with phenomenalist attempts to foist a single, sense-data language upon scientists. Indeed, Cohen cites Mach's goal that every scientific entity be conceivable in a "mixture of vocabularies." Mach's doctrine of elements also

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97 {{5 Mach,Ernst 1960; }}
98 {{8 Mach,Ernst 1959; }}, p.41
99 {{30 Cohen,R.S. 1970; }}

aids in the project of unification by acting as a perpetual check on theoretical exuberance and obscurantism, and before we discuss this "anti-metaphysics" in greater detail, we will quickly say something about the unity of science and the campaign for social justice.

It is important to note that a vision of scientific unity of the type just described is closely linked, at least historically, to an ideal of social sympathy and to the goal of the universal satisfaction of basic human needs. Friedrich Stadler has discussed at length the connection between the Unity of Science movement and "socio-economic enlightenment," and Elizabeth Nemeth has written about the close relationship between Otto Neurath's conception of scientific unity and his project of instituting a planned economy, one potentially more stable and humane than the capitalist model.[100] In general, by appealing to both non-reductionism and theoretical sobriety, we aim to point out a link between the extension of scientific transparency, communication, and cooperation, and the promotion of public health, education, and welfare. And while some manifestations of this vision in urban planning and social engineering are unique to the 20th Century, certain components trace back to the work of Comte, St. Simon, Bacon, and beyond. We will see that Mach shared many of these views with respect to the practical aims of a unified science, and in Chapter IV we will examine the different contributions which biological and technological empiricism can make to such a project.

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100 *Re-discovering the Forgotten Vienna Circle* {{38 Uebel,Thomas E. 1991; }}

1.3.3.3 Anti-Metaphysics

The anti-metaphysical attitude, which we can provisionally define as the preference for experience over speculation, along with the complete denial of decisive force to the latter, is one with deep historical roots. Auguste Comte, one of the most well-known modern proponents of the scientific attitude, defined the "Real Stage" to which mankind is progressively moving as one characterized by the "subordination of imagination to observation," and the "renunciation of absolute investigations." For it was within the domains of experiment and observations that Comte saw the "rapid deepening" of knowledge, and by thus avoiding the "vague principles" of scholasticism and speculative logic, which admit of "no sufficient proof," Comte hoped that human thought could continue to progress from empty speculation to fruitful science.[101]

Comte was not the first to make such suggestions. Concerned with the development of medical knowledge and techniques, Hippocrates wrote the following approximately twenty five hundred years ago: "…Wherefore I have deemed that medicine has no need of an empty postulate, as do insoluble mysteries, about which any exponent must use a postulate, for example, things in the sky or below the earth. If a man were to learn and declare the state of these, neither to the speaker himself nor to his audience

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[101] *The Spirit of Positivism* {{55 Comte,Auguste 1974; }}

would it be clear whether his statements were true or not. For there is no test the application of which would give certainty."[102]

It is thus no wonder that Wittgenstein was less than captivated by the publication of the propaganda pamphlet of the Vienna Circle, ["The Scientific World Conception" (1929)] in fact mocking its treatment of the elimination of metaphysics "as if it were something new." And indeed, from Kant's claim that knowledge of the soul is impossible without a "persisting intuition," through Durkheim's denial of a social contract, ("which the observer does not confront in his path,") to the "verification principle" of the logical positivists themselves, anti-metaphysics of one form or another has been a stable part of modern philosophy of science for centuries.

We are interested in the various features of Mach's own "anti-metaphysical" position. We recall that in the *Science of Mechanics*, Mach treats the terms "anti-metaphysical" and "enlightening" as synonymous, and so we should suspect that the former holds a prominent position in his thought.[103] We will find that Mach's anti-metaphysical eye, his "incorruptible skepticism," as Einstein called it, was directed both at issues within science and outside of it. We will also identify as the other crucial feature of Mach's anti-metaphysics its conspicuous lack of logical formalism, i.e. its closer affinity to an ideal of *candor* than to one of "verification." But let us fist turn to

[102] *Ancient Medicine*, {{85 Hippocrates 2005; }} p.15
[103] {{5 Mach,Ernst 1960; }}, p.1

an interpretation of Mach's rejection of metaphysics within the positive sciences, and in general to his criticism of theoretical fundamentalism.

In the *Science of Mechanics*, Mach makes the claim that it is better to "learn to tolerate incomplete world views" than to accept a complete, "but inadequate system." This idea lies at the very core of Mach's thinking, and its influence can be detected in various strains of contemporary ethics and philosophy of science.[104] It also provides a starting point for understanding Mach's notion of anti-metaphysics.

Turning to intra-scientific concerns, we are interested in better understanding Mach's attitude toward scientific theory. Frank begins his evaluation of Mach's philosophy of science with a quotation from Goethe, who writes that "The constancy of phenomena alone is important; what we think about them is quite immaterial."[105] Goethe's claim, if not somewhat overstated, seems consistent with the provisional definition of anti-metaphysics offered above, and indeed, Frank bothers to cite Goethe because he is considered to be a forefather of modern phenomenalism, a standpoint that embraces precisely the "preference for experience" over abstraction, and moreover for economic description over fundamental explanation.[106] Some might see this type of sentiment as a rejection of the role of imagination and hypothesis in our understanding of the world, and

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[104] see for example the introduction to Neurath's "Anti-Spengler" or Cartwright's "The Dappled World," in which Neurath is quoted to the effect that "the system is the great scientific lie"{{86 Cartwright,Nancy 1999; }}
[105] Frank, in {{30 Cohen,R.S. 1970; }} p.220
[106] We will return to these issues and distinctions in greater depth in Chapter III on Mach, Planck, and Cartwright

there will be ample time to discuss the affects of an anti-metaphysical stance on scientific creativity in the context of Max Plank's criticism of Mach. For now, we note that Frank rejects this view, citing Maxwell as an example of a famously creative scientist with a phenomenalist worldview, as well as attributing to phenomenalism an even greater "freedom of imagination" than to various types of realism.

Cohen agrees that Mach is clearly no enemy of hypothesis, and instead sees it as his primary goal to work against dogmatism and absolutism within physical theory. He writes that Mach is eager to expose "what is illusory" in science, and in particular to replace all claims to certainty with expressions of the provisional nature of all knowing.[107] It is in this context that Mach's elements describe a common source of experience, a "phenomenal confirmation base" against which theory can be tested. This base encourages the researcher to pursue the "factual kernel" of a theoretical assertion, and thus to also identify and evaluate any "pictorial and metaphorical fictions," along with other possible sources of "pseudo-intelligibility."[108]

We can now better evaluate Mach's alleged "reduction" of physical theory to propositions about sense experience. A classical articulation of this type of reduction can be found, unsurprisingly, in Comte, who describes the following as a "fundamental rule" of the real stage of human knowledge: "Any

[107] {{30 Cohen,R.S. 1970; }} pp.126, 129
[108] Ibid, p.140

proposition that is not directly reducible to the simple enunciation of a fact, whether particular or general, can have no real and intelligible meaning."[109]

We will find that Mach rarely engages in this type of rigid formulation of his own anti-metaphysics. Indeed, we do not ascribe to Mach a project of reduction, but one of translation and sobriety. We will now look at Frank's interpretation of Mach's anti-metaphysics, and although Frank does use the language of "reduction," we will see how he means it non-dogmatically, as the *potential* for translation into experience, and how he correctly views the most important aspect of Mach's anti-metaphysics as its rejection of "the misuse of auxiliary hypotheses."

Frank begins by describing Kroenecker's reduction of mathematics to statements about integers as an analogy to Mach's elemental monism. While such a project might in practical terms seem pointless and unnecessarily laborious, Frank explains that it is nonetheless "in principle highly enlightening to know that all theorems about irrational numbers *could* be expressed as theorems about integers." The same is true in the physical sciences. Although it might never be practiced day to day in laboratories and colloquia, and with good cause, the perpetual *possibility* of the translation of scientific theory into the terms of direct experience of the elements, and the sobriety and responsibility which such a possibility demands, can be of great value for science.

[109] {{55 Comte,Auguste 1974; }}, p.26

That value is twofold. On the one hand, Mach's age experienced an unprecedented popular and even intellectual skepticism towards science. Plank himself characterized the situation as a "crisis," reporting that "there is scarcely a scientific axiom that is not nowadays denied by somebody," and noting that even the principle of causality, once regarded as "the indispensable postulate of scientific research," had been put into question.[110] Mach too was concerned with this advance of skepticism, and Frank sees Mach's reduction to the elements as a safeguard against this trend, one that provides a stable foundation for science and an unassailable reply to overblown external attacks.[111] Skeptics would no longer be able to bring down science by pointing to its more abstract theoretical notions, or in Frank's words, "the reality of physics can never be shaken by any criticism of the auxiliary concepts."[112]

Some of the auxiliary hypotheses, the 'helping concepts,' that Frank has in mind here are "atom" and indeed "matter" itself, and he suggests that as long as not these, but rather the elements of experience, are regarded as the "building blocks for ultimate science," the latter will be secure. By "auxiliary concept" then, Frank is referring to specialized, abstract theoretical structures that are not accessible to direct experience. Although such structures may be helpful and indeed indispensable tools to the specialists working within a particular domain, there is a perpetual risk that they will be

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[110] "Where is Science Going" {{10 Planck,Max 1977; }} p.66
[111] Compare with Poincare's position in "The Skepticism of M. Leroy" {{87 Poincaré,Henri 1958; }}
[112] Frank, in {{30 Cohen,R.S. 1970; }}

exported beyond the confines of that domain in a less precise, metaphysical form. According to Frank, such a process is what transformed the auxiliary concept of "matter" into one-sided "materialism," a total worldview according to which the former was no longer the abstract concern of specialists, but rather the "essence of the world."[113] It is in these pathological forms that auxiliary concepts may become a source of intolerance, obscurantism, and cruelty, and so the "misuse of auxiliary concepts" may serve as a provisional definition of theory fundamentalism.

Perhaps there are those for whom the relevance of such concerns, at least within the sciences, seems dated. Given the extraordinary advances of the last century in atomic physics, bio-chemistry, genetics, etc., for example, can we not say that micro-structural science is secure and that realism about those structures remains the only tenable position? With respect to the nature of Mach's critique of "atomism" (as opposed to the "atomic theory") there will be more to say in Chapter III. More generally, it is here that we arrive at the second advantage of Mach's anti-metaphysics, according to Frank, and that is its refusal to become complacent with respect to criticizing the more abstract and speculative claims of physical science. Frank sees Mach's work as consistent with a *continuing* project of enlightenment, the latter again understood precisely as the "limiting of the misuse of auxiliary concepts." Frank says "continuing," for enlightenment in its essence is not to be understood as referring to a particular time period, namely the 18th Century

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[113] Ibid. p.230

"Age of Reason." Rather, it refers to a perpetually skeptical spirit, a will to challenge all absolute claims, including those of the great natural and political philosophers of the 18th Century themselves. With respect to the need for such a skeptical voice in contemporary science, one can perhaps point out both the persistent vagueness and reverence surrounding such concepts as "genes," "superstrings," and "free markets."

But perhaps to speak of "limiting the misuse of auxiliary concepts" is not to capture the full import of Mach's doctrine of elements for the spirit of anti-metaphysics. "Auxiliary concept" is too technical a notion, limited perhaps to concern with formal, scientific theories, and Mach was concerned with all sorts of "theoretical monstrosities" through which philosophical, religious and scientific over-exuberance could plague the rhythms of ordinary life.[114] He was a critic of various sorts of popular mysticism, 'spiritualism,' nationalism, and racism, challenging all "one sided" idolatries and ideologies.[115] Seen in this light, Mach's doctrine of elements is far more critical than metaphysical. It is not its aim to disturb the expression and activity of everyday life by forcing upon it a rigid language of "sense-data," but

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[114] {{8 Mach,Ernst 1959; }} p.33

[115] In a letter to Oswald from 1913, Mach mentions an autobiographical sketch that he had written for Paul Carus and thought of as a kind of practice obituary. Mach's main focus was to make sure that the "clerical-reactionary period of Austrain history" through which he lived was described. {{32 Blackmore,John T. 1992; }}

rather to dilute, to "neutralize" an already present theoretical and ideological disturbance.[116]

The language of science is a crucial modern-day mode of popular and political expression. Just as Socrates was the rhetor who challenged sensational rhetoric, Mach was one of the scientists who sought to limit and pacify scientific expression. Both worked by opening up a space of conversation and translation, and despite the more dogmatic and formalized approaches concocted by the "disciples" of each, both Socrates and Mach conducted his own campaign within the ordinary language.[117] Thus for Mach, the goal was to commit science and scientists to the most humble, sober, and transparent presentation of their findings possible. According to Mach, science and its concepts, by their very nature, have nothing to do with 'the deep' or the "darkness of mystery;" science requires no "pompous show."[118] We will deal with these aspects of Mach's view of scientific expression shortly in our discussion of the principle of economy. First, however, it is important to relate these ideas to Mach's broader advocacy of tolerance, candor, and social sympathy.

In his great historical-critical works, Mach shows a talent for making a hero out of the physical researcher, and most often that hero's greatest virtue

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[116] Compare with Mach's epistemological goal as stated in Knowledge and Error: "I have aimed not at introducing a new philosophy into science, but at removing an old and stale philosophy from science." {{2 Mach,Ernst 1976; }} p.xxxii

[117] In a way, Mach's project was to have the language of the elements and their relations come to be understood as the ordinary language of science.

[118] {{39 Mach,Ernst 1898; }} Compare with the *Scientific World Conception(1929)*: "in science there are no "depths," there is surface everywhere" {{15 Neurath,Otto 1973; }}

is his “candor.” When speaking of Galileo, Mach uses this term often, and when providing an introduction to the influence of Huyghens, Mach says the following:

> Huyghens shares with Galileo, in all its perfection, the latter’s exalted and inimitable candor. He is frank without reserve in the presentment of the methods that led him to his discoveries, and thus always brings his reader to a full comprehension of his performances. Nor had he cause to conceal these methods. If, a thousand years from now, it shall be found that he was a man, it will likewise be seen what manner of man he was.[119]

It was through such observations that Mach helped to shape a generation of European scientists. His lesson was one of candor, not clarity, though the latter soon after became regarded as the prevailing goal of “logical positivism” and subsequent “analytic” philosophy. Clarity is value neutral and takes place on the blackboard; it is drawn from the shallow and banal end of enlightenment, as in Nietzsche’s attack on Mill: (“clarity as an insult.”[120]) Candor is one of the highest virtues, and is developed in the soul of the serious scientist committed to pursuing enlightenment to its unreachable end.[121]

In light of this distinction, we can perhaps understand that Mach was not eager to promote a new age, one with a well-defined conceptual agenda or a rigid scheme of neo-logisms. On the contrary, Mach claims to have a

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[119] {{5 Mach,Ernst 1960; }}- In a separate work, Mach compares Darwin to Galileo in a similar fashion: “With the same direction of purpose…he pursues his way. With the same candor and love of truth, he points out the strengths and weaknesses of his demonstrations. With masterly equanimity he holds aloof from the discussion of irrelevant subjects and wins alike the admiration of his adherents and of his adversaries. From *On Mental Adaptation*, in {{39 Mach,Ernst 1898; }}

[120] {{88 Nietzsche,Friedrich Wilhelm 1997; }}

[121] It would be fruitful to compare the various formulations of *Sachlichkeit* in modern German philosophy with those of *sophrosyne* in Greek virtue ethics

"distaste for artificial terminology" and rejects the limitations found within "the four walls of a system."[122] Instead, his ideals seem to be those of good sense, peace, tolerance, and general sympathy. To get an idea of Mach's ethical sentiments, we might recall a passage from the *Bacchae* concerning the dangers of theoretical excess: "Tongues that know no bridle/ and folly that knows no law/ end in misery/ But the peaceful life/ and good sense/ no billows toss these/ these bind together men's houses."[123]

Voltaire is another historical thinker with whose ethical and political sentiments Mach showed the greatest affinity. Mach was a great admirer of Voltaire, and Popper-Lynkeus not only wrote an entire book defending his artistic legacy, he also committed significant parts of his ethical and political works to resurrecting Voltaire's spirit.[124] In "The Right to Live and the Duty to Die," Popper-Lynkeus provides a list of some of the remarkable achievements of Voltaire:

> With greater vitality than any other European, he awoke within us a new sentiment in which justice and love of mankind are united: tolerance.
> He destroyed false piety.
> He taught us to seek the joys of life without reserve.
> He created outrage in us with respect to the degradation of men through ceremonies and symbols.
> He railed against every type of fanaticism.
> He taught us justice in judgment.[125]

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[122] {{8 Mach,Ernst 1959; }} p. 47 see also *Knowledge and Error* in which Mach describes himself as a "naive observer free from any system" (xxxii)

[123] {{89 Euripides 2000; }} p.45 With respect to Euripides, it would be very interesting in another context to discuss Mach's latent ethics, especially by comparing his and Nietzsche's relative approximations to the "Dionysian."

[124] Frank, in {{30 Cohen,R.S. 1970; }} p.228

[125] *Das Recht zu Leben und das Pflicht zu Sterben* {{52 Popper-Lynkeus,Josef 1924; }}(my translations)

Given the above, we should not hesitate to situate Mach's philosophy of science in this tradition of Voltaire's enlightenment of tolerance and charity.

Before turning now to an introduction of Mach's principle of the "economy of thought" and its role in his philosophy of science, we should briefly review the results of our introduction to the elements. We first showed the ways in which Mach's doctrine of elements (1) challenges our habitual notion of the world, particularly with respect to overcoming the *boundaries* assumed by both naïve realism and dualistic metaphysics, (2) rejects the excesses of metaphysical realism, in particular the notion of the "thing-in-itself," and (3) promotes the unity and cooperation of the individual, scientific disciplines. We then briefly considered a metaphysical interpretation of the elements, but soon left it behind in favor of one that links Mach's elements with a singular focus on experience. This focus was shown to have both constructive and critical components, the former with respect to the promotion of psycho-physiological research, and the latter to a methodological pluralism that rejects reductionism and an anti-metaphysical program that aims to limit theory fundamentalism, understood as the "misuse of auxiliary hypotheses." All of these functions of Mach's elements will be discussed in greater detail in the next two chapters.

1.4 Introduction to the Economy of Thought

We recall Mach's fundamental view, namely that the task of science is to neatly and succinctly describe "the connections between the elements," and we are aware that while we have spent much time discussing the nature of the "elements" themselves, our discussion of Mach's view of science in particular has been somewhat limited. It is now necessary to examine Mach's "epistemology" in greater depth, as well as some of the criticisms of it that have been offered, specifically in the context of his well known description of science as an economy of thought (*Denkoekonomie*). Our goal is to bring out the various meanings of this concept, including its affinity with empiricism and instrumentalism, its appeal to a biological and evolutionary view of science, and finally its significance as a pedagogical tool for the shaping of scientific expression and the promotion of popular scientific education.

Mach often takes the time to situate his views about the nature and purpose of science along a continuum of epistemological possibilities. In general, he distinguishes investigations into what we might call the logical-theoretical-mathematical foundation of science both from those into its empirical side and those into its biological and psychological sources and functions. Concerning the first distinction, Mach concedes in his *Mechanics* that "both sides of Mechanics, the empirical and the logical, require investigation." He sees examples of the latter in works like Hammel's "On Space, Time, and Force as A priori Forms of Mechanics," and he states his belief that such investigations "do not do any harm to the subject."[126] However, with typical candor he adds that his own work is "for good reasons turned especially to the empirical side." This focus plays itself out through Mach's attentiveness to experience as a foundation of scientific knowledge, as well as to certain details concerning scientific praxis and the history of experimentation.

Concerning the former, the following quotation reveals Mach's staunch empiricism: "the aim of my whole book is to convince the reader that we cannot make up properties of nature with the help of 'self-evident' suppositions, but that the suppositions must be taken from experience."[127] Mach describes the aim of this goal as getting to the "real significance of mechanics," and in the process simultaneously getting rid of "metaphysical obscurities." In the context of this goal, mathematics and logical demonstration are somewhat marginalized within the *Mechanics*. Mach explains that "what little mathematics it contains is merely secondary."[128] When he does address logic and the power of proof, Mach is emphasizes observation and testing over a priori demonstrations. He advises us "to be comfortable with principles and facts which have been seen to prevail" rather than "suffer ourselves to be overawed by a specious demonstration." In

[126] {{5 Mach,Ernst 1960; }} p. xxviii
[127] Ibid. p.27
[128] Ibid. Preface. There will be much more to say about Mach's relationship to mathematics.

general, Mach is concerned about a “mania for demonstration in science that results in a rigor that is false and mistaken.”[129]

Mach also highlights practical and technological considerations, citing the role of craftworks and machines for the historical development of science. He observes that “long before theory was dreamed of, implements, machines, mechanical experiences, and mechanical knowledge were abundant,” particularly among the Egyptians and Assyrians, whose scientific capabilities we often underestimate.[130] Mach claims that conversely we tend to overestimate the Greek fascination with theory, thereby neglecting their significant “experimental tendencies and achievements.” He cites, for example, Pythagoras’ use of a monochord to test the relationship of string length and harmonic emissions, as well as Anaxagoras’ experimental verification of the corporeality of air.

It is also common to group logical and mathematical considerations in epistemology as separate from biological and psychological ones. It is by observing Mach’s focus on the latter aspects that some thinkers, for example Husserl and Musil, attempted to criticize his epistemology as one-sided, at times suggesting that Mach was not even aware of other directions of inquiry. Mach answers these criticisms directly: “I am perfectly able to distinguish between psychological and logical questions.”[131] Mach adds that the reason

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[129] Ibid. p.93- for a similar report on the dangers of a misguided rigor in science, specifically economics, see Cartwright, “The Vanity of Rigor”

[130] {{5 Mach,Ernst 1960; }}, p.2 Edgar Zilsel on the interaction of craft development and progress in scientific theory

[131] Ibid. p.593

why he did not attempt to construct a “theory of theory” built on logical considerations was that such a task was “’too difficult” for him, and would probably only suit “one who took mathematics as one’s subject matter.”

Instead, Mach explains that he found it “helpful and restraining to look upon everyday thinking and science in general as a biological and organic phenomenon.” Thus, in place of that grand ‘theory of theory’ Mach describes his work in the philosophy of science as a series of “epistemological sketches” involving the “biological-psychological investigation of the development of the sciences,” one based upon the “theory of mental economy.”[132] He concludes that even if it was decided that mental economy suggests only a “teleological and provisional theme for guidance,” this would not exclude its emergence from “deeper foundations,” but in fact “advances this possibility.” Finally, Mach rejects Husserl’s claim that his variety of analysis is guilty of a “degradation of science” insofar as it does not make a sharp enough contrast between scientific and “vulgar thinking,” calling this instead an “exaltation,” one which depicts a science “deeply rooted in the life of humanity.”[133]

And so Mach identifies his epistemology with both empiricism and with a biological-psychological standpoint. Both of these are related to an understanding of science as “economy of thought.” Indeed, the latter concept envisions a science that offers “concise descriptions of the relations between

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[132] Ibid. p.593
[133] Ibid. p.594

phenomena." The goal of staying close to the *phenomena* themselves, of *describing* experience, including experimental and technological experience, expresses Mach's empiricism. As noted above, however, economy is also a teleological notion, and its description of the goals of science as "saving mental energy," "sharing accumulated knowledge," rendering the surprising "familiar," and "meeting biological needs," all reveal fundamentally biological and psychological concerns. Indeed, it will be argued that they are all connected to an evolutionary vision of science, one that sees the latter as an extremely powerful tool of human *adaptation*.

We will now pursue this aspect of the theory of mental economy (as a teleological description of science) that Mach considered fundamental.[134] Our discussion will have two parts, each examining the theory of economy and its central notion of "adaptation" from a unique perspective. We will first look at the principle from the evolutionary point of view, reviewing Mach's ideas about the relationship between science and instinctual knowledge, the satisfaction of biological needs, and generally man's adaptation to his *natural* environment. We will then turn to economy from a communicative and cultural perspective, demonstrating the role of Mach's principle in his broader campaigns for scientific unity, the elimination of metaphysics, and the extension of popular education, each of which is to be considered as

[134] "my fundamental conception of the nature of science as Economy of Thought" {{5 Mach,Ernst 1960; }} p.xxiii

necessary for broad intellectual adaptation within advanced, industrial societies.

1.5 Economy and Adaptation- Evolution, Instinct, Needs, Psychobiology

In the introduction to the *Science of Mechanics*, Mach briefly restates his theory of mental economy: "science seeks the most economical and briefest description of the phenomena." He then elaborates, calling this description a "comprehensive, compact, consistent and facile conception of the facts," and citing the "process of adaptation of thoughts to facts" as its driving force.[135] According to Musil, "once science is seen to be no more than a means of mastering facts, made necessary by the struggle for existence," it is seen "within an evolutionary perspective."[136] If we regard this statement as true, then before we make any assertion about Mach's evolutionary account of science, we should ask about his view of the relationship between science and the fulfillment of biological needs.

Musil, having already asked that question himself, concludes that for Mach, "laws, concepts, and theories of science appear as economic tools to help us adapt adequately to the practical demands arising out of our relationship to our environment," and that thus Mach approaches science "from the point of view of self-preservation" according to which "theoretical interests can be reduced to practical interests."[137] He quotes Mach's

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[135] {{5 Mach,Ernst 1960; }} p.6 Compare with Schopenhauer: "science, the storing up of previous experience, the summarizing into one concept what is common, the communication of truth…"{{82 Schopenhauer,Arthur 1966; }}
[136] {{57 Musil,Robert 1982; }} p.16
[137] Ibid. p.21

Knowledge and Error in which it is stated that “every scientific interest may be viewed as a mediate biological interest.”[138] There is good reason to accept Musil’s conclusions about Mach’s theory. Regarding the understanding of laws and theories as tools, Mach’s descriptions do often make these sound like useful recipes, for example when he states in the *Economical Nature of Physical Inquiry* that “all physical ideas and principles are succinct directions, frequently involving subordinate directions, for the employment of economically classified experiences, ready to use.”[139] With respect to the aim of such deployments, Mach instructs us to turn to the “homely beginnings of science” which best reveal to us “its simple, unchangeable character.” Of these origins he discusses both “material welfare” as first motivation and instinctual knowledge as primary instrument.[140] Regarding the latter, Mach describes it as “the outcome of the relation in which the processes of nature stand to the satisfaction of our wants.”[141]

Given the evolutionary component of Mach’s epistemological sketches, we can ask about the role played by the brand of knowledge that he calls “instinctual” in supporting the adaptive function of positive science. Mach claims that this sort of knowledge is based on “primitive psychological functions” which are “rooted in the economy of our organism not less firmly

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[138] Ibid. 21
[139]{{39 Mach,Ernst 1898; }}, 204 Interesting to replace “economically classified experiences” with “acquired knowledge about capacities”
[140] Ibid. p.189
[141] {{5 Mach,Ernst 1960; }}, p.1

than are motion and digestion," and even includes a basic knowledge of causation that is common to "the whole animal world."[142]

It is important to mention that Mach sees instinctive knowledge as playing a primary role in the development of positive science, often granting it significant authority. In the *Mechanics*, he claims and that it is "frequently taken as the starting point of investigations," there placing instinctive knowledge alongside "experiences of the manual arts." We have already discussed above the "treasure store" of instinctual knowledge which Mach ascribes to our pre-verbal experience, and to which he attributes a "high value" based on its "freedom from all subjectivity." It is precisely the fact that instinctive knowledge is "independent of our participation," and thus its immunity from the kinds of monumental errors attributable to abstract and explicit reasoning, that gives it its "authority and power."[143]

Mach makes it clear throughout, however, that he does not wish to promote some sort of "cult of instinctive knowledge." As important as this basic relationship to nature is, it is not alone sufficient to be called science, and is usually only capable of telling us "what can not happen" in nature. Mach states that true science only emerges when this instinctual knowledge comes to be "embedded in clear, articulate thought," and he thus often speaks about the process by which instinct comes to discover and express the principles on which it itself is based.

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[142] {{39 Mach,Ernst 1898; }} p.189, Mach's attribution is meant to go over and above Schopenhauer's ascription of the same type of causal knowledge to his "pet dog."

[143]{{5 Mach,Ernst 1960; }}, 35 Compare with Schopenhauer, *World as Will and Representation*, Volume 1

In articulating these principles, science achieves its aim of explanation, rendering a certain domain familiar that was once alien. Thus Mach writes: “when once we have reached the point where we are everywhere able to detect the *same* few simple elements, combining in the ordinary manner, then they appear to us as things that are familiar; we are no longer surprised, there is nothing new or strange to us in the phenomena, we feel at home with them, they no longer perplex us, they are explained.”[144] This movement *from strangeness to familiarity* is absolutely central to Mach’s philosophy of science, providing an understanding of adaptation both from the evolutionary and the communicative perspective. With respect to the former, Mach sees the distinct position of modern, scientific man in the familiar understanding with which he confronts the natural world, for as a result of scientific investigations, “that which appeared wonderful to us is no more wonderful than other things which we knew instinctively and regard as self-evident.” In general, the orienting function of science brings it about that “our puzzle turns out to be a puzzle no more.”[145]

It is in this context that Mach compares the “child of the forest” and “modern man” in his popular lecture “On Transformation and Adaptation in Scientific Thought.”[146] The former is “perfectly at home” in his forest, knowing each path by heart, however, in the face of “unwonted phenomena” such as a lunar eclipse, or in confronting the technology of modern civilization, he

[144] Ibid. 7
[145] Mechanics, 41
[146] {{39 Mach,Ernst 1898; }}

lapses into "impotency and helplessness." The man "who has made the achievements of modern science and civilization his own," on the other hand, possesses an empathetic and familiar understanding of a vast number of phenomena, and even where he is "not able to trace the direct relation of things," he takes habitual recourse both to his tables and instruments which lie ready at hand, as well as to the opinions of others, which he "knows how to meet in civil argument" even when he does not at first agree. In general, primitive man "is surprised and nonplussed at every step," whereas the modern "follows and anticipates events," for his "thoughts have become adapted to the larger field of observation and activity in which he is located."[147]

For this type of adaptation, this ability to mold the self to the environment, Mach uses the term "plasticity," which he describes as the all-important quality of organic nature. According to Mach, just as Galileo achieved a revolution in the study of inorganic nature through his employment of direct and unbiased *observation*, Darwin accomplished a similar breakthrough with respect to the organic by developing the concept of *plasticity*.[148] It is hard to overestimate the impact that Darwin's theory of evolution had on the scientific research of his day. Boltzmann, for one, when giving his opinion on the scientific legacy of the 1800's, speculated that it would one day be known as the "century of Darwin." Mach too alludes to the

[147] Ibid. p.230

[148] {{39 Mach,Ernst 1898; }}, p.216

future “tenability and fruitfulness of the Darwinian ideas in the different provinces,” and observes that already “his ideas are firmly rooted in every branch of human thought.” In fact, Mach goes on in his epistemological lecture to “consider the growth of natural knowledge in the light of the theory of evolution.”

Given Mach’s evolutionary account of epistemology, his attention both to the satisfaction of biological needs and the aim of science, as Cohen puts it, “not to master the universe but only to help us in our cosmically local way through life,” one might be inclined to deem Mach an instrumentalist.[149] However, as it is clear from the above that Mach was a pluralist even when it came to epistemology, perhaps we are to regard him as agnostic when it comes to certain questions concerning, for example, the mathematical structure of nature and the “real necessity” of natural laws. Musil faced this problem as well, framing it as “indifference versus skepticism” in the interpretation of Mach. While Mach was most certainly a skeptic, it seems proper not to regard that skepticism as absolute, but rather to see Mach’s “epistemological sketches” in the context of the prevailing trends of modern science, especially physics. In particular, as we will shortly see, Mach tended to regard science, at least from a philosophical point of view, as a particular type of communication, unique for its precision, transparency, and universal comprehensibility. Seen from this standpoint, as a cultural and evolutionary phenomenon of a particular sort, it is not fitting to see Mach’s views as

[149]{{30 Cohen,R.S. 1970; }}, p.132

diametrically opposed to that of the "realist," but rather to understand the ways in which it informs the latter, attempting to steer scientists away from the follies of absolutism.

1.6 Economy and Translation- Transparency, Models, and Public Education

We are interested now in interpreting Mach's principle of economy as a prescription for a particular type of scientific communication, one characterized by its transparency and precision, and thus by its avoidance of obscurity, hidden assumption, and claims to absolute authority. Such an interpretation, if valid, would place Mach's pluralist epistemology among the wide variety of philosophical movements aimed at forestalling the widespread enmity of language so common in human history.

But first we must generally establish the connection between the principle of economy and various issues of language and communication. This does not prove to be difficult. We have just looked at Mach's views of instinctual and early mechanical knowledge and their necessary but not sufficient role in the development of science. Building on this foundation, Mach observes that "to the necessity of putting these experiences into *communicable* form and of disseminating them beyond the confines of class and craft, science owes its origin."[150] Likewise, in the *Economical Nature of Physical Inquiry*, Mach states that "The first real beginnings of science appear

[150] {{5 Mach,Ernst 1960; }}, 191

in society, particularly in the manual arts, where the necessity for the communication of experience arises," and which thus forces the 'researcher' for the first time to identity "the important and essential features of the discovery."[151]

We can thus see that it is often communication, especially qua teaching or instruction, that Mach associates with the economy of thought achieved by science. In the *Mechanics* he highlights a crucial function of science as the "sharing of accumulated knowledge," and in the *Economical Nature* he states "the aim of instruction is simply the saving of experience; the labor of one man is made to take the place of that of another." Once again in the "Economy of Science," Mach writes that "science is communicated by instruction, in order that one may profit by the experience of another and be spared the trouble of accumulating it for himself; and thus, to spare posterity, the experiences of whole generations are stored up in libraries."[152] This is all consistent with the view of scientific ideas and principles as recipes that we previously encountered, as well as with Mach's affinity for data tables and the virtues of natural constants, for he believes that the labor-saving, "abridged descriptions" offered by these are "really all that natural laws are."[153] Universal accessibility to these descriptions is a key feature of their economical nature, and Mach places an enormous value on the widespread popular dissemination of scientific knowledge. In fact, lecturing on one

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[151] *Economic Nature of Physical Inquiry*, in {{39 Mach,Ernst 1898; }}p.191
[152] {{5 Mach,Ernst 1960; }}, p.577
[153] {{39 Mach,Ernst 1898; }} p.193

occasion about the good service performed by the medieval nobles who commissioned the translation of key works out of Latin and into the vernacular, Mach observes that "the days were now passed when acquaintance with the language and literature of science was restricted to a caste, and in this step, perhaps, was made the most important advance of modern times."[154]

Mach's view is that the simplicity, clarity, and universal comprehensibility of scientific expression functions by building upon the fact that ordinary language already possesses many of these features. "The most wonderful economy of communication is found in language," Mach reports in the *Economical Nature*, and in the *Mechanics* he states the following: "Language, the instrument of communication, is itself an economical contrivance. Experiences are analyzed, or broken up, into simpler and more familiar experiences, and then symbolized at some sacrifice of precision." According to Mach, science merely augments this already present characteristic, striving for ultimate transparency and simplicity in the construction of its "rigid world picture," which, Mach allows, is likewise achieved only at the expense of total fidelity.[155] Mach discusses this sacrifice of exactness and wholeness often, especially in the context of his discussions

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[154] *On Instruction in the Classics and the Sciences*, {{39 Mach,Ernst 1898; }}p.342 Compare with Hegel's view of "Science" as the essential 'Notion' of modernity, one that should not be developed in vague or esoteric terms, but rather must "be capable of being appropriated by all" {{90 Hegel,Georg Wilhelm Friedrich 1977; }}

[155] *Economical Nature of Physical Inquiry*, {{39 Mach,Ernst 1898; }} p.192 "Language, with its helpmate, conceptual thought, by fixing the essential and rejecting the unessential, constructs its rigid pictures of the fluid world on the plan of a mosaic, at a sacrifice of exactness and fidelity."

of idealization and experimental set-up. For example, Mach states that "in reality, the law always contains less than the fact itself, because it does not reproduce the fact as a whole but only is that aspect of it which is important for us, the rest being either intentionally or from necessity omitted."[156]

However, despite the sacrifices inherent to the economical presentations of science, much is gained in both universality and functionality. Of the former, we notice that Mach almost always speaks of the development of a universal language or notation, a "Universal Real Character," in the context of his discussions of the economy of science. He predicts, "with respect to the economy of written intercourse there is scarcely a doubt that science itself will realize that grand old dream of the philosophers of a Universal Real character." Along these lines, Mach often highlights Chinese and English as good ordinary-language role models, the former for its direct ideography, and the latter for its relative avoidance of "unmeaning and needless accidents of grammar." Ultimately, Mach believes that science will produce a common language not by pre-meditated artifice, but through an organic interplay of already existing notations, for example "numerical characters, the symbols of mathematical analysis, chemical symbols, and the system of musical notation."[157]

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[156] Ibid. p.193

[157] There are many rich connections here to later work, especially by Neurath and the Unity of Science movement. With respect to ideography, compare with Neurath's "From Vienna Method to Isotype," especially "Visual Education: Humanisation versus Popularization." {{15 Neurath,Otto 1973; }}With respect to the relationship of "positivism" to the English language, it would be very interesting to compare the views of the English language and the English-speaking world in general of figures like Mach, Carnap, and Neurath, with those of key figures in "phenomenology" and historical sociology,

Recognizing this communicative aspect of the economy of science is crucial in furthering the goals of adaptation and orientation within advanced, industrial societies.[158] It entails in essence an extended critique of scientific mysticism and absolutism, with the contrary aims of transparency, accessibility, and skepticism. We have already touched upon the question of absolutism in the context of Mach's concerns with the spreading influence of "physico-mechanicalism," and before returning to these concerns, we will briefly examine Mach's position on the relationship between science and mystery.[159]

Mach presents it as one of his chief goals to expose "the substantial sameness of science and everyday thought." One of the main obstacles to

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for example Heidegger and Weber. Finally, Mach's allowance for the empirical development of a hybrid universal language is later echoed in Neurath's conception of a "universal slang."

[158] see for example {{8 Mach,Ernst 1959; }}, p.77 on the development of "intellectual independence" as an adaptive tool: "in time the most important thing of all will be for him to be on his guard against his fellow men who want to oppress him violently or abuse him treacherously by misleading his understanding and emotions."

[159] Skepticism and mysticism are often opposed to one another. If one is willing to describe the former as the properly scientific attitude and the latter as the one appropriate to religion, then Bertrand Russell offers one traditional version of the opposition when he says:

"The important and effective mental attitudes to the world may be broadly divided into the religious and the scientific. The scientific attitude is tentative and piecemeal, believing what it finds evidence for, and no more. Since Galileo, the scientific attitude has proved itself increasingly capable of ascertaining important facts and laws, which are acknowledged by all competent people regardless of temperament or self-interest or political pressure. Almost all the progress in the world from the earliest times is attributable to science and the scientific temper; almost all the major ills are attributable to religion." {{65 Russell,Bertrand 1954; }}

A traditional reply to a view like Russell's can be seen in the following from Heidegger:

"Here the most extreme flattening out and uprooting of the traditional theory of judgment is accomplished under the semblance of mathematical science. Here the last consequences of a mode of thinking which began with Descartes are brought to a conclusion: a mode of thinking according to which truth is no longer disclosedness of what is and thus accommodation and grounding of Dasein in the disclosing being, but truth is rather diverted into certainty- to the mere securing of mathematical thought against all that is not thinkable by it. The conception of truth as the securing of thought led to the definite profaning of the world. The supposed "philosophical" tendency of mathematical-physical positivism wishes to supply the grounding of this position. It is no accident that this kind of "philosophy" wishes to supply the foundations of modern physics, in which all relations to nature are in fact destroyed." {{80 Friedman,Michael 2000; }}

this goal is the aura of mystery and secrecy that surrounds both the activities and the results of science. One instance in particular that is troubling for Mach is the widespread fetishizing and mystification of mathematics. According to Mach, mathematics is simply "the greatest perfection of mental economy" on account of the fact that it, of all the sciences, has reached "the highest formal development." The power of math "rests upon its evasion of all unnecessary thought and on its wonderful saving of mental operation." This applies at all levels, and Mach concludes that "the most elementary as well as the highest mathematics are economically-ordered experiences of counting, put in forms ready to use."[160]

Given this understanding of math, Mach encourages us all to approach it with more confidence and a lighter heart. It is not an awesome and uncanny majesty that confronts us when we use mathematical techniques to solve complex problems of computation, but rather the work of thousands of regular individuals assembled and ordered over time for the sake of efficiently conserving mental energy. "The moment we look at matters in this light," Mach advises, "the uncanniness and magical character of our impressions cease, especially when we remember that we can think over again at will any one of those alien thoughts." It is on account of this understanding of math as an economical ordering, calculating, and repeating that Mach was quick to point out the vast potential for computational and "calculating machines" like

[160]{{39 Mach,Ernst 1898; }} p.195- In another text, Mach states, "mathematics may be defined as the economy of counting." Compare with similar albeit more formal treatments of the foundation of mathematics in Russell and Wittgenstein, for example.

those of Babbage, who Mach reports to touch upon these issues in his own "The Economy of Manufactures and Machinery."[161]

It is thus also that Mach rejects attempts to regard mathematics from a "spiritual" point of view. He regards the study of math from a position of awe as of "scarcely more educational value than busying oneself with the Cabala."[162] In his discussion of the scientific role of non-Euclidean geometries and the "fourth dimension" this point comes out once again. We will have the opportunity to discuss Mach's positive view of the role of these developments later, but with respect to the excessive enthusiasm that accompanied their development, Mach wryly points out that "the fourth dimension was a very opportune discovery for the spiritualists and the theologians who were in quite a quandary about the location of hell." What is true for his view of mathematics extends to the rest of science as well. In the *Mechanics*, Mach writes that "the economical office of science, which fills its whole life, is apparent at first glance; and with its full recognition all mysticism in science disappears."[163] In an attempt to avoid fetishism and obscurantism, Mach rejects "beliefs in the magical powers of science," as well as "fairy tales" about the ability of science to open up "unfathomable abysses of nature."[164] Instead of understanding scientific progress as the "fruits of sorcery," Mach

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[161] *Economical Nature*, {{39 Mach,Ernst 1898; }} p.196

[162] {{5 Mach,Ernst 1960; }} p.586- The Kabbalah was a skeptical target of Popper-Lynkeus as well, who in "The Right to Life," in the context of his discussion of the "Degradation of Man Through Symbols" associates the "arrogance of the mystic" with the failure to influence through clear and open discussion and appeal to sympathy, and instead by stimulating a certain respect before nothingness, before symbols, costumes, and figures, all of which recalls for Popper "the times of magicians and Kabbalah. {{52 Popper-Lynkeus,Josef 1924; }}

[163] {{5 Mach,Ernst 1960; }} p.577

[164] {{39 Mach,Ernst 1898; }}p.189

points out the "excellent housekeeping," the sober and diligent experimentation, record-keeping, and collaboration, that is genuinely responsible for advances, both in science as well as in civil life.[165] Indeed, throughout his work, Mach shows an affinity for humble clarity and familiarity and a disdain for reverent mystery and paradox.[166]

Mach's principle of economy, understood as a prescription for a certain type of scientific expression, has then two chief goals with respect to the fate of science. The first is that science not become a new religion for modernity, especially one characterized by absolute dogma and extremist tendencies.[167] The second is that science not become restricted to a small caste of isolated and revered experts and authorities. Regarding the former, Mach joins Comte (and many others) in broadly outlining the "progress" made by mankind as he has moved from the animism of old, with its view of a nature "filled with demons and spirits," through fetish-worship and monotheism and into the scientific world view. The latter was born slowly and with much difficulty out of the soil of superstition and cruelty, and Mach remarks of the

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[165] Ibid. p.198. These views will be important in shedding doubt upon Lenin's attempt to associate Mach's work with what he calls "fideism." Mach's views on economy and housekeeping were also of great concern to Planck.

[166] See for example *Mechanics* p.41- "As a fact, every enlightening progress made in science is accompanied with a certain feeling of disillusionment. We discover that that which appeared wonderful to us is no more wonderful than other things which we know instinctively and regard as self-evident; nay, that the contrary would be much more wonderful; that everywhere the same fact expresses itself. Our puzzle turns out then to be a puzzle no more; it vanishes into nothingness, and takes its place among the shadows of history." Mach thus weighs in on what we might call the "riddle wars" between "positivists" and "phenomenologists" culminating in Wittgenstein's claim that "there is no riddle" (*Das Raetsel gibt es nicht*) and Heidegger's discussion of the "enigma a priori" of human existence {{91 Wittgenstein,Ludwig 1990;92 Heidegger,Martin 1996; }}

[167] "Similarly, it would not become physical science to see in its self-created, changeable, economic tools, molecules and atoms, realities behind phenomena, forgetful of the lately acquired sapience of her older sister, philosophy, in substituting a mechanical mythology for the old animistic or metaphysical scheme" {{39 Mach,Ernst 1898; }} p.207

sixteenth and seventeenth century that "whilst Stevinus, Kepler, and Galileo were slowly rearing the fabric of modern physical science, a cruel and relentless war was waged with firebrand and rack against the devils that glowered from every corner." Mach thus praises these pioneers and describes the age of enlightenment that they helped to inspire as the one in which "the coming of the mind of man into the full consciousness of its power" took place, and the one which first offered both "intellectual freedom" and "the splendid precedent of a life really worthy of man."[168]

As we have already noted, however, Mach's relationship to the Age of Enlightenment is complex, and along with the trends just discussed, Mach observes another prominent development in modern science reminiscent of the metaphysics of Democritus, and which, like the animistic worldview, "claims exclusive competency to comprehend the universe."[169] Mach calls this view "physico-mechanical," and states his belief that it "determines the ideals and the character of our times."[170] The core elements of the view are witnessed in the exorbitant enthusiasm of Laplace, both with respect to the perfect order of the universe and the potential emergence of the perfect science to grasp it in its entirety.[171] As noted above, Mach believes that the time for such excesses is past, that the philosophy of science now faces "*new*

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[168] {{39 Mach,Ernst 1898; }}, also Scheler's criticism of the "positivist doctrine of the three stages in any of its forms" that all three are "essential permanent spiritual attitudes and forms of cognition that are already given with the essence of the human spirit as such"

[169] {{39 Mach,Ernst 1898; }} p.187

[170] Mach is famous for declaring that the day physics becomes a church, he no longer wishes to be considered a physicist.

[171] {{39 Mach,Ernst 1898; }} p.188

tasks," namely the development of a historically and critically informed, transparent, humble, and inter-disciplinary science dedicated to satisfying the needs of humanity. Mach sees his principle of economy as capable of furthering this goal, which is why he calls it the "pacificatory, enlightening, and refining" element of science.[172]

If all sciences are rooted in the common world of experience, of "colors, sounds, temperatures, pressures, spaces, times, and so forth," than we cannot build the 'true world' up from a foundation of our own abstractions. Mach puts it this way, "We cannot climb up into the province of psychology by the ladder of our abstractions, but we can climb down into it." What we find in that primordial and variegated experience is above all the total "interdependence" of natural phenomena. As such, Mach concludes that our theoretical and predictive abstractions can possess only partial and limited truth, that "absolute forecasts have no significance in science." We must therefore expose and account for all of the procedures whereby we isolate, examine, and formulate scientific conclusions about the world, and as we will see in Chapter III, Mach has interesting ideas about modeling and measurement that foreshadow many recent developments in pluralist epistemology and the philosophy of science.[173]

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[172]{{5 Mach,Ernst 1960; }}, p.7

[173] Relevant here is also of course Mach's rendering of causality as "functional dependence," a concept which he claims to prefer because it "forces us to greater accuracy of expression," freeing us from the "incompleteness, indefiniteness, and one-sidedness" of the traditional and popular notions of "cause." {{5 Mach,Ernst 1960; }}

With respect to Mach's goal of universal scientific education and thus his rejection of an elite caste of theoretical and technical experts, we have already seen his views on the vast importance of the dissemination of scientific literature throughout the population.[174] Moreover, we have mentioned Mach's personal commitment to the Vienna Adult Education movement, and it is important to note that this commitment was kept up long after his death by kindred spirits within the "Ernst Mach Society" and the "Vienna Circle," especially Neurath and Zilsel.[175] In general, there is much remaining to say about the relationship between enlightenment, "positivism," the scientific attitude and the commitment to popular education and the dissemination of culture generally. Many of these issues will emerge in Chapter IV's discussion of the philosophy of science and politics.

1.7 History

One of the most prominent criticisms of 20th Century positivism charges that it was egregiously ahistorical, and thus, according to Lakatos' formulation, doomed to "emptiness."[176] Criticisms of positivist ahistoricity from cultural perspectives 'beyond' the philosophy of science tend to be even less forgiving. Leaving aside the question of whether these criticisms are

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174 *Education in the Classics and the Natural Sciences* {{39 Mach,Ernst 1898; }}
175 see for example Dvorak, "Otto Neurath and Adult Education" and Stadler, "Otto Neurath: Encyclopedist, Adult Eductionalist, and School Reformer" "Rediscovering the Forgotten Vienna Circle"{{38 Uebel,Thomas E. 1991; }}
176 "Philosophy of science without history of science is empty. History of science without philosophy of science is bind." {{58 Stadler,Friedrich 2001; }} p.9

valid even with respect to the "neo-positivism" of the Vienna Circle, (and not just the caricatured view of the same that has served as straw man to the opening paragraphs of so many "post-positivist" contributions to the philosophy of science) our interest is to briefly demonstrate that they have nothing to do with the work of Ernst Mach.

With respect to regarding the study of history as crucial in gaining knowledge about the origin and nature of scientific concepts, we recall that Mach spent a great deal of his time writing historical-critical accounts not only of the development of the science of mechanics, but also thermodynamics, optics, and the principle of the conservation of energy. According to Karl Menger, "that the *historical* presentation of a branch of science is the most penetrating approach to the subject matter and leads to the deepest insights was one of Mach's general methodological ideas."[177] Cohen adds that "Mach saw that a theory of history must supplement epistemology, and perhaps even complete it."[178] In the *Analysis of Sensations*, Mach alludes to the effect of cultural and sociological influences on scientific practice. He notes that "wherever the word of recognition must be given," be it amidst class struggle, nationalist conflict, or indeed the egoistic clashes of natural investigators, the "battle of existence" serves to undermine our highest theoretical aims. "Given our present social conditions," Mach concludes, "the pure impulse towards

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[177] {{5 Mach,Ernst 1960; }}, p.1 see also "Knowledge and Error", where Mach expresses his affinity with Duhem in that the latter also understands the "historical and genetic" method of investigating science as the "correct one and the pedagogically most effective."{{2 Mach,Ernst 1976; }} preface to the 2nd edition

[178] {{30 Cohen,R.S. 1970; }} p.136

knowledge is still an ideal."[179] Noe thus points out that Mach tends to share more similarities with "the movement against logical positivism led by historically minded philosopher of science" than with the positivists themselves, at least with respect to their conventional reputation.[180] It is thus no wonder that long before that movement, Mach had a significant influence on empirically-minded investigators of science and society, especially within Austria.[181]

These brief comments have hopefully served to at least establish the historical horizon in Mach's work. Although this horizon is not the focus of this thesis, the flexibility and circumspection of Mach's philosophical standpoint is, and so it is important to at least make note of Mach's significant historical consciousness.

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179 {{8 Mach,Ernst 1959; }} p.23
180 {{34 Banks,Erik C. 2003; }}p.10
181 see {{58 Stadler,Friedrich 2001; }} pp.133-140

Chapter 2

Empiriocriticism and Materialism

2.1 Background of the Debate

Vladimir Lenin published *Materialism and Empirio-Criticism* in 1909. The book was to serve several purposes, but in particular Lenin's goal was to respond to certain critiques of "philosophical materialism" that had just been published in Russia. Written by a group of self-described Marxists working from the standpoint of "recent positivism," Lenin took it as his task to demonstrate that the thought contained in those works offered "something incredibly muddled, confused, and reactionary."[182]

Lenin uses "empirio-criticism" as a synonym for "recent" and "modern" positivism, and thus Ernst Mach quickly enters (and in fact comes to dominate) the picture. For, as Lenin observes, the fact "that Ernst Mach is the most popular representative of empirio-criticism today is universally acknowledged in the philosophical literature." Much of Lenin's book thus serves as an extended criticism of "Machean positivism." His two chief arguments against Mach, and in particular against the doctrine of elements, are as follows:

[182] {{83 Lenin,Vladimir Ilich 1964; }}, p.10

(1) Mach's philosophy is an almost literal restatement of Berkeley's, and as such is an example of subjective idealism, which is ultimately and inevitably nothing but (untenable) solipsism.

(2) Mach's attempt to synthesize materialism and idealism by "inventing a new word" ('element') is half-hearted and unsuccessful.

In order to set up his first argument, Lenin reviews some of the "new" criticisms of philosophical materialism advanced by Bozarov, Bogdanov, Yushkevich, Valentinov, Chernov, "and other Machians."[183] This occurs in the introduction, whose title anticipates Lenin's first objection: ("How Certain 'Marxists' in 1908 and Certain Idealists in 1710 Refuted Materialism"). Ultimately, Lenin will conclude that "the 'recent positivism' of Ernst Mach was only about two hundred years too late."[184]

Lenin reconstructs the claims of some of the Russian critics, particularly with respect to a certain untenable dualism inherent to materialist philosophy. Specifically, they charge that materialists "recognize something unthinkable and unknowable," "things-in-themselves," "matter outside of our experience" and "outside of our knowledge."[185] As such, they claim, materialists are guilty of "duplicating the world," of erecting a "metaphysical idol beyond sense experience," and thus of fetishizing "holy matter."[186]

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[183] Ibid. p.13
[184] Ibid. p.40
[185] Ibid. p.14
[186] Ibid. p.14

Lenin situates his reply in the following way: "In order to test whether these arguments are new…we shall give some detailed quotations from an old idealist, George Berkeley." Thus Lenin turns to Berkeley's *Treatise Concerning the Principles of Human Knowledge*, published in 1710 ("14 years before the birth of Kant"), and reviews the main claims. According to Berkeley, the objects of knowledge are "ideas actually imprinted on the senses...by sight, I have the ideas of light and colors…by touch I perceive hard and soft, heat and cold, motion and resistance…smelling furnishes me with odours; the palate with the tastes; and hearing conveys sounds…And as several of these are observed to accompany each other, they come to be marked by the same one name, and so to be reputed as one thing."[187] Lenin goes on to illustrate the path from these claims to Berkeley's famous positive conclusion, "Esse est percipi" ("To exist is to be perceived")

As far as Berkeley's critical agenda, Lenin points out that his work was meant to challenge the "doctrine of Matter" that had "taken so deep a root in the minds of philosophers," a doctrine which supposed that "houses, mountains, rivers, and in a word sensible objects have an existence, natural or real, distinct from their being perceived." It was thus Berkeley's view that materialism involved a "manifest contradiction" in recognizing "objects in themselves," and that the doctrine of the latter was a "repugnant thing" that bore along with it "ill consequences." For Berkeley, those consequences included "atheism and irreligion," as well as "an incredible number of disputes

[187] Ibid. p.15

and puzzling questions" that created "so much fruitless work for mankind."[188] It was thus in an effort to undermine these consequences that Berkeley offered to the world his "deductions in favor of peace and religion."

Lenin's concerns should thus be clear. He declares that the arguments of the Russian positivists "concerning the problem of whether things can exist apart from their action on us do not differ in the least from Berkeley's." With respect to Mach, his own complaints about the "monstrosity" of the *Ding-an-sich,* which we have already examined, do now seem to echo Berkeley's attacks on the "repugnant" doctrine of the object in itself. Both make explicit claims against the pseudo-problems generated by materialism, and although Mach the atheist would have no gripe with "irreligion" per se, as a pacifist and a socialist he was indeed an ardent proponent of "peace." Furthermore, Berkeley's sensationalism, his primary focus on "lights and colors…hard and soft, heat and cold," and Mach's doctrine of elements do, at least at first impression, share many similarities, and Lenin concludes (erroneously, as we will show) that the latter is a "simple rehash" of the former.[189] Lenin then moves on to articulate what he considers to be the metaphysical consequences of both.

He charges that the sensationalism of both Berkeley and Mach is consistent with "subjective idealism and solipsism." He writes at length of the

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[188] Ibid. p.19

[189] {{83 Lenin,Vladimir Ilich 1964; }}34 For Lenin, Berkeley's idealist path towards "religion and peace" correctly "expresses the essence of the idealist philosophy and its social significance." Our task will be to identify the corresponding goals of Mach's thought insofar as they exist, and to assess Lenin's appraisal.

(failed) attempts of both thinkers to evade these labels. But why evade them at all? On what grounds are such descriptions considered pejorative?

One may critique subjective idealism from two standpoints, one ethical-political and the other epistemological. Of the former, Robert Cohen has discussed the "typically Russian apprehension of the dangers of subjectivism" that developed in the 19th Century.[190] He notes that both atheists and theologians at the time "saw every subjectivist conception of knowledge and of life as a decisive, and irrevocable step towards solipsism." Of the latter, they saw "utter corruption" as its inevitable outcome, whether in suicide, as Bakunin suggested, or in other anti-social and criminal behavior, including murder, as Belinsky, Herzen, and Dostoevsky believed. Therefore, to combat these tendencies of isolation and alienation, many Russians thinkers believed that "theoretical philosophy must lead practical life in a great struggle to overcome any private inward focus of consciousness, a struggle toward other persons and towards community."[191]

With respect to politics, one must add that Lenin had supreme doubt about the ability of Machian positivism to serve as a component of an effective political philosophy, for, as Cohen notes, "subjectivism had already been linked, almost equated, with skepticism; and would skepticism not destroy a revolutionary spirit?" Cohen correctly suggests that Lenin saw the

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[190] {{30 Cohen,R.S. 1970; }} p.157 It is this apprehension that is supposed to mark that particular country's and era's "counter-current to empiricism and Kantianism"
[191] {{30 Cohen,R.S. 1970; }} p.157

Machist philosophy as passive and agnostic, an outlook that "could not inspire men in this world of conflict and action."[192]

Epistemologically, Lenin spends a great deal of time criticizing what he sees as Mach's relativism, a standpoint that Lenin associates with "skepticism, agnosticism, sophistry, and subjectivism."[193] While we will address many epistemological issues in the next chapter (in the context of Max Planck's criticisms of Mach's principle of economy) it is worthwhile to note that Lenin's most fervent objection to the conception of knowledge that he attributes to Mach is that it "denies any objective measure or model existing independently of humanity to which our relative knowledge approximates," and thus makes it impossible to account for "the advance of absolutely objective knowledge." One of the specific tasks of this chapter will be to begin to draw out some of the consequences of these views for the theory and praxis that take place on the borders between metaphysics, epistemology, and politics.

2.2 Framing the Metaphysical Opposition

Given this background, the task is now to reconstruct and evaluate Lenin's arguments against Mach in *Materialism and Empiriocriticism (M&EC).* One characteristic feature of Lenin's mode of argumentation, both here as well as in his (more overtly) political texts, is that he tends to depict each

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[192] Ibid. p.160
[193] {{83 Lenin,Vladimir Ilich 1964; }} p.135

debate in terms of some fixed and absolute opposition. Putting aside for the moment his more infamous political caricatures of "dogmatism and revisionism" within Marxism, our current concern is his view of the metaphysical struggle between "materialism and idealism."

For Lenin, this confrontation involves the "two irreconcilable fundamental trends in philosophy." Put most generally, these two "lines of thought" differ on the basic question, "are we to proceed from thought and sensation to things or from things to thought and sensation," or, in the more potent form invoked by Lenin throughout *M&EC*, "is sensation or matter primary?"[194] It is thus that Lenin divides philosophers into two fixed and enduring camps, namely "materialists, who regard matter or nature as primary," and "idealists, who regard spirit, mind, and sensation as primary."[195] We are going to temporarily ignore the problematically vague notions of "nature," "mind," and "spirit" that Lenin uses here, for we will shortly examine more closely his understanding of the fundamental principles of both materialism and idealism. As far as the severely underdefined concept of 'priority' that he may have in mind, i.e. what it in fact means for matter or sensation to be 'primary,' this remains unclear throughout Lenin's critique. Indeed, it often seems that the vagueness surrounding this question helps to preserve the fruitless debate between metaphysical reductionists and pluralists.

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[194] Ibid. p.37
[195] Ibid. p.47

For now, however, it is enough to cite the time and energy that Lenin dedicates to establishing the “irreconcilability” and “fundamentality” of idealism and materialism. It is crucial, according to Lenin, that we recognize this irreconcilability and, following the lead of thinkers like Diderot, “draw a clear distinction between the fundamental philosophical trends.”[196] With respect to fundamentality, Lenin regards the question of the priority of matter or sensation as basic to one’s total worldview, and as we will see, offers some proxies for it- whether with respect to color, the brain, or prehistoric Earth- which he believes are clear, decisive, and unavoidable.

It is on account of these views that Lenin regards any attempt to ‘overcome’ or ‘go beyond’ the metaphysical opposition between idealism and materialism with great skepticism. Thus, for example, when Bogdanov, the leading Russian “Machist” (and political challenger to Lenin) makes the claims that empiriocriticism “is not…concerned with materialism or with spiritualism, or with metaphysics in general,” and that “the truth is not a ‘golden mean’ between the trends, but lies outside of both,” Lenin is unimpressed.[197] He rejects the possibility of a standpoint lying “outside” of the opposition, and instead accuses the advocates of such a position of concocting a “pauper’s broth” of sophistry and vacillation.[198] Mach’s doctrine of neutral elements in particular is made the target of such attacks, with Lenin arguing that “the word element…in reality only obscures the question for it is a meaningless term

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[196] Ibid. p.31
[197] We will discuss the case and importance of Bogdanov at greater length in Chapter IV on (Anti)Metaphysics and Political Emancipation
[198] {{83 Lenin,Vladimir Ilich 1964; }}MEC 57

which creates the false impression that a solution or a step forward has been achieved," adding elsewhere that it constitutes an "evasion," a "futile verbal invention," and "a reactionary trick." According to Lenin, empty phrasemaking with respect to a fundamental question leads ultimately to a "muddled" position, a situation in which "in word, you eliminate the antithesis between the physical and the psychical, between materialism and idealism… while in deed, you promptly restore the antithesis."[199]

According to Lenin, this type of confusing inconsistency inevitably results from the "confounding of the two fundamental, philosophical trends" and constitutes the "whole wisdom" of thinkers like Mach. We will shortly evaluate this claim. For now, we observe that for Lenin, there is no room for metaphysical compromise, i.e. he believes that to achieve mere consistency a thinker must espouse "either a one-sided idealism or a one-sided materialism." The following sections will attempt to depict Lenin's support of this idea as strange, and the idea itself as false. The former claim asks how a Marxist who declares that "we must think dialectically," and who understands dialectics as "the inadequacy of all polar opposites" could reject the possibility of reconciliation when evaluating a dispute laden with vague concepts and born from complex and diverse motivations.[200] In fact, we will see that Lenin's thought is not devoid of such insight, that alongside his metaphysical fundamentalism he articulates a flexible and coherent epistemology, one

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[199] Ibid. p.47
[200] Ibid. p.50

rooted in praxis and committed to tracing the historical progress and development of human knowledge and industry. In fact, we will show that this truly "dialectical" position (which shares much in common with what we will later call *technological empiricism*) shares many similarities with Mach's standpoint, itself described not as subjective idealism but rather as *biological empiricism*, a rich complex of developmental *psychophysiology*, methodological *pluralism*, and an *evolutionary* understanding of both psychology and the purpose and progress of science. It will be argued that both positions, insofar as they offer viable alternatives to the stale debate between idealism and materialism, directly challenge the metaphysical one-sidedness championed in *Materialism and Empirio-criticism*.

2.3 Preliminary Characterizations

Our goal is thus to make our way from the rigid metaphysical opposition framed in *M&EC* to more accurate representations of the positions of Lenin and Mach. It will be necessary then to show that this opposition (Lenin the philosophical materialist vs. Mach et al. the subjective idealists) is made up of inaccurate caricatures that distort and oversimplify the thought and the thinkers involved. The hope is ultimately to resolve the tension that inspires works in the philosophy of science like *M&EC*, and furthermore to bring some resolution to parallel disputes within social philosophy (for example the longstanding disharmony between the task of extending political self-consciousness and that of promoting socio-economic reform).

Turning then to the presentation of Mach's "subjective idealism" in M&EC, we are unsurprised to see that Lenin is very careful in choosing which excerpts from Mach's writings to highlight. This is rhetorically sensible, for most commentators will admit that, if one is so inclined, there are a number of ways to portray Mach as an idealist, a subjectivist, or even a solipsist. Banks, for one, states that "I fully grant, of course, that Mach made numerous remarks that sounded very solipsistic."[201]

Lenin's particular strategy is twofold. On the one hand, he focuses on the work of the younger Mach, and on the other he carefully extracts Mach's most metaphysically suggestive statements while leaving behind the many qualifications that accompany them. The former strategy is adopted explicitly in M&EC, with Lenin stating his intention to highlight the position of Mach (and that of another prominent 'positivist,' Richard Avenarius) "in their early philosophical works." Specifically, Lenin quotes the following passage form Mach's "The Principle of the Conservation of Energy" (1872):

> The task of science…(1) to determine the laws of connections of ideas (psychology) (2) to discover the laws of connections of sensations (physics) and (3) to explain the laws of connections between ideas and sensations (psychophysics)…the subject matter of physics is the connection between sensations and not between things or bodies.[202]

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[201] {{34 Banks, Erik C. 2003; }} p.113
[202] {{83 Lenin,Vladimir Il□ich 1964; }} p.32

Quickly switching strategies, Lenin adds another quotation from Mach's *Mechanics* (1883), a much more mature work, which he however believes to "repeat the same thought." Mach famously writes: "sensations are not 'symbols of things.' The 'thing' is rather a mental symbol for a complex of sensations of relative stability. Not the things (bodies) but colors, sounds, pressures, spaces and times (what we usually call sensations) are the real elements of the world."[203]

There is indeed much that sounds like Berkeley in these quotations, and on their basis Lenin seeks to convince us of Mach's "subjective idealism," his belief that "the world is my sensation" and thus that one may "recognize the existence of the philosophizing individual only." However, there are some preliminary reservations that should be pointed out. First of all, it is clear that Mach tended towards idealism in his early writings. This is a point which he readily admits, writing in the *Analysis of Sensations* about the "idealist phase" which he "actually went through in [his] youth." However, this idealism was in time to give way to his "mature position," the position which is the subject of these chapters, and which we are calling biological empiricism. Furthermore, in comparing the two above quotations it is clear that they do not at all present "the same thought." In the quotation from the "Conservation of Energy," Mach is writing about the sciences themselves and going so far as to explicitly limit their domains of research, especially that of physics, to sensations. This is not at all his intention in the passage from the *Mechanics*,

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[203] Ibid. p.82

however, and we have seen in Chapter One that by the time of the *Mechanics (1883)* and the *Analysis of Sensations (1886)* Mach had become a methodological pluralist who very much appreciated the productive use that could be made of concepts like "body" within certain sciences, especially physics and chemistry.[204] By the time that *Knowledge and Error (1905)* was published, Mach put it this way:

> our elements are only provisional…Although for our purpose of eliminating philosophical sham problems reduction to these elements seemed the best way, it does not follow that every scientific enquiry must begin with them. What is the simplest and most natural starting point for the psychologist need not at all be so for the physicist or chemist who faces quite different problems or different aspects of the same question.[205]

Indeed, by this time, the idealist trend within Mach had taken on new, more fruitful forms. Ideas concerning the "real elements of the world" and regarding the world as "*one* coherent mass of sensations" had now become part of a broad and incisive view of science and its progress, limitations, and unification, a view with both constructive and critical components. But before pursuing this developed view in greater depth, we turn to the other "fundamental trend of philosophy" and examine Lenin's various formulations of "philosophical materialism."

Lenin defines and re-defines philosophical materialism throughout M&EC. Much to the reader's frustration, the phrase "this is materialism" is

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[204] {{8 Mach,Ernst 1959; }}
[205] {{2 Mach,Ernst 1976; }} p.12

affixed to several different ideas in the text. These ideas can be grouped, however, into fixed categories. Most commentators agree that Lenin's most basic definition of materialism is "recognition of an external world, of the existence of things independent of our minds."[206] The Austromarxist Max Adler agrees, writing in 1930 that "Lenin sees the foundation of materialism in the belief in an external reality independent of consciousness."[207] This belief, in turn, in the existence and *independence* of an external, material world is supposed to yield the crucial result of its *priority*, i.e. that "matter is primary," and thus that "thought, consciousness, and sensation" are secondary, mere "products of a high development" of this matter.[208]

One of Lenin's favorite examples in support of this view comes from Diderot, one of his favorite "great materialists."[209] In his "Conversations between Diderot and D'Alembert," Lenin reports that the well-known French materialist and encyclopedist points out an egg to his interlocutor and claims that "this is what refutes all the schools of theology and all the temples in the world." He explains that "from inert matter organized in a certain way, impregnated with another bit of inert matter, by heat and motion, sensibility, life, memory, consciousness, emotion and thought are generated."[210] According to Lenin, through this example of the egg and its development the

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[206] {{83 Lenin,Vladimir Ilich 1964; }} p.48
[207] *Der Materialismus bei Lenin* in *Austromarxistische Positionen* {{49 Mozetič,Gerald 1983; }}
[208] {{83 Lenin,Vladimir Ilich 1964; }} p.69
[209] The other great materialists listed by Lenin are "Feuerbach, Marx, and Engels." The plurality of views possessed by these four thinkers help to explain the difficulty that Lenin has in maintaining a consistent definition of materialism, why his statements range from radical reductionism to dialectical instrumentalism.
[210] {{83 Lenin,Vladimir Ilich 1964; }} p.28 The actual content of Diderot's dialogue is much more sophisticated.

independent existence and priority of the external, material world is indeed illustrated.

We noted above, however, that Lenin provides a number of different definitions of materialism in M&EC. All of these can be grouped into one of two main categories, the metaphysical and the epistemological. The former refer to the nature of the world independent of human experience, and the latter to the form of that experience itself, as well as its relationship to knowledge. Our first definition, belief in an "external" world, by its very nature constitutes a metaphysical position, one that we will call the metaphysical *recognition* of matter. We will ultimately find that this, practically-speaking, rather inconsequential article of faith is what really separates Lenin and Mach (and later, Mach and Planck). Another brand of metaphysical materialism that Lenin sometimes advocates is one that we might call the metaphysical *reduction* to matter. The paradigmatic formulation of this view is invoked by Lenin in M&EC when he writes that "there is nothing in the world but matter in motion."[211] Ideas of this sort, as we have seen in Chapter One, are the most alien to and least favored by Mach, ideas consistent with the hierarchical domination of the sciences by physics. In terms of metaphysical caricatures, the notion of the world *as* "matter in motion" represents the polar opposite of the subjective idealist's world *as* "my sensation."

The bridge that moves us from metaphysical materialism to epistemology comes in what Adler describes as Lenin's "copy theory of

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[211] {{83 Lenin,Vladimir Ilich 1964; }} p.177

knowledge," or in Lenin's own words, his position that sensations provide a "photograph" or "image of the external world."[212] On the one hand, such a notion is merely the epistemological analogue or consequence of the metaphysical recognition of matter, and as such is simply a broad and benign statement of faith. According to such an interpretation, to advocate a "copy theory of knowledge" is essentially a formal commitment, a simple affirmation that there is something 'out there' to copy, i.e. a world independent of our experience. On the other hand, as an actual working epistemology, i.e. as an account of the synthesis of experience and the development of knowledge, the "copy theory" is oversimplified, especially when compared to more developed, constructivist accounts of the plasticity of knowledge and the active organs of cognition, such as Mach's. Regardless of differences in depth, however, it is important to note that in the epistemological realm Lenin and Mach already seem to be approaching one another. When Lenin states one more time, "this is materialism: matter acting on the sense organs produces sensations," he is opening up his epistemology to positive research horizons in the physiology of the sense organs, horizons to which Mach, as a leading sense physiologist of his day, was completely committed. But before we look at the full extent of this commitment, as well as the rest of the refinements and qualifications that Lenin later makes to his own "materialist" position, let us briefly look at some of the main examples and "arguments"

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[212] Ibid. p.52

that Lenin deploys in support of philosophical materialism in M&EC, more specifically those related to (1) prehistoric Earth, (2) color, and (3) the brain.

Throughout his arguments in defense of materialism, Lenin seeks to pose the findings of "natural science," as well as the standpoint which he takes to be that of "the vast majority of natural scientists," against the muddled, "philosophical obscurantism" of the professors, the immanentists, and the idealists.[213] For example, geological research into the age and pre-historical conditions of the Earth are supposed to act as direct refutations of claims to the metaphysical fundamentality of "experience," or as expressed in a quotation that Lenin takes from Plekhanov, "the history of the Earth shows that the object existed long before the subject appeared…the history of the Earth reveals the truth of materialism."[214] The latter half of Plekhanov's assertion apparently also draws upon a notion of materialism as the "priority of matter," and an understanding of this priority as original and independent existence. Lenin puts the point in his own words: "natural science positively asserts that the Earth once existed in such a state that neither man nor any other creature existed or could have existed on it. Organic matter is a later phenomena…matter is primary."[215] Feuerbach is also called upon here, for his is a similar (though broader) position that simply names "nature," not just

[213] Ibid. p.72
[214] Ibid. p.77
[215] Ibid. p.69

pre-historic Earth but everything that is an "absolutely non-human entity," as that which causes the "downfall of idealism."[216]

We have encountered arguments like this in Chapter One, briefly considering replies from Schopenhauer on the part of idealism, replies that indeed view "knowledge" as the metaphysical foundation of the "world." There are a number of additional arguments of this type against the case of prehistoric Earth, some for example dealing with the necessary presence of an understanding for any and all meaningful references to chronology. However, such arguments were not of interest to Mach, who chose to emphasize experience for quite different reasons, some of which we are by now familiar with.

In general, we are dealing here with an opposition between something like a materialist (or realist) thing-in-itself and an idealist (or phenomenalist) "stream of life."[217] What we will eventually find, however, is that these paradigms are hardly opposed, that both mean to advocate this-worldliness and conscious presence, albeit with significantly different emphasis. Ironically, once we expand our notion of "materialism" by explicitly introducing Marx's writings into our discussion, the views of Feuerbach for one will come to more closely resemble the "idealist" position.[218] We will then be able to ask productive questions about the relationship between immanent peace,

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[216] Ibid. p.79

[217] see for example R. Willy, "things outside men are…bits of fantasy fabricated by men with the help of a few fragments we find about us…Need the philosopher fear the stream of life, the moment which alone can bring happiness?" {{83 Lenin,Vladimir Ilich 1964; }}

[218] See, for example, *The German Ideology*

scientific progress, and revolutionary social praxis. As for Lenin, for the time being the pre-historic Earth example is to provide support for the metaphysical recognition of external matter.

Lenin, perhaps unsurprisingly, also uses the example of color in his attack on idealism. This example bridges the gap between metaphysics and epistemology by appealing both to an independently existing reality and to the nature of human experience. In particular, Lenin criticizes attempts by Mach and his Russian enthusiasts to try to incorporate advanced scientific knowledge about color into their idealist, experience-based accounts. He mentions, for example, Bogdanov's discussions of "the dependent and the independent series of experience," the former relying directly on the sense organs (the retina, for example) and the latter decided by interactions between the elements themselves.[219] Mach offers an extended account of a similar notion early on in his *Analysis of Sensations*:

> Let us consider, first, the reciprocal relations of the elements of the complex ABC…, without regarding KLM…(our body). All physical investigations are of this sort. A white ball falls upon a bell; a sound is heard. The ball turns yellow before a sodium lamp, red before a lithium lamp. Here the elements (ABC…) appear to be connected only with one another and to be independent of our body (KLM…). But if we ingest santonine, the ball again turns yellow. If we press one eye to the side, we see two balls. If we close our eyes entirely, there is no ball there at all…The elements ABC…, therefore are not only connected with one another, but also with KLM. To this extent, and to this extent *only,* do we call ABC… *sensations.*[220]

Mach then applies his point to the specific example of color, stating:

[219] {{83 Lenin,Vladimir Ilich 1964; }} p.53
[220] {{8 Mach,Ernst 1959; }} pp.15,16

> A color is a physical object as soon as we consider its dependence, for instance, upon its luiminous source, upon other colors, upon temperatures, upon spaces, and so forth. When we consider, however, its dependence upon the retina (the elements KLM…), it is a psychological object, a sensation. Not the subject matter, but the direction of our investigation, is different in the two domains.[221]

Mach, in his typical manner, thus attempts to deal with the problem of color methodologically rather than metaphysically, accepting a plurality of research horizons and vocabularies without sanctioning a divide between, for example, sensible and non-sensible realities or primary and secondary attributes. Lenin, however, is unsatisfied with this result for two reasons. First, he rejects the idea that Mach is metaphysically agnostic, pointing out the stubborn idealism and sensationalism that continue to inform his identification of the "primary elements" with sensation-like phenomena, as well as some of Machs' statements, such as "the severing of a nerve sets in motion the *whole* system of elements," which border on the solipsistic.[222] At the same time, Lenin rejects both idealist and agnostic attempts to work physical science into an experience-based schematic, for example with the notion of "an independent series," as "illegitimate, arbitrary, and eclectic." He writes that "if you admit physical objects…acting upon my retina," if you acknowledge "lengths of light waves existing outside of human retinas, outside of man and independently of him," then you have "in fact adopted the materialist standpoint and have completely destroyed all the indubitable facts

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[221] Ibid. pp.17,18
[222] Ibid. p.17

of idealism, together with all the 'complexes of sensations,' the 'elements' of recent positivism, and similar nonsense."[223]

Finally, Lenin looks to the human brain to make his case for materialism. Once again he turns to "natural science," which "inflexibly holds that thought is a function of the brain, that sensations, i.e. the images of the external world, exist within us, produced by the action of things on our sense organs."[224] According to Lenin, this basic truth undermines the totality of idealist talk of the "coordination" of the subject and the object and of the primacy of "environment."[225] On the contrary, a basic understanding of modern neuroscience, according to Lenin, shows that it is not the elements that make up sensual experience which are fundamental but rather "brain matter and external world-matter interacting."

Overall, we have found in Lenin's case for materialism arguments mainly in support of the metaphysical recognition of matter as well as an epistemology which in part highlights the objectivity of scientific knowledge, and in part focuses on the electrical and chemical mechanisms of our brain and sensory organs. Much rarer in *M&EC* are statement of metaphysical reductionism, of the world *as* "matter in motion." This initial situation leaves room for a convergence between the two thinkers, and that is precisely what we will begin to find as we now turn back to Mach's work, going beyond the metaphysical caricature offered in *M&EC*.

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[223] {{83 Lenin,Vladimir Il□ich 1964; }} p.53
[224] Ibid. p. 86
[225] See Avenarius and Fichte

2.4 Mach from Subjective Idealism to Biological Idealism-Developmental Psychophysiology

This section will search within Mach's writings for possible responses to some of the examples and arguments offered by Lenin in favor of materialism. We will turn especially to Mach the experimental scientist, the psychophysicist and sense physiologist. We will find a series of views bearing little or no resemblance to subjective idealism. On the contrary, we see Mach busy with all sorts of physical and psychological investigations of fact, especially into the neurological and sense-physiological aspects of thought and sensation. This seems reasonable, for Mach was first and foremost an experimental scientist, and not a professional philosopher.

Due to the origins of the Vienna Circle in the "Ernst Mach Society," as well as to many other broad affinities, Mach is often discussed as a leading 20th Century "positivist," associated especially with logical positivism. But even if one chooses to see Mach as a positivist (a title which he himself rejected) it will be suggested here that he should be viewed neither as a logical positivist, like Carnap for example, nor as a theological positivist, as we might consider Berkeley. Rather, one could call Mach a biological positivist, for it was first and foremost biological interests and considerations which motivated his work, both as an experimenter and as a philosopher of science.

The main features of this biological basis will be developed throughout the remainder of these chapters, and many of them have already been mentioned. To list a few, there is Mach's focus on the border between physiology and psychology, his use of biological concepts and categories to critique those of physics, the central importance of evolution for his work, both in psychology and in the historical development of science, and finally his general concern with the sphere of life, the 'lifeworld,' as rich and unique from both a scientific and a philosophical point of view, bringing to both of these discourses paradigms distinct form those of physics, including the organic, adaptation, learning and plasticity. Since this section will focus mainly on the constructive features of these interests of Mach, particularly in what we will come to call developmental psycho-physiology, we will not yet be able to make the full case for Mach's positivism, or more fittingly, his empiricism, both of which are essentially linked to pluralism and skepticism.[226] For now, we are content to move forward from Mach the subjective idealist to Mach the biological idealist.

We can start by going back a step further, however, to Lenin's concerns about the reality of the "external world," in order to identify several of Mach's statements that satisfy at least some of Lenin's worries. For

[226] The reasons why Mach's thought is best characterized as an empiricism and not a positivism, as will be shortly discussed, relate to the weightier metaphysical commitments of the latter, as well as its association with Comte's account of an inevitable, historical progression of human orientation to the world. Similarly, the empiricism attributed to Mach is not what Cartwright calls a "radical empiricism," an attempt to build up the world solely from so-called "sense data," but rather involves a skeptical check on theoretical fundamentalism in the name of tolerance, sobriety, and the ordinary language.

although Mach was always opposed to describing a metaphysical, “material” reality existing outside of experience, he wrote constantly about a rich and manifold world composed of infinite *facts*, and we have already looked at some of his statements recognizing independent, physical objects, at least in the contexts of practical life and physical research. For an example of the former type of sentiment we may look to Mach’s *Popular Lectures*, where he states that “the human mind, with its limited powers, attempts to mirror to itself the rich life of the world, of which it is itself only a small part, and which it can never hope to exhaust.”[227] This is hardly characteristic of a passive solipsist. And although Mach’s notion that the primary goal of science is to “mimic facts in thought” is ‘metaphysically’ distinct from Lenin’s copy theory of knowledge, there are also important, practical similarities. These come through when we look at other statements from Mach, such as when he says that “nature exists only once” over against “our schematic mental imitation.”[228] Similarly, Mach observes that “the stone which we hold in our hand not only falls to ground in reality, it also falls in our thought.”[229] Finally, to foreshadow some issues concerning laws and determinism, Mach was a considerate physicist who was capable of making statements such as “every organism together with its parts is subject to the laws of physics.”[230] Where he saw the limitation in such ideas, however, and how he thought that biological concepts

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[227] {{39 Mach,Ernst 1898; }} p.186
[228] Ibid. p. 200
[229] *On Transformation and Adaptation in Scientific Thought*, {{39 Mach,Ernst 1898; }} p.220
[230] {{8 Mach,Ernst 1959; }} p.98

such as teleology as well as refinements in our notion of causality could assist in these areas, will be the subject of later sections and chapters.

As we start now to ask about color and then sense physiology and neuroscience, we find more convergence of the ideas of Mach and Lenin. In Chapter IV of the *Analysis of Sensations*, entitled "The Chief Point of View For the Investigation of the Senses," Mach describes a recent psychophysical study in the following way: "Young saw that an unlimited number of kinds of physical light with a continuous series of refraction indices (and wavelengths) was compatible with a small number of color sensations and nerve processes…that a discrete number of color sensations did answer to the continuum of deflections in the prism."[231]

It seems then that Mach had no trouble distinguishing light as a physical phenomenon and as a psychological one, and no problem describing the former in terms of retina-independent wavelengths. And with respect to the dependency of the latter on the bio-chemical mechanism of the eye, Mach was informed of and involved in researching these mechanisms throughout his career, expressing his findings in statements like, "six fundamental colors, six fundamental chemical processes in the retina."[232] In general, there is a clear affinity between Lenin's definition of materialism as "matter acting on the sense organs produces sensations," and Mach's demand that "we must look

[231] Ibid. p. 64
[232] {{8 Mach,Ernst 1959; }} p.7

for the reason why a body K throws an image upon the retina N, and sets up a visual sensation E."[233]

In Chapter One, we reviewed some of Mach's ideas regarding the great prospects of psycho-physiological research. It was this research, according to Mach, and not logical, epistemological, or theological speculation which would "reveal to us the true elements of the world," which Mach provisionally established as colors, sounds, temperatures, pressures, spaces, and times. We saw how Mach, quoting another noted physiologist, Hering, had praised the latter's vision of the "psychophysical tunnel" which such research would open, allowing greater insight into the correlation (and ultimate unity) of the physical and the mental. And indeed, the tunnel was to be open from both ends. Mach formulated his own version of this research agenda when he spoke of the "principle of the complete parallelism of the psychical and the physical."[234] Turning now to this agenda in greater detail, we will, in order to answer the concerns of Lenin, pay special attention to his strong focus on the path leading from the physical to the mental, on the physiological and neurological aspects of sensation, thought, and behavior.

We have already established that Mach was profoundly interested in the physiological basis of sensation. This basis was for Mach the *sin qua non*

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[233] Ibid. p. 92

[234] Ibid. p.60- For an excellent discussion of the development of this concept by Fechner and its meaning within both his own work and in general to 19th and 20th Century German thought, including the "philosophy of nature" tradition as well as the more strictly empiricist trends of German naturalism and wholism, see Heidelberger, "Nature From Within: Gustav Theodor Fechner and His Psychophysical Worldview" The conclusion of this thesis will attempt to make certain comparisons between "psycho-physical parallelism" and Spinoza's philosophical program.

of all sensual experience, and thus we find him expressing the idea that "a certain nervous process, as the final link in the chain, is the essential and immediate condition of the sensation."[235] But Mach's principle of complete parallelism, which he described as a "heuristic principle of research", demands investigation into the physiological aspect of all psychological phenomena, including thought and behavior. Furthermore, given Mach's focus on the experience of infants as especially important for our understanding of both the world of elements and the derivative emergence of ego and object, we should not be surprised to find Mach pursuing the physiological basis of early human development. Recalling Lenin's interest in Diderot's egg, we find Mach pointing out the "remarkable progress made by experimental embryology and the mechanism of development using physico-chemical methods."[236]

Turning to thought, consciousness and the brain, it becomes obvious that Mach had no reservations at all about the physiological basis of mental life. In the opening chapter of *Knowledge and Error*, he laments the fact that we have "only lately begun to accept a psychology without a soul." Later on in that work, in a statement that could be mistakenly attributed to many contemporary "materialists," Mach asserts that "consciousness is not a special mental quality or class of qualities different from physical ones, nor a special quality that is added to physical ones to make the unconscious

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[235] {{8 Mach,Ernst 1959; }} p.60 It is crucial to remember that for Mach, "the mental is no more or less mysterious than the physical, from which indeed it does not differ essentially."
[236] Ibid. p.95

conscious," adding that the "integrity of consciousness hinges on the integrity of the cerebral lobes."[237] Finally, Mach eagerly anticipated the results of research, ongoing to this day, attempting to localize mental functions to their corresponding regions of the brain.[238] For the time being, we will not seek to determine where these ideas situate Mach with respect to the contemporary debate in the "philosophy of mind" between identity theorists, eliminativists, functionalists, and so on. For now their importance lies in the vast gap that they create between Mach's perspective and that of his caricature in M&EC.

Mach extended these ideas to the study of learning and behavior as well. It is here that we first uncover Mach's early formulations of the conceptual paradigm that eventually frees developmental and cognitive psychology, as well as the philosophy of mind, from the stale oppositions of materialism vs. idealism and nativism vs. empiricism, that of *plasticity*. In fact, one can find in Mach's writings rudimentary versions of concepts such as prototypes, representational spaces, and the three levels of learning, which thinkers like Paul Churchland are using today to establish a "new

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[237] {{8 Mach,Ernst 1959; }} p.31

[238] see for example {{2 Mach,Ernst 1976; }}where Mach, writing about memory, observes that "to each partial memory corresponds a portion of the brain, some of them fairly accurately localizable even now." Mach continues on about how the different regions of the brain, responsible for different functions are connected by "association fibers," the establishment and arrangement of which are responsible for much of our "second order understanding." Indeed, there is much in common between Mach's (more primitive) vision of psychophysiological research and contemporary work on the "neural correlates of consciousness." Some advocates of the latter, however, insist on framing their work as part of a "good reductionist" program, as opposed to any number of "fuzzy" alternatives. (see for example, Koch, Christof "Quest for Consciousness: A New Biological Approach") At the same time, however, despite a grand vision of a materialist-mechanistic "theory of consciousness," Koch admits that at this point we have only begun to identify the neuronal mechanisms behind the fairly basic percepts of, for example, color and face recognition. It will be interesting to see how rigid the metaphysical lines can remain as these researchers continue towards their ultimate target of the pre-frontal cortex, and thus of understanding self-conscious reflection, self-control and discipline, long term planning and deliberation, etc.

epistemology" based on mental plasticity. For now, insofar as we are concentrating on those of Mach's accounts which stress the physical and physiological aspects of consciousness and behavior, we turn to some of his rather astonishingly naturalistic and mechanistic psychological positions, for example those found in Chapter II of *Knowledge and Error*, entitled "a Psycho-Physiological Consideration."

Attempting to narrow the allegedly vast gap existing between involuntary, automatic behaviors ("the pupils of the eye contracting mechanically with brightness," "digestion, nutrition, and growth," etc.) and voluntary, deliberate courses of action ("opening a drawer," "the processes we call weighing, deciding, willing," etc.) Mach points out that even the latter "seem to follow a pathway of stimulus-response mediated by a series of involuntary memory-associations."[239] For example, according to Mach an invitation from a friend for dinner at his home might incite the following series of associations: "We remember hearing his witty conversation, the piano standing in his room and his excellent play of it; suddenly we remember that today is Tuesday and that this is the day on which a quarrelsome man generally visits our friend, and so we thank him but decline the invitation."

Regardless of our final decision, Mach observes that "in the simplest as well as in the most complicated cases, memories that become effective influence our movements just as directly," and that "we do not control what memories come to the surface and which of them will carry the day." Mach

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[239] {{2 Mach,Ernst 1976; }} p.19

concludes, therefore, that "in our 'voluntary actions' we are no less automata than the simplest organisms."[240] Indeed, if human beings tend to regard themselves as "totally different" than these latter it is only because of our relatively more complex mental life. To bring home the actually rather small scope of this difference, Mach provides the following analogy:

> A fly whose movements seem to be determined and guided by light, shade, smell, and so on, may have been chased off ten times, it will settle back on the same part of the face and cannot give in until it drops to the floor swatted. A poor beggar is anxious to get a penny to secure him for the day and therefore goes on pestering a comfortably somnolent bourgeois until the latter dismisses him with a curse.

In both cases, Mach observes, we are dealing with actions that are "automatic," although in the latter drama the actors are "somewhat less simple automata." In concluding these reflections, Mach carries his ideas into history, looking for like-minded allies among great thinkers. According to Mach, Descartes, who indeed regarded animals as machines, lacked the courage, especially in the face of the Inquisition, to extend this characterization to men. Spinoza, according to Mach, thus offers an advance from Descartes. And while Mach praises the work of Lamettrie, for example his book "*L'homme machine*,"(1748) he finds it's content dated. In the end, the historical thinker who receives Mach's most direct approval is none other than Diderot himself! Mach cites in particular the "Conversations between D'Alembert and Diderot," (the precise text quoted approvingly and at length

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[240] Ibid. p. 19

by Lenin in M&EC) as a “penetrating work” which “anticipates the ideas of modern biology.”[241]

How then can it be denied that Mach’s work was consistent with, and indeed at the cutting edge of, the “natural science” of his day, especially with respect to psycho-physiological and neurological research? It is as if our new task is to remind ourselves why Mach is not himself a “materialist,” to figure out how to reconcile Mach’s technical research with his doctrine of elements, and to demonstrate that this combination offers a coherent and compelling re-orientation of the scientific world conception.[242] As we will shortly see, Lenin denies the possibility of such a demonstration, concluding that Mach’s body of work represents an unsavory blend of good science and bad philosophy.

Lenin’s view is misguided, however, and before we formulate his objections at length, we might consider a few roles that Mach’s philosophical positions could ultimately play, thus simultaneously answering the question of why Mach is not a “materialist.” First of all, we have discussed at length Mach’s anti-reductionism. Not only will the doctrine of elements play a role in discouraging the identification of reality with a non-sensible world of matter in mechanical motion, so too will Mach’s sense of the “complexity of the organic,” which in his estimation “resists the reduction of living things to physical processes.”[243] We will shortly see the way in which this latter view is associated with Mach’s deep interests in both (what is today called)

[241] Ibid. p.21
[242] Heidelberger makes a similar case for Fechner’s “day-view phenomenology” and his “non-reductive materialism” in “Nature from Within” {{37 Heidelberger,Michael 2004; }}
[243] {{2 Mach,Ernst 1976; }} p.98

evolutionary psychology and the study of the relationship between culture and human development.

Ultimately, the goal is to demonstrate that Mach was neither a materialist nor an idealist, that his biological empiricism was an essentially pluralistic program, one that however stressed the promise of one relatively neglected research program in contemporary science. Mach suggested that the reinvigorated pursuit of this research, which we have called developmental psycho-physiology, would not only disabuse us of several antiquated and potentially dangerous conceptions of science and scientific truth, but could simultaneously set science upon a rich, new path of discovery. For a clearer picture of this vision, we can look to an excerpt from Mach's lecture "On Symmetry," delivered in Prague in 1871.

Mach opens his talk by recalling an ancient philosopher who criticized some of his peers for seeking knowledge of the moon, suggesting instead that genuine wisdom turns our inquiries within, especially towards our moral ideas and ideals. For his part, Mach is both critical of that thinker's myopia and sympathetic to his general concerns. In the following passage he attempts to synthesize these reactions:

> The motions of the moon and the other heavenly bodies are accurately known. Our knowledge of the motions of our own body is by far not so complete. The mountains and natural divisions of the moon have been accurately outlined on maps, but physiologists are just beginning to find their way to the geography of the brain. The chemical constitution of many fixed stars has already been investigated. The chemical processes of the animal body are questions of much greater difficulty and complexity. We have our

> *Mecanique celeste*. But a *Mecanique sociale* or a *Mecanique morale* of equal trustworthiness remains to be written.

In this way, Mach means to celebrate the advances of modern science while simultaneously challenging investigators to pursue new horizons. He sees great value in the "celestial journey" on which science, especially mathematical mechanics, has taken mankind over the last few centuries, and appreciates in particular the fact that this journey has sharpened our thought with "clear and simple ideas." However, Mach ultimately sees these advances as a prelude, a necessary preparation for a renewed venture into the "more complicated domain" of psychology.[244] One can perhaps detect the Kantian roots of such a program, out of which, however, has sprouted a biological conception of mind instead of a logical one, as well as positive research methods to replace transcendental analysis; thus the ingredients necessary for a "biological idealism."

Mach believed that the results of the union of modern natural science and physiological psychology would, "in all likelihood, far outstrip those of the modern mechanical physics."[245] It is not our task to evaluate the ultimate truth of his prediction. It is instructive, however, to point out the last century's great advancements in neurobiology, as well as evolutionary, developmental and cognitive psychology, For now, however, we return to Lenin's critique of Mach, taking up again the question of the consistency of Mach's science with his philosophy.

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[244] *On Symmetry*, in {{39 Mach,Ernst 1898; }}89
[245] *The Economical Nature of Physical Inquiry*, {{39 Mach,Ernst 1898; }} p.212

Lenin was himself somewhat aware of Mach's research work and interests. He cites a section of the *Analysis of Sensations*, for example, where Mach "allows that the physical-chemical analysis of the brain gives insight into the physiological processes corresponding to sensation."[246] As already noted, however, he does not believe that such research is reconcilable with Mach's "philosophical" position that the "real elements of the world" are colors, tones, etc., demanding rather that the research points to fundamental elements of "brain matter interacting with external world matter." Overall Lenin does not find in Mach's writings a cohesive and enlightening advance "beyond metaphysics" and the excesses of reductive, modern physics, but a confusing and "reactionary" hodgepodge that "vacillates between idealism and materialism" and thereby "mechanically jumbles fragments of Berkleianism with the views of the natural sciences."[247] These philosophical fragments, according to Lenin, "vanish" whenever Mach treats of problems of physics, in which cases he "speaks plainly, without idealist twists, i.e. as a materialist."[248]

Our task is then to once again justify the role played by the doctrine of neutral elements in Mach's thought, this time within the framework of biological empiricism that has been developing throughout. It is interesting to note, as Lenin does, that this type of justification has been attempted before, in particular by the supporters of Berkeley. For example, attempting to evade

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[246] {{83 Lenin,Vladimir Ilich 1964; }} p.34
[247] Ibid. p.37
[248] Ibid. p.58

charges of subjective idealism and solipsism, Berkeley's editor denied the accusations and instead described the Bishop's work as "natural realism." Similarly, Valentinov, one of the "Russian Machists," attempted to free Berkeley from his reputation as a "solipsist and a preacher of religious metaphysics," by characterizing his philosophical observations simply as good sense and "thoughtful analysis."[249] We will thus shortly turn to the "thoughtful analysis" of Mach, though hopefully without arousing charges of empty sophistry. It will be shown that Mach's doctrine of elements is the foundation of a tolerant pluralism grounded not in theology, but in biology, physiological and evolutionary psychology, and keen observation of the history of science.

Before we turn to the specific features of Mach's standpoint, however, we should say something about the general form and possibility of such an outlook. Some might object, for example, that Lenin is correct to demand a metaphysical commitment from Mach. On the one hand, the latter might make some good methodological points about the programmatic benefits for science, at least for the time being, of the deployment of a plurality of concepts and methods by a number of independent, though collaborative disciplines. On the other hand, at the end of the work day, when we come together to articulate and recognize truths about the world, must we not have a determinate answer regarding the priority of matter or spirit? For indeed,

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[249] Ibid. pp.20,30

must not the metaphysical truth about the 'world itself' be one way or the other- all day long?

In response, it seems that first of all we should not underestimate the force of the methodological objection to metaphysics. If the latter can be shown to be fruitless, (or worse) contributing nothing to the daily tasks of representation and intervention in the various specialized fields of science, then why shouldn't we heed calls to abandon talk of a *total*, metaphysical worldview altogether? If reality is indeed "infinitely rich and inexhaustible manifold," than it is unlikely that genuine researchers would have the time to engage in speculative metaphysics, especially the polemical variety. On the contrary, some people will simply find themselves more intrigued by the micro-structure of organic and inorganic objects, some by the psychological and physiological aspects of human learning, and some by the optimal patterns of social and productive organization for satisfying common needs. Regardless of the conceptual framework prevailing within their specialty, however, each will engage, in the course of their day, a plurality of stuff, as well as of vocabularies and techniques for dealing with it. To borrow (and expand on) a point made by Mach in a late essay on "Sensory Elements and Scientific Concepts," metaphysical aphasia will not lead us into methodological apraxia.[250]

With respect to the 'world itself,' one aim of this thesis is to argue that if metaphysical speculation is indeed fruitful, it is not so for scientific progress,

[250] {{Blackmore, 1992;}} p.123

understood conventionally, but rather for any number of ethical and political ends.[251] The problem with such speculation, however, arises when alternatives are expressed polemically. How are we to adjudicate between ultimate truths about the world when no confirmation in experience is possible? Moreover, and perhaps more importantly, how can we arrive at metaphysical conclusions when the very notion of ‘world’ admits of many interpretations? Part of the reason to avoid (or supersede) metaphysics is that the ‘world’ is essentially a value-laden concept. Perhaps this is why Kant attempted to bracket the content of the noumenal as unknowable, leaving intact the possibility of speculation but not its force.

But this sounds like Mach again, although he of course throws the form of the noumenal out with its content. Lenin will object that, all pleasantries aside, any reasonable, scientifically-minded person will recognize that ultimately, matter is all that there *is*. One need only respond that uncompromising “materialism” of this sort represents the misuse of an auxiliary concept, the exaggeration of a specialized notion into a worldview. Historically, this worldview might be linked to the critique of traditional theism, but that debate remains undecided to this day, including among respectable scientists. And when it comes to the admission of a “material basis” of the world, it is fairly easy to find metaphysical systems that incorporate that basis, using teleological notions, for example, into a brand new theology.

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[251] a deeper discussion of these issues can be found within the next Chapter, in the section on “Ethics and Metaphysical Recognition”

Furthermore, it goes without mention that various forms of speculative pan-psychism remain completely unrefuted. In all cases of these total, speculative worldviews, extra-scientific notions of purpose or purposelessness, familiarity or alienation, discipline or play, etc. seem to play as big a part as reasonable, scientific thinking.

And so it is not at all clear that, generally speaking, Lenin is justified in demanding a metaphysical commitment from Mach, let alone a tacit affirmation of materialism. Before we now continue our discussion of Mach's anti-metaphysics, his rejection of speculation in favor of a tolerant and pluralistic empiricism, it is instructive to think about the way in which Mach's standpoint places him somewhere in the middle of speculation and anti-metaphysics. When Mach writes about *Sinnlichkeit*, about our "customary sensory world" and its priority, he is working all along the continuum of metaphysical possibilities. On the one hand, he is not rejecting the physical world in the name of an independent, psychical one, nor is he rejecting the value of abstract concepts in favor of immediately given sense data, for indeed Mach denies that there is any such "deep chasm between human sensations and the world of concepts." Mach favors the "customary sensory world" not because it is free of theory, but because it embraces a mixture of theoretical orientations and evolutionary adaptations, and thus because it grants predominance to no one, specialized concept or metaphysical system. At the same time, however, Mach himself views *Sinnlichkeit*, views "sensuality," in his work and his personal beliefs, as an especially relevant scientific and ethical (perhaps even metaphysical) realm- we might call it the *sensual whole*. It is our acquaintance and ever-deepening familiarity with this sensual world that Mach sees as our deepest concern, and so it is immersed in the sensual elements that Mach believes that we may finally find peace, especially a "falling away of the apparent bounds of a person."[252] For now, however, we are interested in how Mach applied these more speculative beliefs within a methodological context, through his pluralist rejection of reductionism, particularly in psychology.

2.5 Mach from Biological Idealism to Biological Empiricism- Pluralism and the Unity of Science

We have described the constructive component of biological empiricism as a commitment to the reinvigorated pursuit of research in developmental psycho-physiology. One might describe such a program in isolation as biological idealism, a Kantian-style attempt to, as Mach puts it, "unravel the subjective conditions of a finding."[253] What distinguishes this *biological* idealism from its "transcendental" predecessor, however, is its shift in focus away from the systems of propositions, judgments, and other language-like structures that are supposed to make up the knowledge of the epistemological subject, and towards the organism and its total *acquaintance* with and *adaptation* to its environment. As such, although both Kant and

[252] {{Blackmore,John 1992;}} p.192
[253] {{2 Mach,Ernst 1976; }} p.6

Mach are concerned with providing an account of what William James called "active perception," the latter incorporates naturalist methods and concepts in order to more fully pursue what Churchland has called the "incredibly plastic conceptual and perceptual possibilities" that characterize human behavior and experience.

A crucial feature of this naturalistic approach would be, for Mach, the expansion of our understanding of evolution, along with it's central concept of adaptation. As we saw in Chapter One, Mach believed in the "tenability and fruitfulness of the Darwinian ideas in the different provinces," observing that they had already become "firmly rooted in every branch of human thought." Mach himself was particularly interested in utilizing the still vague but promising concepts of evolution both for our understanding of the nature and historical development of science, and as an additional inspiration for the psychological portrait of human nature. Of the former goal, he appeals to the need to "consider the growth of natural knowledge in light of the theory of evolution," and, in general, to look upon all forms of conscious inquiry, as an "instinctive activity of animals and men both in nature and society." One aspect of this activity is its tendency to pursue a state of equilibrium, to follow the pattern of "habit, disturbance, and adapted habit."[254] Mach thus presents a model both for the progress of knowledge as well as the growth and

[254] {{8 Mach,Ernst 1959; }} p. 57

development of individuals that resonates in the writings of American pragmatism.[255]

With respect to the development of individuals and the species, Mach was an ardent proponent of what has come to be called evolutionary psychology. He states that we should "regard ourselves and every one of our ideas as a product and a subject of universal evolution." Attaching a research horizon to this description, Mach suggests a demystified study of the collective unconscious in the form of a "precise investigation into the species memory."[256] The goal of such research for Mach seems to be to gain a deeper insight into the mechanisms of human habituation, learning and adaptation, thus ultimately paving the way for interventions meant to expand our experiential and cognitive sphere of familiarity, to "adapt to a wider range of spatial and temporal surroundings." At the same time, Mach hoped that we would observe, and perhaps consciously advance, the "unlearning" of antiquated evolutionary adaptations belonging to life "in the forest," replacing them with advanced critical, intellectual, and moral capacities.[257]

This focus on evolutionary psychology requires the recognition, according to Mach, of an autonomous, non-reducible sphere of sensations and psychic life. Sensations are to remain an important part of psychological research because of their necessary role in the "development of reflexes and

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[255] see Dewey, *Logic: The Theory of Inquiry* and Peirce, *The Fixation of Belief*
[256] {{2 Mach,Ernst 1976; }}
[257] {{8 Mach,Ernst 1959; }} p.65

instinctive actions" and other behaviors directed toward "self-preservation."[258] Since all subsequent behavior and mental life, including the "strength and clarity" of imagination shown by the "thinking adult," is based upon this foundation of basic, self-preserving activity, Mach argues that in order to understand the organism and its adaptation, we must preserve a place for sensations in our psychology, a psychology that includes developmental and evolutionary, and not just cognitive, components.

Furthermore, a circumspective psychology will need to incorporate an account of *culture* as well, of the transfer of knowledge and values and the patterns of collective learning that are so instrumental in shaping the individual's experience of and adaptation to the world.[259] Mach himself made much of the cultural transformations seen in modern, civilized societies, and their influence on the growing power and importance of imagination and free mental life, of the depth and breadth of associative thinking. It is thus that he concluded that *both* "biology and the history of civilization are equally valid and complimentary sources for psychology and the theory of knowledge."[260] Mach unites the physiological, evolutionary and cultural approaches to psychology in his concept of the "sensible idea," an amalgamation of sensations, associations, habits, memories and reflections that characterizes

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[258] {{2 Mach,Ernst 1976; }} p.46- he writes, for example, about "first sensations of organs from all parts of the body which reach into the cerebrum as hunger, thirst, and the like and form the basis of instincts."

[259] For a more contemporary discussion of culture, psychology, and the brain, see for example Paul Churchland's lecture on "Inner Spaces and Outer Spaces"

[260] "On the Development of Individuality in a Natural and Cultural Habitat" in {{2 Mach,Ernst 1976;}}

the bulk of human experience, leading Mach to characterize our "seeing" of the world as a complex and dynamic form of "recognition."[261]

We will return to Mach's discussions of "sensible ideas" in the next chapter, but we should at least note here that Mach viewed the complexity involved in the construction of a sensible idea as another reason to not "reject so-called 'introspective psychology' entirely." In the *Analysis of Sensations*, he gives the example of trying to predict, psychologically, the thoughts that a given physicist would connect with the observation of a particular "optic fact." In order to make such a prediction accurately, Mach reports, "we should have to know the previous events of his life, the force of the impressions which they left behind them, and the facts of the development of general and technical culture by which he has been influenced." And so he concludes that there are situations in which "self-observation is not only an important means, but in many cases the only means of obtaining information as to fundamental facts."[262]

These considerations help us to move from the constructive to the critical aspects of biological empiricism, for they represent an opposition to reductionism and a call for pluralism with respect to our psychological

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[261] "Memory, Reproduction, and Association," in {{2 Mach,Ernst 1976;}}

[262] {{8 Mach,Ernst 1959; }} p. 340 There is much in common between Mach's anti-reductive arguments for the autonomy of psychology and those, for example, found in William Bechtel's essay, "Reducing Psychology While Maintaining Its Autonomy Via Mechanistic Explanation." Mach, like Bechtel, was enthusisastic about the way in which *physiological and neurological mechanisms could account for psychological phenomena*, and believed, also like Bechtel, that the attempt of some psychologists to ignore such mechanistic knowledge, where available, is, as Bechtel describes it, "foolhardy." However, both thinkers claim that additional, non-reductive information concerning the situation of these mechanisms within an environment (Bechtel mentions the work of ecopsychologists and psychophysicists) is also relevant in understanding the broader context and function of the mechanism, and thus for understanding the phenomena itself.

methods. The doctrine of elements, which is, as we have seen, fundamentally a plea for methodological pluralism, thus aims to ward off any attempt that physics might make to completely swallow biology or psychology. It is thus relevant both for Mach's specific, constructive agenda with respect to the empirical sciences, as well as for his broader critical and ethical positions.

As we now continue to examine both, it is important to remember that Mach himself never presented a systematic philosophical position, that our re-construction of "biological empiricism" is derivative and somewhat artificial, though hopefully suggestive. What Mach lacks in logical rigor he makes up for in candor and, more importantly, a sense of practical relevance and applicability, for as he often asserted his task was "not philosophical but methodological." He had no interest in introducing a new, comprehensive world-view nor a set of "Machean" neo-logisms designed to uniquely capture ultimate reality. Rather, he sought to "shake free of all wild philosophies," to work exclusively "in the ordinary language" and thereby demonstrate its richness and flexibility, its own capacity, as documenter of experience, to serve as a common ground for scientists working across the disciplinary boundaries.[263] It is these goals of criticism and cooperation, and not absolute or ultimate truth, that allow us to view Mach's work as an attempt to get beyond metaphysics, i.e. not as a once-and-for-all, systematic "biological idealism," but as a tolerant, provisional, and pluralistic contribution to the

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[263] {{2 Mach,Ernst 1976; }} p.7

philosophy of science, a “biological empiricism” meant to advance scientific self-understanding and inter-disciplinary collaboration.

Given these commitments, it makes sense that when we speak of Mach’s “empiricism” we do not attribute to him what Nancy Cartwright has called a “radical empiricism,” i.e. a foundationalist epistemology that focuses on sense data and the *tabula rasa*. Rather, Mach’s focus on the primacy of *experience* is meant as a critical check on theoretical exuberance, as a “staunch empiricism,” as Cartwright calls it, understood as a persistent skepticism that continually asks the questions “what do you mean?” and, perhaps more directly, “what is the relevance for experience?” Consistent with at least one aspect of the enlightenment tradition with which Mach identified so strongly, his empiricism sought to exonerate everyday life by challenging the dangerous aura and illegitimate authority of inherited systems- religious, political, *and* scientific.[264] In the next chapter, in the context of Mach’s debate with Planck, we will discuss this aspect of Mach’s thought as his “critical phenomenalism.”

But let us first review the basic, critical components of Mach’s position. The first crucial element is its broad foundations in biology and the biological standpoint. We read in Chapter One of Mach’s interest in science as a

[264] According to the Austromarxist Otto Bauer, this type of empiricism is historically linked with English political philosophy, in particular with its individualism and concern for autonomy. These, according to Bauer, form the basis of the “bourgeois understanding” that, particularly through the influence of Locke, emerged in modern times as the general understanding, and which exists in perpetual conflict with and contradiction to the total *interdependence* and prevalent exploitation characteristic of global capitalism. We will return to some of these issues in Chapter IV {{49 Mozetič,Gerald 1983; }}

"biological and organic phenomenon," and can elsewhere find him recommending that we "conceive of all psychical life, including science, biologically."[265] We have also mentioned Mach's focus on the sphere of life itself as especially interesting and unique from a scientific perspective, his belief that "in the sphere of the organic a much larger section of the world-process is manifested."[266] It is in this context that Mach was intrigued by Darwin, by his biological revolution that did for the concept of plasticity what Galileo's pioneering work in physics had done for measurement. As we have seen, Mach's hope was that this sphere of the organic, and in particular the domain of thought, sensation, and learning, could now be explored with greater precision, with "biology serving as an intermediary between physics and psychology." [267]

Mach furthermore engages in a criticism of physical concepts from the biological standpoint, in particular the concept of causality. Much of this discussion will be put off until the next chapter, in which we will consider the debates between Mach and Max Planck in the philosophy of physics concerning objectivity, causation, idealization, and the nature of scientific education. For now, we simply mention Mach's views that "the old causal formula is incapable of embracing the multiplicity of the relations that exist in nature," and that the biological category of teleology can be consciously and

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[265] {{8 Mach,Ernst 1959; }} p.50

[266] {{8 Mach,Ernst 1959; }} p.92 Mach's concern for the "lifeworld" provides a connection between his work and that of a great number of modern, German thinkers from across the philosophical spectrum

[267] {{6 Blackmore,John 1983; }} p.112

productively used in research alongside mechanistic notions of causation, especially where full insight into causal mechanisms is lacking.[268]

As we will see, the main goal of Mach's writings on causality was to "force us into a greater accuracy of expression," and as we saw in the first chapter, this thrust towards candor and transparency may be described as the principle aim of all of Mach's critical, "anti-metaphysical" work.[269] On the one hand, it involves for Mach the avoidance of absolutism and overstatement in science, and as such we encounter his explicit sympathy with contemporaries like Poincaré and Duhem, expressed, for example, by praising the latter for "rejecting any metaphysical interpretation of questions in physics," and instead seeing it "as the aim of that science to determine the facts in a completely economic way."[270] There is generally a demand for humility in such sentiments, the kind that is eager to describe the fundamental skill set of successful science as "good housekeeping."[271]

Mach's anti-reductionism was also discussed at length in Chapter One, and we bring it up here again, now alongside Mach's positive agenda in psychophysics, in order to further develop our understanding of Mach's unique version of empirical control. So the question remains: what does it mean for Mach to speak of colors, sounds, temperatures, pressures, spaces, and times, which are often discussed as "sensations," as the "primary

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[268] see for instance Chapter 5 of the *Analysis of Sensations*, entitled "Physics and Biology: Causality and Teleology."
[269] {{8 Mach,Ernst 1959; }} p.92
[270] {{2 Mach,Ernst 1976; }}
[271] *The Economical Nature of Physical Inquiry,* in {{39 Mach,Ernst 1898; }}

elements?" On the one hand, a science that has re-centered its research agenda onto problems in psychology might deal to a great extent with such elements, and as we have seen, Mach was one to argue for their continued, fundamental role in that science. Time and again, he criticized those who asked "how it is possible to explain feelings by the motions of atoms in the brain," responding that "this will never be done," that "the problem is not a problem."[272] In general, Mach was highly critical of any attempts to eliminate sensations from science by reducing them to the more fundamental realities of matter in motion. In *Knowledge and Error*, he declares that sensations are frankly "too simple and fundamental to reduce to something else," adding that this whole line of thinking was quite precarious. However, with typical candor, Mach does add the qualification "at present," suggesting that at some future time such a reduction might seem more plausible. And yet, elsewhere in *Knowledge and Error*, in an important passage that we have already examined in part, Mach provides a justification for the doctrine of neutral elements that appears to be more timeless. The full passage reads as follows:

> Our elements are thus only provisional…Although for the purpose of eliminating philosophical sham problems reduction to these elements seemed the best way, it does not follow that every scientific inquiry must begin with them. What is the simplest and most natural starting point for the psychologist need not at all be so for the physicist or chemist who faces quite different problems or different aspects of the same question. However, notice *one* thing. While there is no difficulty in building up every physical experience

[272] Ibid. p.280

> form sensations, that is mental elements, we can foresee no possibility of representing any mental experience in terms of the elements currently used in physics": i.e. from the masses and motions in the rigid form that alone is serviceable in that special branch of science.

Mach's advocacy of neutral elements is ultimately meant as a long-term means of establishing peace and collaboration between the scientific disciplines by both fending off the domination of psychology by physics *and* by providing a tolerant and pluralistic atmosphere for all varieties of research based upon reference to a common world of experience. It is an attitude that challenges the claim of physico-mechanicalism (both in the late 19th Century and today) to "exclusive competence in comprehending the universe," yet without seeking to halt or undermine physical research. Rather, it seeks merely to remind or persuade physicists that they too are "always operating with sensations," albeit in complex ways- motivated by complex hypotheses and utilizing complex instruments and experimental setups- which will be the topic of the next chapter.

Insofar as it seeks to provide a tolerant atmosphere for all varieties of research based upon an (ultimately) common experience, and insofar as it means to challenge mechanistic hegemony, Mach's biological empiricism shares many features with other exemplars of staunch empiricism and pluralism, for example various "postmodern" positions as well as the *technological empiricism* that we will shortly attribute to thinkers like Otto Neurath, Alexander Bogdanov, and Nancy Cartwright. All are philosophies of freedom, exposing choice and possibility where others formulate pseudo-necessity, and each would likely celebrate along with Mach the "sublime glow of freedom from presupposition by which we recognize the true inquirer."[273]

As such, all of these positions likewise share an unwavering commitment to pluralism, Neurath going so far as to call it the "backbone of [his] thought."[274] And just as Mach claims that "nature has many sides," thinking especially of the psychological and physical aspects of the world, we will shortly see Neurath et al's pluralistic commitment to the *many measures* with which we can approach, report on, and re-arrange that world. This is similarly true with respect to the postmodern commitment to the plurality of "language games."

In all cases, whether working with 'elements,' 'capacities,' or 'discourses,' the thinkers stress the provisionality and flexibility of boundaries, often agreeing with Mach that "the subject matter of knowledge is common to all domains of research," and thus that "fixed, sharp lines of demarcation cannot be drawn." Communication and collaboration are the general goals that follow, under which different ideals of a "unity of science emerge," one more closely related to psychophysical fluidity, one to organizational solidarity, and one so skeptical of the potential for hegemony latent in the concept of unity that it is only willing to formulate the weakest versions of procedural oneness.

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[273] {{8 Mach,Ernst 1959; }} p.50
[274] {{38 Uebel,Thomas E. 1991; }}

In all cases, however, community, experience, and election are privileged over abdication to an unseen, deterministic mechanism- whether physical, economic, or cultural. Up until now, we have been focusing on Mach's particular vision, one linked closely to biology and committed to innovations in learning and experience forged under the paradigm of *psychological plasticity*. We will also have occasion to discuss aspects of the work of Neurath, Bogdanov, and Cartwright (whether with respect to the Lenin-Mach debate inside Marxist circles or the reconciliation of Mach and Planck in physics) and to witness their commitment to technological and social innovation forged under the paradigms of *engineering* and *planning*.

We will briefly return to the metaphysical opposition framed by Lenin in M&EC, for having exposed one half of Lenin's portrait as an inaccurate caricature (Mach as "subjective idealist") it is time to turn to Lenin's own position. We will quickly find that there are sharp limits to his "philosophical materialism," and as he qualifies and refines his views it will become clear that what he is actually engaged in is a campaign for practical progress and expanded self-consciousness forged under a paradigm of *dialectics*.

But let us first review the main features- constructive, critical, ethical, political, and speculative of Mach's *biological empiricism*:

<u>Methodological-Constructive:</u>

(1) a focus on the border of psychology, physiology, and physics towards the development of a (non-reductive) developmental *psycho-physiology*

(2) a focus on *evolution* as a paradigm both in psychology and the philosophy and history of science

(3) a general, biological standpoint that concerns itself with the *sphere of the organic* as rich and unique from a scientific and philosophical point of view.

By combining (1), (2), and (3) we arrive at the key constructive concepts of adaptation, familiarity, sensible ideas, and plasticity.

<u>Methodological-Critical (Anti-metaphysics):</u>

(1) Methodological pluralism and rejection of reductionism- in Mach's case, especially the reduction of psychology to physics

(2) Anti-fundamentalism and the "economy of thought"- fundamentalism understood as the "misuse of auxiliary concepts" (e.g. "physico-mechanicalism," the "algebraic world") 'Economy' understood as concise description of phenomena, adaptive familiarity, and transparency of expression.

(3) In general, an empirical and skeptical preference for the "customary sensual world" over any specialized conceptual or mathematical rendering of a more fundamental world 'behind' it. For Mach, concepts prove their value when "tested in experience" and mathematics is an important, though limited, "tool for ordering."

<u>Ethical:</u>

(1) Sympathy

(2) Candor

(3) Sensual Unity and Belonging- a “serene, impersonal philosophy” (Cohen) related to both the more skeptical and the more speculative aspects of Mach’s thought.

Speculative:

(1) Observer-Independent Elements and the *Sensual Whole*

(2) Mach, describing himself as only a “half-mystic,” valued skeptical candor and rejected the occult too vehemently to ever fully embrace, at least in his public writings, the speculative end of his thought

Political (see Chapter 4)

(1) Transparency and Freedom of Expression

(2) Universal Satisfaction of Basic Needs

(3) In general, a Social Democratic political standpoint linked both to Austromarxism and to what Blackmore calls Mach’s “half-individualism, half-socialism.”

2.6 Lenin from Philosophical Materialism to Praxis and Progress-Dialectics

We have characterized Lenin’s early formulation of his “materialism” in M&EC as the view that “matter is primary,” a position made up in part of the metaphysical *recognition* of a material reality external to and independent of human experience, and in part, though far less prominently, of the metaphysical *reduction* of the world to "matter in motion." We will now examine some of the qualifications and refinements of these views that Lenin makes through the course of M&EC, attempting to establish their real, practical significance within a conversation about knowledge, science, and their development. We will find that, consistent with his Marxist roots, Lenin is quick to disassociate himself from both vulgar and contemplative materialism, and that shifting paradigms from "matter" to *dialectics*, he begins to sketch an epistemology based on approximation, development, and the criteria of experience and praxis, one that is committed to the historical extension of education or, as he puts it, to "developing human consciousness."[275]

We will give this position, reconstructed from the fragments that Lenin provides in M&EC (and supplemented by some central ideas of Karl Marx) the provisional name of "dialectical realism." It should be understood that no claim is being made to a thorough investigation of Lenin's epistemology, especially as articulated outside of the context of M&EC, and no systematic formulation of dialectical realism will be attempted. The sole purpose of the following section is to bring to light a kind of 'materialism,' based on the concept of dialectics, which is distinct from traditional, philosophical materialism and which was embraced, at least in part, by both Marx and Lenin. And while a 'reconciliation' of this form of materialism with biological empiricism (let alone Lenin's standpoint with that of Mach) would require a complete, separate thesis, we merely hope to suggest the possibility of such

[275] {{83 Lenin,Vladimir Ilich 1964; }} p.136

a reconciliation, and thus to shed further doubt on the relevance of Lenin's "two irreconcilable, fundamental trends in philosophy."

Lenin first qualifies his materialism in response to a quotation from Mach, one that we have already examined from *Knowledge and Error* criticizing materialist reductionism. According to Lenin, in that passage Mach "rejects the ability of physicists to reconstruct psychical experience from the rigid concepts of physics alone (matter and motion)." In response to Mach's worries, Lenin agrees that certain materialists, namely anti-dialectical, "metaphysical" materialists, are to be criticized, later on adding that neither his own materialism, nor that of Engels (another "great materialist" whose views are prominent in M&EC) are consistent with this brand of "vulgar materialism."[276] For Lenin, vulgar materialists are "crude dogmatists" who, as Engels reports, pretend that "the brain secretes thought in the same way that the liver secretes bile." "Real materialists," on the other hand, like Engels, Diderot, and Lenin himself, do not attempt to "derive sensation from the movement of matter," rather they simply (and completely) "recognize" sensation as "one of the properties of matter in motion."[277] It is in this context that Lenin first appeals to the crucial concept of dialectics, for he states that although the vulgar materialists should be criticized, it should not be by thinkers like Mach who "do not understand the difference between relativism and dialectics." We shall return to this questionable assertion, but should first

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[276] Ibid. pp.39, 40
[277] Ibid. p.40

look at the relationship between philosophical and "dialectical" materialism by briefly introducing the role of Marx.

In his *Theses on Feuerbach* (1844), as well as in *the German Ideology* (written with Friedrich Engels), Karl Marx famously scolds the professional philosophers of the day for their detachment from the actual lives and concerns of human beings, for their focus on the power of ideas and intellectual criticism rather than on the *material* realities and socio-economic activities that in fact dictate the course of human history. Thus one refers to Marx's "materialism," although it is clear that his position bears little resemblance to the philosophical assertion of the priority of unseen "matter." Rather, the matters that concern Marx are the concrete contents of our daily lives, especially the stuff of technology, production, and commerce, of "industry and society." In the *German Ideology*, Marx and Engels state that "the social and political world are constantly evolving out of the lives of individuals, but not their abstract lives, their real, working, producing lives." These "working, producing lives" with their "unceasing sensuous labor and creation" represent for Marx the basis of human nature and historical reality, and by means of them one can allegedly provide a more accurate account of the evolution of both. Thus Marx proposes a new kind of philosophy, no longer independent or self-sufficient, that takes as its subject matter precisely these productive lives as well as their external, historical limitations and constraints.[278]

Given Marx's position that objective "reality" should be conceived of in terms of "praxis," in terms of palpable, "sensuous human activity," including of the "revolutionary" sort, it is not hard to see why he would oppose his "active" materialism to the "contemplative" brand that he attributes, for example, to Feuerbach. Socio-politically speaking, Marx concedes that Feuerbach is also interested in overcoming the widespread alienation characteristic of life in modern society, however he criticizes the latter's prescribed method of reconciling spiritual ideals and the mundane world through a simple act of consciousness. Marx and Engels mock Feuerbach's direct "intuition" of a cherry tree, for example, meant as a conciliatory experience of that object in the "here and now," for it frivolously omits the commercial and agricultural realities without which that variety of tree would not even be found in the region. Marx's materialism contrasts the contemplative "here and now" of the blossoming cherry tree with the "here and now" of the coal mine, the factory floor, the shipping lane, the trade summit, and the union rally. For Marx and Engels, "liberation is a historical and not a mental act," and so the resolution of the "inner-strife" and "self-contradiction" of the everyday world can only be achieved through real praxis and solidarity, through "practical-critical activity."[279]

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[278] {{93 Marx,Karl 1998; }}
[279] Ibid.

For Marx, the same standard applies in epistemology. In the *Theses on Feuerbach*, he writes that the question of the "objective truth of human thinking" is a "practical question," one that can only be answered through practical "demonstrations of the reality and power" of that thinking. In contrast, the attempt to settle the question contemplatively, to debate and speculate a priori on the absolute truth or untruth of human knowledge, is "purely scholastic."

In general, we find within these seminal texts Marx's own attempt to go beyond traditional metaphysics, focusing his attention instead on the essential malleability of human nature and its historical determination both economically and indeed by the "totality of social relations." Marx identifies certain patterns in this development that predict a future situation of greater freedom and solidarity, and insofar as it attempts to elucidate a particular structure of this progression, his thought is called "dialectical." This dialectical account of concrete, *material* history simultaneously offers a guide for those activists who presently seek to reform the "circumstances and upbringing" of modern life, to extend and continue the extension of enlightenment beyond the negative rights and contemplative hypocrisy of bourgeois civil society. The philosophical vision of Marx's *dialectical* materialism is ultimately that of a "humane society," of social progress generated by "activity and self-transformation."[280]

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[280] {{93 Marx,Karl 1998; }}

Lenin was a devout student of Marx, and so it is not surprising that his work shares many of the principles and motivations just described. With respect to epistemology, Lenin follows directly on Marx's heels when he writes in M&EC that "a standpoint of life, of praxis, should be first and fundamental in the theory of knowledge."[281] Statements like these are part of Lenin's attempt, mentioned above, to distance himself from both vulgar and contemplative materialism. They seem relatively disconnected from Lenin's early metaphysical formulations in M&EC, and they mirror Marx's thought in their attentiveness to praxis.

Thus, defending Engels from charges of dogmatism, Lenin cites his epistemological focus on the activities and recent innovations of "chemical engineering," and in general his attention to "experiment and industry."[282] Within these spheres of praxis, Lenin recognizes the fundamentality of experience, granting that "we all agree that experience is the starting point of knowledge," also admitting the importance of "an element of skepticism" in the progress of science.[283] This *progress* becomes the "basic focus" of a "dialectical" epistemology concerned with "knowledge and its development," one thus related again to the concerns of Marx.

With respect to this progress, Lenin offers a preliminary definition of dialectics as the account of "how knowledge emerges from ignorance."[284]

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281 {{83 Lenin,Vladimir Ilich 1964; }}
282 Ibid. p.97
283 Ibid. p.126, 136
284 Another definition of dialectics offered by Lenin in M&EC, as mentioned above, is a standpoint that views "all polar opposites as inadequate."

This is a crucial conception with potentially far-ranging consequences for both science and politics. The ideal of progress is furthermore applied by Lenin to a particular sort of anti-metaphysics, one which attacks the thing-in-itself by reducing it to that which is merely “not yet known.” There is even a latent vision here connecting progress to the unity of science, and Lenin makes reference to Engels claim that the “protracted development of philosophy and science” leads to “the unity of the world.”[285]

Lenin’s dialectical reflections on praxis and progress, described in M&EC as the “basic focus” of materialism, lead in two different directions, and much of the rest of our discussion of Lenin, including of his political Marxism, hinges on the relationship between them. On the one hand, Lenin seeks to synthesize these reflections with his prior account of philosophical materialism. On the other, Lenin works out the relevance of his dialectical view to popular enlightenment.

The first path leads to an “updated materialism,” one that combines the idea that verification is exclusively “given by practice” with the other, now familiar tenets of philosophical materialism, namely that “things exist outside us” and that “our perceptions are their images.” These latter are now to serve as the “basic question” of materialism alongside its pragmatic “focus.” Their role is, at various times, both marginalized and lionized by Lenin. He writes that ideas of this sort, indeed the antithesis between matter and mind itself, are important “only within the bounds of a very limited field,” in this case with

[285] Ibid. p.107

respect to the "fundamental epistemological problem of what is to be regarded as primary and what secondary."[286] And yet for Lenin this is crucial, for to "regard" matter as primary is the only way to assure ourselves of the "existence of absolute truth," of an "objectively existing model" towards which our admittedly "approximate" and "conditioned" knowledge is moving "infinitely" and "unconditionally."[287]

On the other hand, alongside these assurances, Lenin also develops his notion of dialectics in the direction of popular enlightenment, stating that its goal is, as we have already seen, "developing human consciousness." In the appendix to M&EC, entitled "On Dialectics," written in 1915, Lenin drops the baggage of "materialism" altogether, stating that "dialectics is the theory of knowledge of Marxism."[288]

In the next and final section, as well as in Chapter IV, we will discuss the relationship, according to Lenin, between the "basic focus" of dialectical materialism (praxis and progress), its "basic question" (matter and absolute objectivity) and what appears to be its essential goal (popular enlightenment). This will allow us to wade into the political aspect of the metaphysical and epistemological disagreements between Mach and Lenin, and will introduce a number of further "irreconcilable" oppositions (including materialism vs. fideism and dogmatism vs. revisionism) which we will hope to also expose as misapplied and one-sided. For now, it is sufficient that we have brought into

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[286] Ibid. p. 147

[287] Ibid. p.150 In Chapter III, we will find that Max Planck expressed similar views in his polemics with Mach

[288] *On Dialectics*, in {{83 Lenin,Vladimir Ilich 1964; }}

doubt the main "metaphysical" opposition presented in M&EC, that between idealism and materialism, at least insofar as it pertains to the dispute with Mach over the "elements" of science. This was achieved, on the one hand, by demonstrating that Mach's standpoint is not that of "subjective idealism" but rather of biological empiricism. On the other hand, by outlining some of the broad features of Marx's dialectical materialism and identifying statement made by Lenin in M&EC which echo these views, we have provisionally identified the latter not with traditional, philosophical (or what he calls "vulgar") materialism, but rather with a standpoint that we have called dialectical realism. Let us quickly re-construct some of the features of this standpoint, using only the ideas that we have already encountered:

Dialectical Realism

(1) Focus on scientific *progress* ("knowledge and its development"- Lenin) specifically measured by the "demonstrated reality and power" (Marx) of the theories involved

(2) Focus on social *progress* towards a "humane society" through both "practical-critical activity"(Marx) and popular enlightenment, i.e. "expanding human consciousness," the move "from knowledge to ignorance," (Lenin) and resulting forms of "self-transformation" (Marx)

(3) The rejection of traditional, metaphysical, "scholastic" philosophy, as well as its rigid oppositions ("the inadequacy of all polar opposites"- Lenin) in favor of "an element of skepticism" and a criterion of relevance to the sphere of

experience, i.e. the "standpoint of life and of praxis" (Lenin) The *here and now* emphasized by dialectical realism, however, is not the here and now of 'passive' (contemplative) sensual experience but of "sensuous human activity," i.e. of our "working, producing lives" in the spheres of "industry and society" (Marx)

(4) In general, a standpoint dedicated to the (real and inevitable[289]) extension of enlightenment, understood as popular emancipation, both from ignorance and exploitation; dialectical realism challenges one-sided excess (ideological and socio-economic) and thus supports both a critique of ideology and "practical-critical activity" aimed at altering the "circumstances and upbringing" (Marx) of modern life.

Once again, without a thorough study of Lenin's (or Marx's) standpoint, and thus without a more extensive understanding of 'dialectical realism,' talk of any 'reconciliation' with Mach's biological empiricism is premature. It is instructive, however, to point out the broad similarities that exist between the two. Both are critical of traditional metaphysics, with its rigid oppositions and esoteric speculations, and favor instead a standpoint of experience, praxis, and life in the here and now. Both believe that the value of scientific theories

[289] For Marx (and subsequently for Lenin) the standpoint of history plays an enormous role alongside the concept of dialectics, especially with respect to claims of the "historical inevitability" of a certain progression of social circumstances and their upheavals. It is thus that the political stanpoint associated with dialectical realism would likely be that of a "scientific socialism," as opposed to the "Social Democratic" orientation shared by biological and technological empiricists. Because we have not yet really concerned ourselves with this issue (it will arise peripherally in Chapter IV) we have used the term "realism" to help express both the undeniability of dialectical progress, as well as, in general, the significant *force attributed to theory* by both Marx and Lenin.

and concepts is demonstrated in experience, and both promote social progress towards a more humane society. At the same time, however, two main differences are apparent. On the one hand, the dialectical 'materialists' seem to be focusing primarily on a different aspect of our common experience, that in which the "power" of our theories is proven, and in which we "work and produce," namely on "industry and society." It is thus probable that the positive sciences that such materialists focus on would not be psychology, physiology, and physics, but rather chemistry, economics, sociology, and all forms and applications of engineering. On the other hand, the 'realism' that we are attributing to Lenin and Marx's dialectical standpoint seems to involve a combination of a historical standpoint with a commitment to, if not the primacy of theory, than at least the great force of a theory, for example the Marxist theory of societal development, in explaining a whole range of phenomena, indeed deterministically. It is thus that such a standpoint would be more likely to privilege notions of scientific 'law,' e.g. the laws of social and economic history.

With respect to these differences, the task of the next two chapters will be to outline, both historically and conceptually, a standpoint that shares Lenin and Marx's constructive concern with the role of science within the social, economic, and productive spheres of our experience, while at the same time turning a skeptical eye to any notions of historical determinism or theory fundamentalism. We will call this standpoint *technological empiricism*, attributing it historically to thinkers like Alexander Bogdanov and Otto

Neurath, and using the work of Nancy Cartwright as a contemporary exemplar. The influence of Mach on the former two is direct and formidable, and through both Neurath's influence on Cartwright and a number of shared, critical commitments, we will argue for a strong link their as well.

Before we can arrive at this new position, however, we must first return to M&EC and the original opposition framed by Lenin of idealism vs. materialism. The goal is now to begin to understand how Lenin means to apply metaphysics and epistemology to the 'elements' of politics. These issues will then be taken up again at length in Chapter IV.

2.7 Transition to Politics- Materialism and Fideism

One could argue that *Materialism and Empirio-criticism* not only has political aspects and undertones, but that it is essentially a political work.[290] This is not surprising. Lenin, unlike Mach, was not a scientist but a lifelong political thinker, agitator, revolutionary, and dictator. It is thus appropriate that Lenin references his plan to write M&EC in a footnote to a polemical political essay, written earlier in 1908, entitled "Marxism and Revisionism."[291] As we will soon see, Lenin borrows many of the politically oriented ideas in M&EC from this essay and the many others like it, including the association of

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[290] For a history of the struggles within Bolshevism, particularly between Lenin and Bogdanov, occurring at the time of the publication of M&EC, and their role as a motivation for its composition, see Sochor, Zenovia, *Revolution and Culture: The Bogdanov-Lenin Controversy* {{73 Sochor,Zenovia A. 1988; }}

[291] The footnote reads, "in a separate pamphlet, I shall prove that everything I have said in this text about neo-Kantian revisionists essentially applies also to the 'new' neo-Humist and neo-Berkeleyan revisionists"

"idealist" philosophers with clericalism and medievalism (and thus with the "stupefying of the people"), and the accusation, like the one against Mach that we have already seen, that these philosophers misunderstand, that they "contemptuously shrug their shoulders," at dialectics.[292]

But one should begin an analysis of the political aspects of M&EC with the emphasis that it places on "developing human consciousness." As we will soon see, one finds throughout the text subtle yet persistent references to the expansion of knowledge and self-consciousness, particularly to and among "the masses," as well as sharp criticisms of those forces that might restrict that expansion. We have very briefly looked at the crucial role that popular enlightenment and emancipation play in the work of Marx, and the following sampling of quotations taken from Marx, Lenin, and Mach, as well as Maxim Gorky and Victor Adler (who will become important later on) will provisionally expose these as explicit, shared concerns of many leading progressives of the day:

> Economic conditions first transformed the mass of the people of the country into workers…The mass is thus already a class as against capital, but not yet for itself…in the struggle this mass becomes united and constitutes itself as a class for itself…the emancipation of the oppressed class thus implies necessarily the creation of a new society…(Karl Marx, *The Poverty of Philosophy)*[293]

> The strength of the modern movement lies in the awakening of the masses. (Lenin, *What Is To Be Done*)[294]

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[292] *Marxism and Revisionism* in {{63 Lenin,Vladimir Ilich 1970; }} p.36f
[293] {{94 Marx,Karl 1963; }}
[294] {{68 Lenin,Vladimir Ilich 1970; }}

> The new structure of political life demands from us a new structure of the soul. [The task of the intelligentsia] is to implant culture in the masses. (Maxim Gorky, *Untimely Thoughts*)[295]
>
> Cultural progress is conceivable only when there is a certain audacity…things of the spirit will spread to the burdened sections of mankind; sooner or later these people will recognize the true state of affairs and confront the ruling sections(Ernst Mach, *Knowledge and Error*)[296]
>
> There is a vast difference between what is accepted as [bourgeois] education, and proletarian education. We do not ask of you any sort of correctness, we demand of you nothing but self-knowledge. To think about what you have become and what you should become…from your awareness of being products of society, you are to become its masters, creators, and stewards. (Victor Adler, lecture to the "Workers Education Society, 1902)[297]

One finds in these quotations repeating themes of "awareness," "awakening, "and "self-knowledge," as well as a strong sense of purpose and even inevitability. It is no wonder then that Lenin, for one, was extremely critical of those forces, discussed at various times as "clerical," "reactionary," or "medieval," which he believed would retard the progress of popular emancipation and enlightenment. In M&EC, these groups are united under the single concept of "fideism," roughly applicable to any doctrine that promotes faith and passivity at the expense of knowledge and action. Within the text, the label of fideism is applied by Lenin to all of those groups or worldviews which he believes distract, pacify, or manipulate the masses, whereas materialism, now as its contrary, is to be associated with the education, liberation, and empowerment of the people. The first group, the

[295] {{64 Gorky,Maksim 1995; }}
[296] {{2 Mach,Ernst 1976; }}
[297] {{38 Uebel,Thomas E. 1991; }}

fideists, includes the usual suspects of priests, theologians, and conservatives, but one of Lenin's main motivations for writing M&EC is to argue that idealists and "professional philosophers," including Mach, are also to be understood among these.

Three tasks follow from Lenin's framing of this new opposition between materialism and fideism. First, to demonstrate that the attempt to include Mach among those who would manipulate or stupefy the masses with theological speculation and medieval superstition is a doomed undertaking. Second, to begin to ask about the "real" differences which might lay at the basis of Lenin's charges, in particular certain methodological disagreements within social progressivism concerning the tension between everyday praxis and progress and the "ultimate aim," the long-term theoretical vision of the movement. Some aspect of these differences is already visible in the above quotations, with Gorky, Mach and Adler focusing more on "culture" and "education" than the others. Thousands of pages have been dedicated to this "argument" in its broadest forms, and it is not our intention, either here or in the final chapter, to simply rehash the stale debate between Marxist "dogmatism" and "revisionism." Rather, since we are fundamentally interested in Mach, our goal will be first to examine the role that his thought actually played in these types of political disputes, specifically in arguments at the borderlands between metaphysics, epistemology, and politics, such as those found in M&EC as well as in various "Austromarxist" writings in support of Mach and the work of Alexander Bogdanov.

As we will see in Chapter 4, however, some of the traditional charges and concerns will indeed be of interest, including the charge that materialism is itself a brand of dogmatic faith as well as the general, ethical tension between absolutist cruelty and pluralist frivolousness. However, as in the case of the metaphysical opposition between philosophical materialism and subjective idealism, our goal is first to reveal the opposition between materialism and fideism as misapplied and fruitless.

Let us first review some of Lenin's formulations and charges of fideism, especially against Mach, in M&EC. Speaking generally, Lenin writes that "we have among us people who would have us regard them as Marxists, yet who bring to the masses philosophy which comes very close to fideism." The philosophy in question is idealism, which Lenin regards as a "professional eclecticism," reminding us that "nearly every professional philosopher sympathizes with one or another form of idealism; for in their eyes idealism is not a reproach, as it is with us Marxists."[298]

And why a reproach? Lenin first makes a connection between idealism and the Church, arguing that "philosophical idealism is a road to clericalism and the class interests of the ruling class," and that the idealists themselves are the "graduated flunkeys of clericalism and fideism."[299] Lenin argues that without recourse to the strict, spartan, consistent ontology of independent, primary matter offered by materialism, as well as of the

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[298] {{83 Lenin,Vladimir Ilich 1964; }} p.90
[299] Ibid. p.190

objective knowledge corresponding to it, idealism becomes nothing but a "disguised and embellished ghost story," a cloudy and eclectic mysticism that opens the door for all sorts of religious and superstitious fantasies. He gives as an example the notion of the noumenal, of things "outside of time and space," as one "invented by priests, maintained by the ignorant and downtrodden mass of society," and finally supported by idealist philosophy. "If time and space are only concepts," Lenin concludes, "then bourgeois professors are justified in receiving salaries from reactionary governments for defending the right to go beyond these bounds, thus directly or indirectly defending medieval absurdities."[300]

Mach is implicated in most of these accusations. In fact, in discussing the motivation for writing M&EC, Lenin states that "the purpose of these cursory comments is to disclose the reactionary character of Machism." Mach's philosophy is explicitly charged, for example, with being unable to refute the existence of "spirits and hobgoblins," and to challenge other "religious beliefs" because of its failure to draw a sharp distinction between appearance and reality. In general, this failure to draw sharp distinctions is perhaps Lenin's most significant concern with the philosophies of Mach and the Russian Machists, for he believes this to have severe ethical consequences.

We have already seen, for example, the charges of "muddleheadedness," "vacillation," and "eclecticism" which Lenin brings

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[300] {{83 Lenin,Vladimir Ilich 1964; }} p.179

against his opponents. These are weighty sins in the mind of Lenin, for whom consistency and clarity are crucial virtues. Lenin's argument, though vague and rarely supported, seems to be that an overly tolerant and ultimately inconsistent and frivolous collage of worldviews will not emancipate humankind from ignorance, but rather the "consistent materialist theory of knowledge," plain both in its meaning and the program of action and infinite development which it prescribes. "Im Anfang war die Tat," writes Lenin, quoting the disturbingly famous passage from *Faust*, and these deeds are to deliver mankind to a state of "freedom," understood by Lenin, now following Bacon, as our becoming the "lords of nature," as our assumption of "control over ourselves and our external nature which is founded on natural necessity." In Chapter IV, we will examine the ways in which Lenin tries to explicitly re-formulate these broad ideas into specific concerns of political theory and strategy.

It is not difficult to defend Mach from Lenin's charges of fideism. As we have seen, his scientific ethics is one that unwaveringly promotes intellectual independence, clarity, and progress. In one characteristic passage challenging complacent passivity, Mach contrasts the Philistine and the child, to whom "everything is familiar," with the "talented young man," to whom the world presents an unending series of questions and problems. A persistent foe of myth and superstition, Mach writes that "strong intellects refute myths before they are even invented." In fact, as has been previously mentioned, Mach considers "intellectual independence" to be *the* crucial adaptive virtue of modernity, enabling an individual to “be on his guard against his fellow men who want to oppress him violently or abuse him treacherously by misleading his understanding and emotions.”[301]

As far as clarity is concerned, Mach’s son Paul has described his father’s entire life as an “exercise in pursuit of clarity,” and as we have seen Mach took every opportunity to challenge mysticism and obfuscation, both within science and without. In terms of a commitment to progress, Mach was almost whiggish in his celebrations of the Enlightenment, which in his mind first offered the “splendid precedent of a life really worthy of man,” and in particular of Galileo’s scientific achievement, which to Mach represented a “revolution in thought felt in all strata of society.”[302] To these he contrasted medieval superstition and the “old barbarism,” including the “frightful, pathological dimensions of modern, Christian animism,” and the 17th Century’s “cruel and relentless war waged with firebrand and rack against the devils that glowered from every corner.”[303]

It is clear enough that Mach’s worldview was thoroughly scientific, and one is not surprised to find certain ideas that Mach supported re-appearing within the manifesto of the Vienna Circle, itself entitled the “Scientific World Conception”(1929). Such views include of course the need to “turn away from metaphysics and theology,” and to achieve solidarity amongst “all those

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[301] {{8 Mach,Ernst 1959; }}
[302] {{39 Mach,Ernst 1898; }}
[303] Ibid. p.186

who stand for earthly being in the here and now."[304] But if the debate is not one between science and mysticism or science and superstition, then how are we to understand the actual significance of Lenin's poorly constructed opposition between materialism and fideism? Where do Mach's "new philosophy of science" and Lenin's "consistent materialist theory of knowledge" actually clash with respect to questions of popular enlightenment and emancipation? If ethical issues are the real concern here, as has been suggested, than how are we to mitigate a supposed opposition between sobriety and resolve? If both sides are as committed to transparency as they claim, these should not be very difficult questions to answer. In chapter 4, we will turn to the intersection of metaphysics, epistemology, and politics, and specifically to the question of the true "elements" of social progress from the points of view of Mach-influenced and Lenin-directed movements. But first we must examine in detail another famous attack on Mach's philosophical thinking, using the misrepresentations found therein to help develop our idea of a *technological empiricism,* a position that completes Mach's biological empiricism within a pluralist philosophy of science.

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[304] *Wissenschaftliche Weltauffasung*, in {{15 Neurath,Otto 1973; }} pp. 305-6

Chapter 3

Economy and Elegance

3.1 Background of the Debate- Planck and Lenin

Max Planck's first public attack on the philosophy of Ernst Mach came at almost the exact same moment as Lenin's. Planck's polemic, in the form of an address presented to the scientific student body at the University of Leyden in December, 1908, was delivered two months after Lenin had finished work on *Materialism and Empirio-criticism* and four months before its beleaguered publication in Russia. Timing is, of course, not the only relevant feature shared by these texts.

Indeed, given the content of the Leyden lecture, one might view Planck and Lenin as unlikely philosophical allies. Just as *Materialism and Empirio-criticism* (subtitled "Critical Comments on a Reactionary Philosophy") offered an extended critique of "Machean positivism," Planck's speech, entitled *The Unity of the Physical World Picture*, has been described as an "apparently gratuitous attack on the leading German-speaking epistemologist of the day, Ernst Mach."[305] The Leyden lecture was also by no means an exceptional case. On the contrary, Heilbron correctly observes that "antipositivism is the leitmotiv of Planck's epistemological writings," and Vogel calls "Planck's struggles against positivism" the "red thread [*rote Faden*] that runs through all

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[305] {{78 Heilbron,J.L. 1986; }} p.44

of his philosophical writings."[306] Vogel for one pays close attention to the affinities between Planck's and Lenin's standpoints, and his analysis of the *Philosophical Influence of Max Planck* attempts to provisionally and partially integrate Planck's ideas into the materialist campaign against the "bourgeois, reactionary philosophies of idealism and positivism."

Although this type of integration conceived from a Marxist standpoint is not the goal here, the similarities between the two polemics with respect to the question of *metaphysical recognition* will be one central focus of this chapter. We will find that like Lenin, Planck was singularly concerned with the claim that "there is a real outer world existing independently of our knowing," and with defending this claim against the type of skepticism allegedly exemplified in this period by the thought of Ernst Mach.[307] However, although Lenin and Planck each engage both metaphysical and epistemological issues, we will see that the latter pays special attention to Mach's account of scientific knowledge, in particular his "principle of economy."

3.1.2 Planck and Mach

But before describing the main points of Planck's critique we can briefly address the question of whether or not its first salvo was, as Heilbron suggests, "gratuitous." In the case of Lenin, we recall that his writing of *Materialism and Empirio-criticism* was anything but spontaneous, that the

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[306] Ibid. 50 {{Vogel, *The Philosophical Influence of Max Planck*}} p.10
[307] "Is the External World Real" in {{10 Planck, Max 1977; }} p.81

book was in many ways an extended political pamphlet meant to slow the spreading influence of positivist ideas amongst Russia's socialists and intellectuals at large, and perhaps more importantly, within his own party at a time when he was locked in a struggle for power with the sometimes Machean Alexander Bogdanov.[308] In the view of Steve Fuller, Planck's attack on Mach can be viewed as no less odd or unexpected.

In Fuller's estimation, the Planck-Mach controversy represents the "realist-instrumentalist debate" of its time. It was unique, however, in that it was not conducted by philosophers of science engaged in "verbal disputes" over pseudo problems and thus "doomed to stalemate," but rather by working scientists representing fundamentally different conceptions of the scientific enterprise and thus ultimately clashing on real life issues of policy and education. Fuller paints a picture of Planck, the "physicist who spent the bulk of his career as an elite functionary for the scientific establishment," squaring off against Mach, the "physicist who spent his time as a parliamentary champion of democratic education." While the former saw the ends of science as fixed by scientists themselves and kept his focus primarily on "the future of the physics community," the latter understood the aims of science under the general rubric of human "welfare," and thus saw "evolutionary biology, and not particle physics, as the background constraint of all inquiry." In this way, Fuller sees the Mach-Planck debate as an all but inevitable clash

[308] For a detailed description of these events, and in particular of the struggle between Lenin and Bogdanov, see *Revolution and Culture: The Bogdanov-Lenin Controversy,* {{73 Sochor,Zenovia A. 1988; }}

between two different visions for the future of science and its relationship to society. While Planck's elitist and corporatist tendencies led him to work towards "enrolling the entire citizenry in the service of a mature science," Mach's democratizing impulses led him to see science and scientific education as a tool with which to empower individuals with critical, sober, and intelligent judgment, especially "in the face of fixed ideas." As far as the relationship among the sciences themselves is concerned, Fuller claims that Planck's eventual "triumph over Mach marked the physics community's success in imposing its vision of science upon all other disciplines."[309]

Fuller is painting here with a pretty wide brush and not very much evidence. He embraces the tendency to caricature, however, and makes suggestive comparisons between Mach and Planck and, for example, Socrates and Plato, and Galileo and Newton. Insofar as we are also interested in caricatures, those framed within early 20th Century polemics over metaphysical recognition, Fuller's descriptions should be helpful. For as we now turn from Lenin's rigid opposition between the materialist and the subjective idealist to Planck's account of the realist versus the "strict logical positivist," we will, like Fuller, ask about the underlying ethical aims of Planck's caricatures, focusing in particular on the question of frivolousness versus *resolve*. And as was the case with *Materialism and Empirio-criticism*, we will find that these purposes are made explicit by Planck in the texts.

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[309] *The Last Time Scientists Struggled For the Soul of Science*, in {{95 Fuller,Steve 2000; }}

In order to achieve the chapter's other major goal, however, namely to demonstrate that these caricatures are accurate neither as a description of Mach's actual thought nor indeed of Planck's own practical epistemology, we will subsequently examine the texts of both thinkers' wider philosophical works. In this way we will identify several areas of practical agreement between Mach and Planck with respect to the questions of scientific hypothesis, experimentation, idealization, and the relationship between theory and observation. This will be accomplished in the secions on "Mach's Concessions" and "Planck's Position." Finally, attempting to leave behind the vague and fruitless debate over metaphysical recognition, we will look to the work of Nancy Cartwright as a thinker who sets out from these agreements and works them into a cohesive whole. Her point of view, which we will call *technological empiricism*, thus contains elements of both 'realism' and 'positivism,' as well as significant political commitments and utility, and we will argue for its role as the ideal counterpart to Mach's biological empiricism within a pluralist philosophy of science.

3.1.3 Planck's Charges

We recall Lenin's major charges against Mach:

(1) Mach's philosophy is an almost literal restatement of Berkeley's, and as such is an example of subjective idealism, which is ultimately and inevitably nothing but (untenable) solipsism.

(2) Mach's attempt to synthesize materialism and idealism by "inventing a new word" ('element') is half-hearted and unsuccessful.

Perhaps unsurprisingly, Planck's own major criticisms of Mach's philosophy also focus on its alleged solipsism and sterility, and in particular its liability to stifle scientific collaboration, imagination, and progress. Planck's views can be reconstructed in the following way:

(1) Mach's solipsism, his belief that there are no realities other than one's own perceptions, disallows scientific collaboration and tends toward relativism
(2) Mach's resulting epistemology, his "principle of economy," is a sterile, shallow concept of merely formal value, and its wholesale attack on theoretical constructs "lames the imagination of leading minds" and "interferes with scientific progress in disastrous ways"[310]

Despite what we have already learned about Mach's actual thought in Chapters I and II, it might appear that we must now start all over again from the beginning. This is not the case, however, and Planck's special focus on *scientific* realism, especially issues in the philosophy of physics, will allow us to probe certain areas of Mach's thought, including his views on "theory" and his notorious attitude towards atomism, upon which we have not yet spent much time. We will then be able to present an important revision of Mach's

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[310] Planck, Max, *The Unity of the Physical World Picture* in {{32 Blackmore,John T. 1992; }}

ideas in Cartwright's work, a development that enables a more acute tracking of the physical sciences. But turning now first to the ethical and spiritual background of the debate over metaphysical recognition, we will see that Planck justifies his plea for the unity and reality of the "physical world picture," and in general for an "unshakeable belief in a real outer world independent of us," with claims and admonitions that recall Lenin's own conceptions of and concerns with frivolousness and resolve.[311]

3.2.1 Framing the Opposition- The Realist

Even if Planck's attack on Mach in 1908 was unprecedented in his earlier work, once he began his critique he never looked back. As with Lenin, Planck's arguments are built upon a rigid opposition between two caricatured positions, in this case between that of the "realist" and that of the "logical positivist."[312] These characters appear throughout Planck's polemical writings, not only in the direct exchanges between 1908 and 1910, but in later collections such as "Where is Science Going," and "The Philosophy of Physics."

As was the case with *Materialism and Empirio-criticism*, we will attempt to distinguish, in our study of Planck's views, between those ideas that are intimately connected with his commitment to metaphysical recognition and those that are not. As we now turn to Planck's caricature of the realist, for

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[311] {{78 Heilbron,J.L. 1986; }} p.50

[312] The former term is used by Planck, for example, in his polemic against Mach of 1910, entitled "On Mach's Theory of Physical Knowledge- a Reply," and the latter, for example, in his essay, "Is the External World Real?"

example, we will focus our attention on *realist metaphysics* (along with its related ethos and vision of the tasks of science) and temporarily leave aside Planck's more practical descriptions of scientific inquiry. The issue of metaphysical recognition, which Planck calls the "metaphysical hypothesis," distinguishes the one from the other by affecting the interpretation of the "world picture" constructed from the theories and concepts of physical science. Thus, we will later find that when the hypothesis of a "real, external world" is not emphasized, Planck's views become more compatible with a *methodological realism*, one that regards the world picture as an indispensable "model" used by specialists in physics to explain natural processes and make predictions within experience. This view is much more compatible with Mach's own concerning the role of "auxiliary" theories and concepts, but before we can discuss these in greater depth, let us examine Planck's ideas surrounding metaphysical and epistemological realism.

In "Is the External World Real," Planck lays out two propositions which he believes to describe the fundamental presuppositions of physical inquiry. The first proposition states that "there is a real outer world existing independently of our knowing." This is the now familiar substance of metaphysical recognition, and one of our general tasks is to study its motivations and applications, especially absent a well-defined program of metaphysical *reduction*. For Planck, recognition of a "real, outer world" has the first consequence of re-orienting our epistemological conception of our sensual life. For according to the realist metaphysical scheme, our sense impressions are not constitutive of the physical world, rather they “bring news of another world which lies outside of ours.”[313] Planck calls this world which lies outside of our own “the real,” [das Reale] and it is the task, in fact the “essence of natural science,” to construct a *world picture* which captures “the real” as closely as possible.

We recall Lenin’s tactic of citing the habits and beliefs of actual, working natural scientists, and find that Planck too claims that every “real physicist” accepts this metaphysical proposition as well as the “high demands” which it places on the physical world picture, specifically that it represent “objective knowledge that is independent of good will, politics, or even man himself.” Turning to Planck’s description of the goals of science according to the realist, we will see that he continually makes a great deal of this “independence” of knowledge, and more specifically of the “emancipation of science from anthropomorphic elements.”

These elements include of course the senses themselves, and so the realist affirms that she cannot ultimately come to know nature through the use of her “bodily eye,” which is itself an object of the natural sciences and not their subjective basis. Rather, she will deploy her “speculative eye,” along with its symbolic and mathematical resources, in order to construct, over time, a “world picture liberated from all subjectivity.” Planck continually emphasizes the permanence and universality of the resulting construction, and it is in this

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[313] {{10 Planck,Max 1977; }} p.80

context that he repeatedly appeals to its validity “for all times and cultures, even for non-terrestrial and nonhuman ones.”[314] We will return to these ideas, assessing the nature of their relationship to metaphysical recognition, when we compare the varying interpretations of scientific *constants* provided by Planck, Mach, and Cartwright.

It is important to note, however, that for Planck, the resulting world picture must be causally determined, for causality is “something fundamental,” to be viewed as “a feature of the world itself.” Planck followed closely the debates of the day on causality, and he consistently rejected the statistical and probablilistic interpretations of scientific theories. These could be overcome, he suggested, either by the continual improvement of our measuring instruments and techniques, or, in the difficult case of quantum theory, by reforming the basic structure of our world picture, a task that Planck thought could be achieved by a “general wave mechanics.”[315] In any case, Planck stressed that science is “based on the assumption of universal causality” and thus “the importance of maintaining the rule of determinism within the world picture.”

According to Planck, the realist ultimately acknowledges that the high demands placed upon the physical world picture- that it be “objective,” “unified,” and “permanent”- can never be fully satisfied. This is the consequence of the second of the two core presuppositions which he offers in

[314] {{78 Heilbron,J.L. 1986; }} p.6
[315] “Causality in Nature,” in {{40 Planck,Max 1936; }}

"Is The External World Real," namely that "The real outer world is not directly knowable." This immutable truth is not to be lamented, however, nor does the realist fear the potential contradiction arising when the two propositions are combined. (i.e. in the assertion that something which can never be directly known exists) On the contrary, this tension represents for the realist the "mystical element" of physics, and it lies at the basis of her ethos of perpetual striving, of engaging in "an incessant struggle towards a goal which can never be reached," of endlessly probing the real world, itself a "land of mystery." [316]

This combination of a *mystical aura* surrounding science, especially mathematical physics, with the establishment of a "metaphysical goal" that demands perpetual "striving towards improvement and perfection" are at the foundation of the great man ethics with which Planck approaches science. They are also, unsurprisingly, areas of disagreement with Ernst Mach. One can see this disagreement play out, for example, in the different ways in which Planck and Mach describe and celebrate the work of key scientists from the past, or in Mach's fervent rejection of mysticism in physics and mathematics. We will turn to these differences, as well as to Planck's general claim for a connection between metaphysics and ethics, once we have laid out the main features of his caricature of the figure opposed to the realist, the "strict logical positivist."

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[316] {{10 Planck,Max 1977; }} p.80. Fuller makes the point that Planck's description of the scientific endeavor has much in common with Max Weber's as articulated in the latter's famous "Science as Vocation" lecture. There he describes engaging in science as "subsuming one's ego to an endless and largely vicarious quest."

But first, we can quickly recount the main features of Planck's caricature of metaphysical realism:

(1) Affirmation of the "metaphysical hypotheses," i.e. "there exists an outer world which is entirely independent of ourselves."

(2) The task of science is to construct a *world picture* that represents this external world and its properties, *das Reale*, as accurately as possible

(3) This world picture is to include *causal determinism*, for the same is assumed of the real world itself.

(4) This world picture is to be, as far as possible, objective, unified, and permanent, representing the sum total of the timeless truths that have been discovered about the independent, external world. To ensure objectivity, it is to be *deanthropomorphized*, omitting all reference to sensory experience, and constructed instead out of symbolic and mathematical elements "valid for all times and cultures, even extra-terrestrial and non-human ones."

(5) The fact that such a world picture could never be complete or completely accurate, that the "metaphysical goal" is unattainable, is not a source of discouragement, but merely represents the "mystical element" of physics, as well as the motivation for the physicist's perpetual striving.

3.2.2 The Logical Positivist

Planck begins his sketch of the logical positivist in his 1908 Leyden lecture. Metaphysically speaking, the positivist rejects the existence of a real, external world, and instead asserts that “there are no realities other than one’s own perceptions.” These perceptions thus represent “the essential and only elements of the world.”[317] This is supposed to be the central idea of what Planck characterizes as “Mach’s popular position,” itself the polar opposite of the realist standpoint. And just as in the case of the latter, the positivist’s metaphysical outlook is described as having both epistemological and ethical consequences.

With respect to our knowledge, the scientific world picture can no longer be understood as an “actual reflection of real natural processes.” Rather, scientific inquiry consists only of an “economic adjustment of our thoughts to our perceptions to which we are driven by the struggle for existence.” *Adaptation* and not permanent, universal truth is the goal of science according to the positivist. His positivism becomes ‘logical’ in light of the fact that absent a realist’s “metaphysical hypothesis,” logical clarity and consistency become his sole epistemological concerns. These, along with the primacy of sense data, result in a *strong antipathy towards theory and hypothesis in science*. In general, the positivist dismisses “any inferences drawn from measurement as illegitimate,” and views each “mental constructions” in science as an “unwarranted human intrusion.”

The consequences of this epistemological orientation are, according to Planck, sterility and stagnation. First of all, he argues, a “strict logical positivist,” given his solipsistic metaphysics, (his view of the world as *his own*

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[317] *The Unity of the Physical World Picture*, in {{32 Blackmore, John T. 1992; }}p.129

perceptions) will be unwilling to accept the data and reports of other scientists for the purposes of his own research. Such a refusal would of course bring a halt to almost all scientific progress. Moreover, in the absence of all objective standards of truth, a pervasive relativism is sure to surface, an all-encompassing tolerance which allows and in fact encourages each researcher to have his own "idiosyncratic world view."

Assuming, however, that these arguments are rhetorical, and that Planck, like Lenin, believes that positivist scientists will often check their strict positivism at the laboratory door, Planck still goes on to list the latent, invidious effects which he believes the positivist ideas themselves are likely to have, both on the psychology of the individual scientist and the productivity of the disciplines as a whole. Specifically, a notion of science as the economic ordering of sense experience is supposed to "lame the imagination" and "disturb the thought processes of leading minds." The evidence which Planck provides for these claims is related to his description of the work of major, historical scientists mentioned above. When Copernicus, Newton, Keppler, Huygens and Faraday made their greatest breakthroughs, Planck surmises, "Mach's theory of economy was the last thing on their mind." On the contrary, it was the "rock-solid belief in the reality of their world picture" which inspired them, which "steeled their resolve" in their battles against "traditional views and towering authorities."[318]

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[318] Ibid. p.131

We will return to this heroic presentation of physics and physicists and its relationship to Planck's broader ethics shortly, only briefly citing here the affinity with Lenin's own celebrations of "steeled resolve."[319] With respect to progress in the sciences generally, Planck views Mach's epistemology as sterile, as having a "merely formal significance," especially given its attitude towards theory in general, and atomic theory in particular. It's tendency towards scepticism and its commitment to transparency, to forcing everything out "into the open daylight," are in part commendable, but do not provide fertile soil for scientific creativity and hypothesis-making, especially of the mathematical variety, nor indeed for the comprehension of actual, scientific inquiry. With respect to the former point, we may recall Albert Einstein's letter to his friend Besso, written towards the end of his life, when he had already abandoned Mach's biological-economical epistemology in favour of an uncompromising realism resembling that of Planck. Einstein describes Mach's epistemology as a "poor little horse" which cannot "give birth to anything living," but can only "exterminate harmful vermin."[320]

With respect to the latter point, Planck asks how, in a world where there are only sense experiences and all sense experiences are equal, and a world in which all mental constructions are regarded as "unwarranted human intrusions," are we to privilege some experiences over others, something which scientists must regularly do in interpreting their results? What is to

[319] {{76 Lenin,Vladimir Ilich 1968; }}see Chapter II
[320] Holton, *Mach and Einstein*, in {{30 Cohen,R.S. 1970; }}

count as a decisive observation, and what as a crucial experiment? In "Where is Science Going?" Planck puts the point this way: "Positivism holds that measurement and sense perception are the be all end all of progress in physical science…while I stress the role of theory in correcting and understanding measurement and observation."[321]

Ethically, logical positivism is, according to Planck, offensively superficial. The realist, although he does not work from the ethical-aesthetic standpoint in his scientific investigations, nevertheless recognizes and respects this standpoint as an "important alternative way to look at nature." The positivist has no such respect, and in fact can not even fathom the existence of "any such ethical-aesthetic values, even outside of science." Engaged solely with the "logical track of thought" and thus unable to face the immense reality in which he "plays a relatively modest and subordinate role," the positivist can not achieve a sense of the sublime. For him, "a sunset is just a series of sense impressions."[322]

3.3 Ethics and Metaphysical Recognition

In his polemics against the character of the "strict logical positivist," Planck focuses on the effects of the latter's worldview on the *ethical and*

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[321] {{10 Planck,Max 1977; }} p.94

[322] {{10 Planck,Max 1977; }} p.72 Compare with the manifesto of the Vienna Circle written in 1929: "clarity and cleanliness are sought everywhere; dark distances and bottomless depths are avoided. In science there are no depths. Everywhere is surface…" Within the context of this manifesto, however, a clear distinction is made between science on the one hand and poetry, music, and mysticism on the other, with the latter seen as valid modes of human expression, but not, however, of "theoretical knowledge" or assertion. {{15 Neurath,Otto 1973; }}

psychological cultivation of scientists, on imagination and resolve. We have seen how Lenin's *Materialism and Empirio-criticism* stresses similar ethical and political consequences for "subjective idealism," and Planck's main claim, just like Lenin's, is that these consequences follow from the failure to recognize a "real, external world." A significant difference, however, is that while Lenin is nominally concerned with the "education of the masses," Planck is focused on the cultivation of an elite, particularly in science.

Indeed, Planck's is a heroic, mystical, and fairly elitist understanding of physical science. We recall Mach's appraisal of Huygens, his celebration of that thinker's "candor," and compare it to Planck's choice to emphasize instead Huygens' "steel resolve" and "rock-solid belief." Planck's image generally is of a science driven by the "forward looking faith" of "great men," not by Mach's historical-critical sobriety, and his ethics is one that highlights the distinction between the "ordinary mortal" and the "highest human genius."[323] The danger of positivism, its potential to "interfere with the progress of science in disastrous ways," lies precisely in its ability to corrupt this faith of the elite few, and thereby to disrupt the "mysterious creative process" of leading minds. Therefore, Planck concludes, in order to remain focused on the infinite task of physical science and thus to avoid frivolous distraction, we must maintain, especially in our pedagogical expression, a clear and consistent commitment to the recognition of a real, physical world existing beyond our experience.

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[323] Planck, *Causality and Free Will* in {{40 Planck,Max 1936; }} p.108

On the one hand, Planck is responding here to some very specific and legitimate concerns about the future of both atomic physics and the careers of some of his own, highly talented graduate students.[324] We will return to these issues shortly when we consider a number of the actual, extra-polemical views of Planck and Mach. On the other hand, it is clear that Planck's polemics address themselves to issues beyond this specific disagreement, e.g. the more general ethical and psychological issues of scientific creativity, the relationship of the few to the many, and the question of metaphysical recognition as a precondition of resolve. Exposing these claims is one of two main tasks of this chapter, and before we move on to the other- an examination of the widespread, extra-polemical agreements of Mach and Planck's epistemologies and their sophisticated revision in what I call the technological empiricism of Nancy Cartwright- it is worthwhile to offer a few provisional responses to Planck's arguments.

On the issue of the effects of a 'positivist' worldview on scientific creativity, we can consult the well-known essay on Mach written by the physicist-philosopher Phillip Frank. Franck rejects Planck's contention that Mach's anti-metaphysics "lames the imagination" and instead cites the case of Maxwell as an example of a scientist of immense creative power who shared Mach's fundamental understanding of the tasks of science.[325] Clearly one can call upon any number of creative and productive positivists from

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[324] See, for example, {{78 Heilbron,J.L. 1986; }} or Blackmore's review of Stadler's book, "From Positivism to Scientific World Conception" {{6 Blackmore, John 1983 }}

[325] Frank, *The Importance of the Philosophy of Ernst Mach for Our Times* in {{30 Cohen,R.S. 1970; }}

history, and yet Frank goes even farther and suggests that there is a kind of anti-dogmatic openness intrinsic to the positivist view of the world that is capable of fostering even more creative innovation than realist standpoints. We thus recall Mach's innovative and influential criticisms of absolute space and time, and one can furthermore mention Henri Poincare's work on scientific hypothesis and convention in this context, particularly on the significance of the development of non-Euclidean geometries for the physical sciences. Mach and Poincare are often discussed in the same philosophical breath, and Frank's contention seems to be that the insights of both help to open up a free, tolerant space for creativity and innovation, for something like what Paul Feyerabend has called "the proliferation of theories."[326] Whether or not Mach himself always embodied these ideals, especially in his attitude towards atomism, it is clear that the question of the relationship of positivism to creativity is an open one, and that Planck's claims, especially in the absence of any concrete evidence, are not very helpful in answering it.

With respect to the few and the many, Planck's tendency towards elitism has been well documented.[327] Unfortunately, it is not possible here to discuss the issue of elitism versus egalitarianism on its own. However, insofar as Planck's (and Lenin's) arguments for metaphysical recognition are linked to the question of the few and the many both *historically*, in the forms of the "fate of the physics community" and the activities and self-understanding

[326] {{18 Feyerabend,Paul K. 1988; }}
[327] See {{78 Heilbron,J.L. 1986; }}

of the Communist Party, and *philosophically*, with respect to the realist critique of the frivolousness of the masses, the question is a relevant one. A number of these issues will arise in the next and final chapter on "(Anti)Metaphysics and Popular Emancipation," but it is helpful here to say a few words in general about the philosophical critique of frivolousness and the normative dimensions of the concept of the "world."

We have seen in Planck's philosophical writings a commitment to both striving and humility. Evidence of the former is seen when he advises that one must "work unceasingly towards an ideal aim," and of the latter when he commends the "unshakeable belief in a real outer world independent of us, in which mankind plays a relatively modest and subordinate role." Putting the two sentiments together, it seems that for Planck, metaphysical recognition is a necessary pre-condition to the fulfillment of many of our ethical obligations, for the cultivation of both resolve and piety. This seems false for a number of reasons.

One might object, however, that Planck's concerns were limited to the experience and worldviews of professional physicists, and thus the concern that positivist ideas could specifically undermine *their* cultivation and progress. This objection is unsatisfactory for two reasons. First, it assumes that the ethical and philosophical development of physicists depends primarily on their views with respect to the "reality" of their most highly theoretical, mathematical accounts of nature. The philosophical treatment of the relationship of physics to the other scientific disciplines, for example psychology and economics, as well as of the role of science with respect to the rest of society is ignored. However, we have been arguing for the relevance of precisely these questions for a well-developed philosophy of science. Moreover, even if we do restrict our interest to the construction and the constructors of what Mach called the "kinetic world picture of colorless particles," to the question of the worldview most conducive to professional uprightness and fecundity in *theoretical* physicists, one need only look to the history of the interpretation of quantum mechanics to see that it remains an open question as to whether an unwavering "realism" is the best answer.[328]

With respect to Planck's apparent intention to take part in a broader, realist critique of the ethical frivolousness of positivism, we need only make the observation that if conduciveness to ethical fortitude, to the development of good *habits*, is the ultimate concern here, then the question of realism versus positivism is an open and experimental one that will, over time and in different places, yield a variety of results. This is a core principle of pragmatism, and was well articulated by many of its founders.[329] It is not the content of an ideological *assertion* that is most relevant, but the effect that it has on the character and behavior of those who adopt it.

Sentiments like these have been eagerly adopted by "postmodern" thinkers, who unfortunately have embraced its negative implications more

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[328] See, for example, *Für und Gegen Atome*

[329] See, for example, {{97 Menand,Louis 2001; }}

strongly than its positive demands.[330] A critique of fundamentalist cruelty must not ignore the problem of pluralist frivolousness, for the two are inextricably linked in modern societies. This is where the debate over metaphysical recognition comes in, especially with respect to the notion of recognizing the fundamentality of this or that conception of the "world," be it the "real, external, physical world," the "world of the elements," or the "material, cultural, and politico-economic world of day-to-day and historic life."[331] *All* of these conceptions of the 'real world' are normative. The positivist's commitment to 'anti-metaphysical' this-sidedness, to the idea that "there is no better reality than the one we have to hand," is no less a call to determined activity than Planck's "incessant striving towards an ideal aim." Similarly, answering to the question of humility, the phenomenalist's "organic stream of elements" is an example of a real, *internal* world in which mankind plays "a relatively modest and subordinate role." The problem for philosophy is to attend to the interplay of these conceptions, challenging both one-sided fundamentalism and no-sided indifference.

The first part of this chapter has been committed to the negative task of exposing an apparent one-sidedness in Planck's polemics. As we now turn to both his own and Mach's actual epistemological views, we will find that Planck's polemical caricatures of the realist and the logical positivist indeed ignore the actual richness and potential agreement of the views involved.

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[330] See, for example, Richard Rorty's review of Michael Lynch's book "Truth to Life: Why Truth Matters"
[331] {{86 Cartwright,Nancy 1999; }}

From these agreements, we will turn to the constructive goal of the chapter, to articulate the main principles of a technological empiricism that can, in concert with the biological empiricism developed in the previous chapters, contribute something to the somewhat isolated and ineffective contemporary debates over metaphysical recognition. Specifically, it is hoped that both an "element realism" and a "capacity realism" can help bridge the gap between the reductionist's "atoms and void" and the postmodernist pluralist's "language games."

3.4 Planck and Mach on Theory and Observation

3.4.1 Mach's Concessions

Let us then look to the validity of Planck's charges of solipsism and sterility in the philosophical writings of Ernst Mach. We have already challenged the former characterization in the first chapter by citing, for example, Cohen's convincing argument that a fundamentally *biological* (as opposed to logical or epistemological) standpoint takes as an ontological assumption the existence of a wide variety of organisms along with their variegated and real sensations, and thus "rules out solipsism a priori."[332] With respect to Planck's specific charge that the solipsistic tendencies of Mach's thought might cast doubt upon scientific collaboration and the exchange of data, we recall those sections of the *Mechanics*, also discussed in Chapter One, in which Mach all but defines his notion of the "economy of science" in

[332] {{30 Cohen,R.S. 1970; }}

terms of communication and knowledge sharing. There he argues that "the key moment of original discovery" was the "sharing of the heretofore accumulated knowledge and experience with the new members of the specialized classes by the old members," and that the task of "imparting the stock of experience and knowledge" provides the "first occasion for distinct reflection." In general, Mach thus concludes that "the origin of science is in making experience communicable" and that science itself "is knowledge sharing."[333]

In order to decisively put the matter to rest, however, we can turn to a passage from *Knowledge and Error*, a quintessentially mature work that contains Mach's richest and most well-considered positions. There, Mach writes that although "hallucinations teach us to recognize sensations as states of our own bodies… a one-sided overestimate of this knowledge becomes the basis of an equally one-sided philosophical system, solipsism."[334] A statement like this one reminds us of Phillip Frank's view that Ernst Mach was completely uninterested in traditional philosophical problems and metaphysical debates, and that it was thus under his guidance that the fruitless controversy between "idealism and materialism" became the fruitful conversation concerning which situations and investigations are best approached with a phenomenalist language, and which with a physicalist one.

[333] {{5 Mach,Ernst 1960; }}
[334] {{2 Mach,Ernst 1976; }}

This last issue will shortly be important for our account of the relationship between biological and technological empiricism.

Planck's second type of criticism concerns the sterility of Mach's principle of economy as an account of the means and ends of science. Our task then is to evaluate this view, one which implicitly attributes to Mach a dogmatic phenomenalism, a position so focused on immediacy and fidelity to sense data that it regards each "mental construction as an unwarranted human intrusion," thereby "laming the imagination" that is so crucial, according to Planck, to succesful science. Mere "economic description" of the phenomena is insufficient, Planck argues, and Mach's failure to appreciate the roles of hypothesis and "bold explanation" in science, and thus the need to work "beyond sense experience," particularly in physics, renders his epistemology one-sided and sterile.

Beginning with some rather broad though suggestive discussion of idealization, hypothesis and the analytic method found in the *Mechanics*, and then moving on to Mach's most advanced methodological pluralism as represented in *Knowledge and Error*, we find that Planck's charges are groundless. Mach was keenly aware of the importance of thought experiment, abstraction, and theory generally to science, and he explicitly assigns them an important methodological role within his epistemology. Where his theory of economy becomes important, however, is with respect to his goal to, as Frank describes it, "limit the misuse of auxiliary hypotheses."[335] It is in describing this task more fully that we will come to a better understanding of Mach's non-dogmatic but rather *critical phenomenalism*- his anti-fundamentalism, his rejection of the mechanistic worldview, his objection to the domination of the scientific disciplines by physics, and in general his preference for the rich and abundant elements of the biosphere to the still quite shoddy and too often imperious realm of abstract, theoretical concepts.

These discussions will culminate with Mach's account of the "sensible idea" as an ultimate aim of inquiry.[336] This notion represents one example of a fruitful *amalgamation* of theory and praxis, concept and direct experience, and indeed one typical of a thinker like Mach who was nursed early on by idealism and tended always towards the psychological side of things. Eventually, we will describe Cartwright's concept of the "capacity" as the counterpart to the "sensible idea" for the materialistically and technologically inclined.

In the *Mechanics*, Mach describes the "great natural inquirer" as the individual who possesses the "unity of abstract formulation and strong instinct." We have already discussed Mach's emphasis on the role of instinctual knowledge as a foundation of science in Chapter One, so let us now turn to his description of the origin and purpose of abstraction and idealization in scientific inquiry, for example in his historical study of two of

[335] Frank, in {{30 Cohen,R.S. 1970; }}
[336] {{2 Mach,Ernst 1976; }}

these great natural inquirers entitled, “the Mental Procedures of Archimedes and Stevinus Compared.”[337]

Mach examines the work of Archimedes and Stevinus on statics, in particular on the nature of the lever and the inclined plane. Concerning Stevinus’ analysis of the latter he describes how he “started with the general view concerning how a mobile, heavy, endless chain” will stay at rest when situated upon such a plane. The plane which takes part in this thought experiment is not a real plane, of course, but an imagined one contrived in thought to meet certain predetermined specifications. It is thus that Mach describes Archimedes’ lever and Stevinus’ inclined plane as “self-created ideal objects of mechanics,” and contrasts them with actual, “physical levers and planes” which “satisfy the logical conditions of these ideals insofar as they approach them.”

Mach discusses the usefulness of this type of *idealization* (which we will shortly distinguish from “abstraction”) in terms of the development of hypotheses. With respect to the inclined plane, Mach reports how for Stevinus “this ideal leads to a hypothesis which would operate without disturbing elements,” thus allowing the system to reach “a static relationship” in thought. Armed with this vision of the behavior of the ideal system, according to Mach, “the hypothesis allows us to reconstruct the facts and acquire mastery of them.”[338]

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337 {{5 Mach,Ernst 1960; }}
338 {{5 Mach,Ernst 1960; }}

Mach thus provides here a rudimentary introduction to the interaction of theory and practice in the physical sciences, one which assigns a key role to thought experiment and hypothesis. (We notice, however, that the ultimate goal is still “mastery of the facts”) With respect to the “disturbing elements” which are idealized away in the cases of the lever and the inclined plane, Mach has in mind characteristics like imperfect rigidity and friction. Like many commentators, Mach strongly associates this practice with the work of Galileo, and characterizes his “method of testing as…idealization.” As we will see in our discussion of Cartwright, one might contrast this type of idealization with certain procedures of “abstraction,” which seek to eliminate a different kind of “disturbing element,” namely possible causal influences other than the one which is being tested in an experiment. Although Mach does not directly attend to singular causation in his work, and so does not account for this type of abstraction with the same precision as Cartwright, he does pay explicit attention to the importance of experimental set-up and even provides a sophisticated discussion of the analytic method within the context of mechanical accounts of vector additions and the composition of forces, that as we will see closely resembles Cartwright’s own treatment.

With respect to experimental set-up, Mach is explicit about the role that theory and hypothesis play in shaping an experiment before it even begins, and thus the inability of a purely passive relationship to the “sense data” to yield fruitful results. Putting the point more precisely, Mach writes that “without some preconceived opinion the experiment is impossible, because ifs form is determined by this opinion." In general, Mach, allegedly a dogmatic empiricist hostile to theory, concludes that "experiment does not ground, it *compliments* our prior experience and suspicions." These broad ideas become more concrete in Mach's discussion of the analytic method, the process whereby idealization and abstraction are used to break down a complicated natural system, or as Mach puts it, to "decompose a phenomena into mutually independent parts."[339] Mach sees the parallelogram of forces, and in particular "Galileo's conception of independent forces acting in the motion of a projectile," as the paradigmatic case of this method, one that demonstrates how "the discovery of independence (for example of two forces acting at a point) can be as fruitful for science as the discovery of dependence," allowing us to "reconstruct in thought what as a whole would be impossible to grasp." We notice here the key concepts of "the whole," "independence," and "reconstruction in thought." For Mach, nature as a whole is characterized by the total interdependence of phenomena, and thus by an ultimately ungraspable complexity. However, in our efforts to gain knowledge and control wherever we are able, we can formulate and test hypotheses about the nature of more limited and direct interactions against a background of simplified conditions. The knowledge gained therein can then be re-applied towards the artificial, regulated reproduction of a given behavior or phenomenon, or in an attempt to provisionally understand more

[339] {{5 Mach,Ernst 1960; }} Although Mach doesn't actually use the term "analytic method," his description closely accords with those of thinkers like Cartwright who do.

complicated natural systems. It is in this regard that Mach quotes the following passage from Volkmann: "in the majority of instances nature exhibits a thoroughly composite character; it is accordingly one of the duties of science to conceive phenomena as made up of sets of partial phenomena and at first to study these in their purity…thus gaining a command over the whole."[340]

These themes will be developed in much greater detail in our discussion of Cartwright's work. For now, it is sufficient that we have begun to notice the importance which Mach attributes to theoretical constructions and reconstructions for scientific inquiry. This remains the case even if these constructions are considered imperfect and incapable of fully grasping the whole of reality, and even if the role that they play is a mediate and instrumental one. Mach addresses these qualifications in the *Mechanics* when he writes that "a rule…cannot possible embrace the entire fact," but rather can only "one-sidedly emphasize the feature that is important to it given its technical aim." He thus concludes that "there is always opportunity for the discovery of new aspects of the fact," and adds that one should always keep in mind the "liability for error" inherent to each of the "mental representations" used in the construction of a rule, ultimately describing each such inherited construction as "an incomplete knowledge fastened into words."[341]

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[340] {{5 Mach,Ernst 1960; }}
[341] {{5 Mach,Ernst 1960; }}

We will now turn to Mach's most explicit and mature formulations of these positions in *Knowledge and Error*. With respect to the relationship between theory and observation, Mach disavows any and all claim to a science constructed solely with the help of the latter, and indeed to the existence of an immediately 'given,' theory-free sphere of observation at all, explaining that "observation and theory are not sharply separable, since almost any observation is always influenced by theory, and, if important enough, in turn reacts on theory." This acknowledgement of the sophisticated interaction between theory and observation, (and thereby the typical theory-ladenness of the latter) is also attributed to Mach by Seeger, who in his account of Mach's work on shockwaves quotes a different source where Mach claims that "mere facts can yield no organic knowledge," but that rather "we must always experiment with our thoughts," thereby facilitating a "constant corrective interchange, an intimate union of deduction and experience."[342] With respect to thought experiment and the importance of imagination with which Planck is so concerned, Mach writes that "the methods of thought experiment…are the very activities that most strongly promote inquiry in the natural sciences," and furthermore that "scientific imagination" and associative "fantasy" are "keys to scientific discovery."[343]

Turning now to physics in particular, we find that Mach's ideas concerning the means and ends of this science match Planck's almost

[342] Seeger, in {{30 Cohen,R.S. 1970; }}
[343] {{2 Mach,Ernst 1976; }} p.113

perfectly. Indeed, Mach's methodological pluralism had matured considerably between his writing of the *Analysis of Sensations* and the publication of *Knowledge and Error*. We have seen how in the former work Mach allowed that the physical concept of a "body" could be arrived at through a particular association of the basic "elements," and thus that these may be referenced in physics just as they are in our ordinary life. This concession, however, seems linked to a quite rudimentary idea of physics, and it represents a stage in Mach's work which still leaned more towards idealism and phenomenalism (*towards* metaphysics) and less towards a methodological pluralism.

Amidst the advances in mathematical physics and the growing evidence for atomism emerging right at the turn of the century, however, by the time of *Knowledge and Error* Mach's concessions to the often super-sensible, highly theoretical *methods* of physics had developed considerably. He writes that "even though the perceptions of our present natural senses will undoubtedly remain the basic elements of our mental and physical world…this does not prevent our physical theories from becoming independent of the special quality of our sense perceptions." There are few statements that better capture Mach's epistemological position, but before we analyze it further let us see where Mach himself takes the thought.

Mach observes that "we do physics in such a way that subjective qualia becomes unimportant," and that this objectivizing effect is made possible by mathematics, by the fact that the results of physics are "expressed in equations." A certain analogy to Planck's envisioned program of deanthropomorphization is thus established, and indeed the link becomes almost literal when Mach writes that "the input of our sensations into the equations has to be translated into one understandable to non-human intellects." Mach suggests that some sort of "graphic representation" might be suitable, and the proceeding reflections seem to imply Mach's support for at least some sort of physical "world picture," some sort of symbolic-mathematical model of physical reality.

But how is Mach's vision supposed to differ from Planck's, assuming of course that even after the proceeding discussion one can still identify a relevant difference between the two? Our answer to this question will come in three parts. First, we will look at Mach's discussion of the emergence of specialized, scientific disciplines and their method of concept formation, as well as the role that these play for human knowledge relative to extra-specialized cognitive faculties and adaptations. This will help us to again understand the positions that theory and experience occupy in Mach's epistemological scheme, thereby setting the stage for a brief discussion of Mach's attitudes towards atomism and the role of mathematics in physics. Second, we will move from these specific attitudes to a broad examination of the role of the elements with respect to physical theory. In the last chapter, we saw how Mach used the doctrine of elements to advocate a *non-reductive psycho-physiology*. In this chapter, we will characterize the role of the elements within a *critical phenomenalism*.

Finally, we will turn to Planck's own, more practical epistemological concerns. And though we will indeed find many areas of agreement between the practical positions of Planck and Mach that are completely omitted from Planck's polemical caricatures, we will also identify the few subtle, highly abstract issues where differences remain between critical phenomenalism and metaphysical realism. These will be exposed most clearly through the distinct interpretations of natural constants which Mach and Planck provide, as well as through their views with respect to causation. It is Cartwright's position on precisely these two subjects that will allow us to suggest her work as an ideal reconciliation of the remaining disputes.

3.4.2 Mach's Reservations

In Chapter VIII of *Knowledge and Error*, entitled "The Concept," Mach provides a gloss on the historical development of concepts by the human species. At first, Mach argues, concept formation was dictated by direct, biological adaptation. This gave rise to a fairly parochial world view, for Mach observes that "the multiplicity of biologically important reactions is much smaller than that of reality."[344] In time, however, "specialists" emerge from the undifferentiated human community, with Mach providing the rather modern examples of "doctors, engineers and lawyers." These groups vastly expand the conceptual catalogue of man, with each specialty "undertaking a

[344] {{2 Mach,Ernst 1976; }} p.93

conceptual classification of its own." The scientific specialties in particular provide a new set of highly "general, abstract" concepts.

This story seems reasonable to the point of banality. Its relevance becomes apparent, however, when we try to determine how exactly for Mach these two stages of concepts are meant to interact. Given the evidence we have just provided that Mach indeed valued the role of theory in human knowledge, no claim that he rejects or even "reduces" the specialized to the pre-specialized will do. And yet Mach makes it clear throughout his writings that it is the world, the "elements" of the latter, and our ever-deepening *familiarity with and adaptation to that world* that is the main focus and goal of knowledge. This is what he means in the quotation cited above when he says that "the perceptions or our present natural senses will undoubtedly remain the basic elements of our mental and physical world…" Mach's commitment to the fundamentality of that "customary sensory world" has both constructive and critical consequences for his own attempted reconciliation of direct experiential and abstract theoretical concepts.

On the constructive side, Mach's analysis of the specialized fields of knowledge describes how, *from the standpoint of a critical epistemology*, their abstract, conceptual edifice, though a helpful and necessary tool in the process of inquiry, ultimately "resolves into characteristic sense reactions." Indeed, in the *Analysis of Sensations* Mach writes that a concept is never a "completed presentation" in itself, but rather always involves an "impulse to perform some familiar sensory operation" which will yield another "definite sensational element," namely "the mark" of that concept. An intricate lecture on "Newton's laws" and the "gravitational force," for example, might be followed up by the *sensual* pairing of a falling apple and the display on a stopwatch, just as a declaration of "love" should proceed the *experience* of hugs, smiles, and favors big and small. In either case, the end result of invoking the concept is "always a sensational element which was not present before."[345]

With respect to the former example (and the issue of scientific pedagogy generally) Mach was indeed concerned and convinced that it is only those individuals who are "chiefly acquainted with the conceptual world through books" who will think of that realm as autonomous, self-sufficient, and indeed as an end in itself. Having worked primarily with symbolic manipulations and sentences expressing 'fundamental laws,' such individuals are likely to "think that there is a deep chasm between human sensations and the world of concepts," whereas those who have "gradually learned about concepts not at the study or writing table but from intercourse with nature" will likely see no such gap.

It is crucial to note, therefore, that the "resolution into characteristic sense reactions" represents for Mach not an elimination of theory in favor of naïve experience, but rather an incorporation of the former into the latter. Theory and abstract concepts are not opposed to sensual facts, they "extend and enrich" them by highlighting certain sense elements and their relations,

[345] {{8 Mach,Ernst 1959; }} p.324

thus adding focus and substance to our acquaintance with a reality that had formerly been "too meager for us." Finally, once our wonder with respect to the newly discovered relations has subsided, Mach claims that the final blessing of "conceptual treatment" is that it helps to re-*simplify* the facts, to create a general sense of comfort and familiarity with the phenomena.[346] We thus recall Mach's distinction, discussed in Chapter One, between the "child of the forest," who is "surprised and nonplussed at every step," and the "modern man," who "has made the achievements of modern science and civilization his own," and thus whose "thoughts have become adapted to the larger field of observation and activity in which he is located."

Mach's constructive account of the role of theory and abstract concepts in science thus makes a distinction between specialized methodology and critical epistemology. The specialist, in an attempt to make progress in her "narrow domain," may invoke all sorts of "limited concepts" as well as "mathematical conceptions and geometrical constructions." Indeed, whatever theoretical explanation she constructs, if inadequate, will be, according to Mach, "best and most quickly corrected by the facts." For the critical epistemologist, however, whose task is to "bring into connection two adjacent departments," or generally who has "in mind the gathering up of the sciences into a single whole," these "limited concepts" of the specialist will no longer do. Only an appeal to the "connections between the elements" is, ultimately, common to every science. As for those who object that with

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[346] Ibid. p.325

respect to physics, for example, the “portrayal of the sense-given facts is of less importance than the atoms, forces, and laws which form, so to speak, the nucleus of the sense-given facts,” Mach replies that “unbiased reflection reveals that every practical and intellectual need is satisfied the moment our thoughts have acquired the power to represent the facts of the senses completely.” This statement expresses the core of Mach’s economical epistemology, that “the adaptation of thought to facts is the end of all scientific research.”

And so familiarity, indeed total *psychical familiarity*, the ability to recognize or diagnose any sensual, factual situation and accurately predict the experiences that will follow, represents for Mach *the goal of science as a whole*, with each special branch making its own contribution.[347] Whatever constructs, whatever “active working hypotheses” those branches use to arrive at their insights, from an epistemological point of view these are “merely intermediate means” that “would be devoid of value, could we not reach, by their help, a sensual representation of the facts.” This latter then is the “end” of science, while the constructs are the “means,” the “quantitative norms.”

Mach reminds us that these quantitative norms are surrounded on both sides by experience. Not only are they ultimately resolved into incisive sensory recognition and prediction, but “sense perceptions” are moreover

[347] “The biological task of science is to provide the fully developed human individual with as perfect a means of orienting himself as possible. No other scientific ideal can be realized, and any other must be meaningless.” p. 37

used all along as "supports" for their development and correction. This is what Mach means when he asserts that "all intellection starts from sense perceptions and returns to them." Specialized knowledge and theorizing, which emerge out of practical, sensory life, justify themselves epistemologically by being re-translated into the common language of sensual experience and the common project of human adaptation. Cohen is thus correct in describing Mach's epistemological standpoint as "species-centered."[348]

Despite our conclusion that Mach is a methodological pluralist who is tolerant of theoretical constructs and "working hypotheses" within the special sciences, some will remain unsatisfied with his ultimate, epistemological rendering of these constructs as "instructions for clearly defined mental or physical activities that, if performed, can evoke in the imagination or present to the senses an object of equally circumscribed reactions."[349] Many will find the description too naïve, too sensual, or too passive, unable to adequately account for the awesome constructive power of our physical and chemical knowledge, nor the technical intricacy involved in the construction and use of our most advanced instruments of measurement and the design of our most complex experimental set-ups. We are interested in such objections insofar

[348] {{30 Cohen,R.S. 1970; }} p.132- Cohen accurately describes species-centrality as "more than subjectivity, and more even than inter-subjectivity"…but less than "finality or objectivity in the sense of final knowledge of what there is." A similar kind of species centrism, one linked with the promotion of "observability" within a "humanist empiricism" that suggests that we "should not try to get away from ourselves" can be found in Hasok Chang's recent paper, "A Case for Old-fashioned Observability" {{*Philosophy of Science*, volume 72 (2005), pages 876–887}}
[349] {{2 Mach,Ernst 1976; }} p.94

as they can even come from pluralist empiricists, who like Mach, reject reductionism and theory fundamentalism and do not recognize the existence of an "independent, external world."

Such objectors, we will find, share with Mach the standpoint of *experience*, but focus on a different aspect of that experience, namely the realm of "independent" physical bodies and their interactions.[350] We have seen above how Mach acknowledges this aspect of experience and invites physicists and chemists to pursue it methodologically. In light of his strong interest in psychology and physiology, however, as well as his epistemological focus on psychic familiarity, Mach does not handle the "independent" physical realm in great detail, and he is famously skeptical with respect to some of its central concepts, including atoms and causation.[351] In the last part of this chapter, we will introduce the standpoint of *technological empiricism* as one that provides a more extensive epistemological treatment of this "independent" aspect of experience, while still sharing Mach's pluralistic and anti-metaphysical commitments.

These thinkers, like Mach, will also identify an *adaptive* end of science, one that however is based on *technical mastery*. The differences between psychic familiarity and technical mastery as paradigms will become clearer

[350] We take the term "independent" directly from Mach and recall that it does not mean "independent of experience," but rather *independent relations* between objects (of experience) i.e. *relations* that are not *directly* dependent upon our sense organs (e.g. between the motion of two billiard balls)

[351] Mach was of course an accomplished physicist, and his *Mechanics* is considered an excellent epistemological treatise on the history of that science, including within it Mach's influential critique of Newton's concepts of absolute space and time. His positive contributions in physics, however, leaned towards psycho-physics, and his epistemological treatments here were decidedly historical-critical. Mach was thus, some have argued, simply ill-prepared to deal with the breakthroughs in micro-structural physics that took place towards the end of his life.

when we go from Mach's epistemological treatment of theory ("instructions for clearly defined mental or physical activities that, if performed, can evoke in the imagination or present to the senses an object of equally circumscribed reactions.") to, for example, Cartwright's view that theories are "fitted out" in *models*, and that models are "blueprints for nomological machines." On the one hand, both "circumscribed sense-reactions" and the "regular operation of a nomological machine" are encountered in *experience*. On the other hand, the latter view is based on the concept of "capacities" and their arrangements, while for Mach "our search is for sensible ideas."

An epistemology focused on "sensible ideas" is one that is based in psychology, with its central concerns being those of mental plasticity (learning), recognition, and familiarity. "Sensible idea" is Mach's term for the amalgamation of conceptual knowledge and direct sensation that makes up human experience. For example, a doctor is presented with a group of red bumps on the arm of her patient. That sensation, already linked to *complex physiological processes* in her brain, is combined with *associations* to patients with similar symptoms, *memories* of prior outcomes, *habits* of judgment style, and *reflection* upon unconsidered possibilities. The resulting *diagnosis* (indeed, prior to its articulation) expresses the doctor's "sensible idea" of the arm, one that would surely be distinct from that of the patient's nine year old daughter, her psychic healer or indeed of a first year medical student.[352]

[352] Mach offers a similar example in the *Analysis of Sensations*: "In order to determine what thoughts a physicist, for instance, will connect with the observation of a particular optic fact, we should have to know the previous events of his life, the force of the impressions which they have left behind them,

Mach's epistemology is focused on the way in which we *see* reality, and indeed with how the sciences can help us become expert *interpreters* of the world, cultivated individuals who are mindful of their surroundings and comfortable in any number of environments. We will later find that the thinkers that we call technological empiricists, namely Cartwright, Bogdanov, and Neurath, focus primarily on what we can collectively *do* in the world, how we can manipulate objects and their causal powers to build desirable machines, and how we can organize ourselves and our creative powers to construct desirable institutions and societies. These thinkers thus focus their insight on the borders between physics, economics, and sociology. But before we can develop the constructive features of technological empiricism, let us return to the critical aim of Mach's epistemology, his *anti-fundamentalism*, which is also shared by the technological empiricists.

The critical aspect of Mach's position on theory involves a vigilant skepticism against the disproportionate reverence for or reliance upon abstract concepts and constructions that lack meaning in the context of experience- a vigilance against, as Frank put it, the "misuse of auxiliary concepts." We have previously described this misuse as *theory fundamentalism*, attributing it first and foremost to the exportation of a specialized abstraction beyond the borders of its native discipline, where it loses its precise role and definition and becomes the basis for a total

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and the facts of the development of general and technical culture by which he has been influenced." {{8 Mach,Ernst 1959; }} p.340

worldview.[353] One common example, discussed extensively by Cartwright, involves the concept of a scientific "law." A close analysis of the meaning of this concept within a specialized discipline, for example physics, shows how its universality, despite common assumptions, is significantly constrained by an implicit *ceterus paribus* clause. As an object of theory fundamentalism, however, just a few of these basic laws are supposed to "govern" the behavior of all natural phenomena.[354]

It is in his concern for this type of misuse that Mach reminds us of his ultimate preference for the biological, physiological, and experiential bases of life, a relatively stable evolutionary arrangement that has "arisen in the process of immeasurable time without the assistance of man," and which is thus "a product of nature, and preserved by nature." In comparison, as Mach reports in the *Analysis of Sensations*, mankind's abstract achievement is not only "an insignificant and ephemeral product of art," but moreover a dangerous source of cruelty and error, of "the monstrosities which easily result from a one-sided and impassioned pursuit of a scientific or philosophical point of view." When we abandon the richness of the world of experience for a fixed and absolute abstraction the worst sorts of problems can arise, and it is thus advisable to instead cultivate within ourselves a tolerant openness and humble skepticism, to achieve, as Mach puts it, the "artificial simplemindedness" associated with the priority of the elements.

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[353] In the Analysis of Sensations, Mach writes that we must not take "the instruments of a special science to be the actual world." {{8 Mach,Ernst 1959; }} p.314

[354] {{31 Cartwright,Nancy 1983; }} We will return to Cartwright's arguments later in this chapter

This attitude is meant as an epistemological counterbalance to (not a methodological substitute for) the realism often assumed by the specialist in the course of their research. Its "artificiality" expresses the fact that the specialist does not give up the expertise that she has acquired. Its "simplemindedness" denotes a pledge, however, not to plague non-specialists nor aggrandize oneself with vague, unnecessary complexities, with the sloppy, metaphysical caricatures of precise, technical tools. Unsurprisingly, Mach sums up his critical intentions most clearly in *Knowledge and Error*, where he writes that "my arguments are never aimed against physical working hypotheses, but only against epistemological absurdities."

This statement also provides the perfect transition to a discussion of Mach's notorious attitude towards atomism, or perhaps we should say, his notorious rejection of atomism. In light of the above, we should not be surprised to learn that Mach's actual attitude towards atomic physics was far more dynamic than traditional caricatures suppose. There have been a number of solid, recent attempts to clear up the story in the literature, and our interest is only in using Mach's relationship to the atom as a (perhaps somewhat exaggerated) illustration of the attitude towards theoretical constructs held by Mach.

3.4.3 Atoms, Atomism, and the Atomic Hypothesis

It is fairly common to suppose that Mach was an ardent anti-atomist, that in fact his entire epistemological program was structured around the denial that atoms exist, and that therefore subsequent development in 20^{th} Century atomic physics have showed his position to be incorrect and his epistemology to be obsolete. Within such stories, Mach is often portrayed as a truly distracting horsefly buzzing his "Have you ever seen one?" [*Ham's schon mal eins g'sehen?]* into the ears of the realist-atomists, in particular Ludwig Boltzmann.[355] This type of caricature is also relevant here because Planck makes direct appeal to the atomic question in the Leyden lecture, and many take the Mach-Planck debate to be a debate about atoms. In actuality, Mach accepted atomic theory, at least as a fruitful hypothesis, at least until around 1864, and included within the textbook on "Physics for Physicians" which he compiled in 1862, were sections on "molecular processes," the "grouping of atoms in a body," and even a "mechanical theory of heat." In this text, Mach imparted to his young medical students the idea that "atoms are merely an assumption, though a very probable one."[356] This is somewhat ironic, for in 1882 Planck still believed that the "atomic hypothesis" would "ultimately have to be abandoned," and as late as 1893 it was not positivism, but indeed "atomism" which for Planck represented a possibly "dangerous enemy to progress."[357]

By the 1870's and 80's Mach had also cooled considerably to the idea of the atom, in large part due to his growing interests in psychology and physiology. His skepticism, however, was not a matter of an everyday rivalry

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[355] Fox, Tobias *Für und gegen Atome*
[356] Hiebert, *Mach's Early Atomism*, in {{30 Cohen,R.S. 1970; }}
[357] {{78 Heilbron,J.L. 1986; }}p.13

between disciplines and certainly not, as we have seen above, a question of the dogmatic rejection of all extra-sensible theory. Rather, returning to his worry about "epistemological absurdities," Mach was genuinely concerned with the talk, so prevalent in Vienna at the time, of a reduction of *all* phenomena to the activities of atoms, and likewise of the assumption that physics would thereby become "the foundation of *all* empirical, natural sciences." Mach not only rejected Boltzmann's suggestion to him that no "analysis of sensations" was in fact achievable until the pathways in the brain were known, from which "all would unfold on its own," he found the very thought to be "ungeheuerlich."[358]

But one might object that it is possible to reject reductionism without rejecting atomism, and so the (supposedly) essential question remains- did Mach believe that atoms exist? A fairer question to begin with might be, did Mach condone the atomic hypothesis as a legitimate "working hypothesis" of physics? Towards the turn of the century, it appears that he in fact did. German reports that, especially in his later years, Mach had no problem with mechanical theories of atomic motion, so long as these were understood as performing an "instrumental" function, and thus as long as the calculations which they furnished described "valid results at the phenomenal level, according to standard criteria." He believed that any scientist who in the course of her research had taken recourse to such an "intuitive

[358] Fox, Tobias *Für und Gegen Atome*

representation," one which helps her to "present the facts," would "happily allow" theories of atomic motion as well.

But what about the atoms themselves? Do they exist or not according to Mach? There is in fact no clear answer to this question, for accounts of Mach's statements conflict, and moreover, concepts of "existence" differ. There are some things that can be said, however. First of all, even if Mach had refused to make the transition from "instrument" to "existent," one should remember that this reluctance was shared at times even by Boltzmann himself. The latter, eager to turn a fruitless polemic between phenomenalists and atomists into a fruitful give and take, often presented himself as a pluralist and his theory as one "spiritual picture" amidst others, adding that it is always valuable to have "as many pictures as possible." Boltzmann indeed at times took on an instrumentalist's language with respect to atomism, asking whether the "picture" based on atoms achieved the best "correspondence with the phenomena," or in other words, whether is was "empirically successful?"[359]

Furthermore, Mach often commented that if atoms do in fact exist, then we should surely assume that they 'exist' in ways that are different than visible objects. In particular, Mach predicted that they would not share the same "spatial relations." With typical prescience, Mach seems to have anticipated some of the later difficulties of quantum theory well ahead of his colleagues, many of whom were writing at the time about an "imitative

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[359] Fox, Tobias, *Für und Gegen Atome*

mechanics" of the tiny, and other such notions concerning the "natural laws" governing the "inside of atoms."

Finally, there is the charge that Mach's skepticism blinded him from seeing the possible experimental methods whereby atoms themselves could (and soon would) become, in their own way, "visible." According to some commentators, this is proven false by the anecdote which has Mach responding, right at the turn of the century, to the excitement of some alpha-particles with the reversal, "Now I believe in the existence of atoms!" And yet even if this story is false, and even if Mach was relatively myopic with respect to these experimental possibilities, it would still seem misguided to judge his skepticism to be worthless. In his response to Planck's Leyden lecture, written in 1910, Mach famously writes that if physics is becoming "the Church of the atom," then he "no longer wishes to be considered a physicist." Mach's critical emphasis here is certainly on the dogmatic aspects of organized religion and not on models of atomic structure, and his concern for pluralism above all else comes out in the very next line, "…for me, freedom of thought is more precious."

What is true for atoms, according to Mach, is true for other "mathematical models" in physics as well. These are "auxiliary representation" that aid in the "presentation of facts." When we represent the [movement of a pendulum] with a Sine function, for example, this is not to suggest that the swinging "*in itself*…has anything to do with a periodic function." Similarly, though Mach was one of the earlier physicists to recognize and acknowledge the potential “usefulness” of mathematical models of “spaces of more than three dimensions,” he was equally adamant that these models need not be regarded as “more than mental constructs.” In fact, in the *Mechanics* Mach jokes about the stir which the mathematical concept of the “fourth dimension” is likely to cause amongst the spiritualists and theologians who now finally have a place to deposit hell. In general, Mach was opposed to any sort of mystical aura surrounding mathematics, which he viewed on the contrary as the most transparent and economical mode of thought possible. And so once again, Mach praises “working hypotheses” at the expense of what he considers to be “epistemological absurdities.”

3.4.4 Critical Phenomenalism in Review

Before moving on to Planck’s own more practical positions, it would be worthwhile to briefly review the key points of Mach’s critical phenomenalism, especially since we will soon find that Cartwright’s work shares many of these features. Contra Planck, Mach’s critical phenomenalism is not at all averse to theoretical constructions, but does indeed reject:

(1) the mechanistic/deterministic world picture

(2) the domination of the scientific disciplines by physics

(3) metaphysical reductionism

(4) all other varieties of fundamentalism

We can again briefly point out some paradigmatic illustrations of these stances. With respect to the mechanistic and deterministic world pictures, Mach, far from disavowing all regularity or stability in the natural world, writes in the *Mechanics* that “nature is like a machine, but not exactly like a machine. (in which the position of one part determines *all* other positions) In nature, more complicated relations obtain.” It is precisely this acknowledgement of the internal complexity of natural relations that leads Mach to a relatively humble view of scientific knowledge. In particular, Mach preferred to see the mathematical equations of physics as providing economical, or, following Kirchoff, “utterly simple” *descriptions* of phenomena, and not “bold explanations” nor ‘governing’ laws. He believed this view to be the one suggested by Newton’s well-known dictum, “hypothesis non fingo.” And so as opposed to the late Einstein, who maintained that physics could provide a “total world view” insofar as nature itself was “the realization of the simplest conceivable mathematical ideas,” Mach preferred to point out that “nature has not studied at the école polytechnique,” and even more directly, that “math cannot prove how nature must be.”[360]

We have already had occasion to discuss Mach’s objection to the domination of the scientific disciplines by physics. Indeed, we have argued that his neutral monism and methodological pluralism are largely meant to point out the integrity of the psychological side of reality as well as to preserve independent methods for the analysis of sensations and the study of

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[360] {{5 Mach,Ernst 1960; }}

behavior. Mach was suspicious of the reductionist agenda that would posit physics at the base of a hierarchy of disciplines, and so he was adamant about the fact that "none of the special sciences has reached the desirable degree of development to be able to serve as a secure foundation for all the others."[361]

Mach's epistemological project generally was clearly not aimed at promoting the construction of a total, mathematical world picture drawn at the cutting edge of theoretical physics. This "kinetic world picture of colorless particles," as Mach called it, was on the contrary Planck's project, and though Mach acknowledged it as a legitimate pursuit, he also believed that Planck's myopic dedication blinded him from the validity of Mach's own task. "Planck does not understand my thought," Mach observed, "which lies completely outside the direction of his work." And indeed, Mach the philosopher is not interested in driving down into the "depths" of physics but rather in encouraging mutual understanding at its borders with the surrounding disciplines and with society at large. One of the main reasons for his resistance to the reduction of our sensual experience to something more "basic," is that *experience* is crucial to this project of inter-disciplinary translation and collaboration, providing a foundation to and common reference point for all empirical research, a "bond between physics and the other natural sciences." Demanding that scientists periodically re-translate their theoretical work into the language of experience is an excellent way to

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[361] {{2 Mach,Ernst 1976; }} p.37

prevent specialists from consciously concealing the weaker points of their research beneath the aura of technical or metaphysical jargon, as well as from unconsciously falling into a routine, unquestioning faith in prevailing abstractions. This is the task of enlightenment, according to Mach, that we "from time to time purify the presentation of our research results of the unessential, superfluous ingredients which have snuck in through the engagement with hypotheses."

This task is meant to cultivate candor and sobriety in the researcher, and the failure to go through with it leads to the kind of one-sided fundamentalism which Mach rejects. "Beware of formula that are too rigid," Mach advises, for if "ideas outbalance experience too much, then drawbacks may result," indeed there is a "risk of serious error and disaster." It is with respect to these principles that Mach worries about Planck's call for a comprehensive and "unified world picture," for in Mach's estimation, "given the problems of the day" this battle cry seems "premature and almost comical." Mach's biological critique of the physical world picture, not unlike the socialist critique of the bourgeois state, is the attempt to bring a pure but somewhat hollow idea "down to Earth," to transform an ideal "system" into real, enlightened habits and practices, to ensure that theory serves life rather than usurps it. Mach thus famously advises that instead of "finding satisfaction in a seemingly complete, but inadequate system," we should "endure an incomplete world view," thus moving forward with a sober recognition of our actual abilities as well as the will to enhance them through collaboration.

Generally speaking, the ethical lessons derived from a close reading of Mach's critical phenomenalism would not be the frivolous abandonment of theory and progress in favor of inert and passive immediacy. Rather, what one finds is a mixture of, on the one hand, determined effort and unceasing experimentation, and on the other, self-conscious sobriety and pluralistic tolerance. Far from being "merely formal," Mach was much more involved with and interested in the organic and practical spheres of life than the logical clarification of concepts.

3.4.5 Planck's Position

Having just contrasted Mach's actual views with the caricature of the "strict logical positivist" assigned to him by Planck, we can now do the same thing for Planck himself, briefly looking at the ways in which his more practical, methodological concerns differ from the bold declarations of metaphysical realism.

As was alluded to in the section on atomism, Planck's philosophical position did not remain static throughout his life. On the contrary, Planck concedes that in his earlier years, much like Einstein, he "considered himself to be one of the most committed followers of Mach's philosophy, which exercised a strong influence on his physical thinking." Indeed, throughout the 1880's Planck wrote of the "need to stay close to experience" in science, and so of the goal to base the energy principle, for example, "on true facts of experience…, with the utmost avoidance of hypotheses." In a prize-winning essay on thermodynamics written in 1887, Planck made the very Machean assertion that "the more certain a law of physics is, the closer its connection with the immediate results of observation must be."[362]

It is hard to pinpoint the moment of Planck's conversion away from these views, and indeed to what extent he actually abandoned them at all. It is at least clear that his beliefs about atoms changed radically right around the turn of the century, and by the time of the debate with Mach, Planck was confidently asserting that atoms were no less real than celestial bodies.[363] It is also clear that somewhere around this time Planck's formidable suspicions shifted their focus from atomism to positivism, thus inaugurating his great "anti-positivist" campaign. But how much of this campaign was rhetoric, and how much substantial epistemology? How does Planck's uncompromising stance on metaphysical recognition filter down into his more practical views, and how do these views differ from Mach's own actual position just described?

We find many similarities between the positions of the two thinkers. Planck's practical concerns seem to have been for the continued generation of creative hypotheses and the recognition of the value of idealization, imagination, and theory generally to scientific inquiry. On the importance of

[362] {{78 Heilbron,J.L. 1986; }} p.45
[363] {{78 Heilbron,J.L. 1986; }}

thought experiments, he writes that these, while indeed "abstractions," are crucial tools that enable investigators to "go beyond the sensory world" in order to "design hypotheses and formulate new questions." This is important, for it is Planck's belief that, *at least in physics*, scientific classification and modeling have gone from being based on sense data to "moving beyond sense experience," as is evidenced from the move from the distinct disciplines of acoustics, optics, and mechanics to more unifying fields like electromagnetism, with its mathematical models of sound waves, light waves, etc. Planck furthermore highlights "approximation" and "idealization" as two key methods of the physical sciences for arbitrating between the theoretical and sensory realms. He details the procedures whereby the "contributions from sensory organs," the "imperfections of measuring equipment," as well as all "logical incoherence" are extracted from experience, experiment, and prior theorizing in order to construct a rigid picture of the world.

When Planck is not simultaneously addressing the issue of metaphysical recognition, however, this picture is described as a "model" within which events and magnitudes "can be denoted by definite mathematical symbols with which we can operate in accordance with exact rules." This *model* thus plays, according to Planck, an "auxiliary function," and calculations made upon the "designated magnitudes of the world image" are translated into corresponding magnitudes of the world of experience for purposes of "approximate forecast" and prediction.[364]

We can see then that some of Planck's practical characterizations of physical science match closely with Mach's described above. Planck, in a later essay on "Pseudoproblems in Science" even echoes Mach's view that the psychological and physical sides of reality are "investigated by different methods" and "from different standpoints."[365] But how then are we to describe that fundamental difference that is supposed to keep them at odds? What is the true source of their famous, and in fact uncharacteristically bitter (on both sides) polemic? Ultimately, by linking up the issue of metaphysical recognition discussed at the beginning of the chapter with the practical descriptions of physical science just examined, one ends up with subtly different, yet vehemently opposed interpretations of the idea of a *world picture*. This should not be surprising, for the intrusion here of the often meddlesome concept of "world" is bound to bring with it a good deal of metaphysical, and as we saw above, even ethical baggage. But is it enough baggage, for example, to take one and the same *auxiliary, approximate, symbolic-mathematical model* and fragment it into two fundamental, irreconcilable world views?

Perhaps, and we can at least confirm that this particular "picture" is a source of the polemic when Planck complains that although he sympathizes

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[364] Planck, *Causality in Nature*, in {{40 Planck,Max 1936; }}p.55
[365] Planck, *Scheinprobleme der Wissenschaft* {{75 Planck,Max 1947; }}

with Mach's fierce criticisms of the "mechanistic world view," he claims that Mach "overshoots the mark by degrading the physical world picture" along with it.[366] But given that we have already seen that Mach supported an extra-sensory, symbolic-mathematical "graphic representation" of the world constructed by physics more than four years before the Leyden lecture, what could Planck mean by this "degrading?" The main difference seems to emerge when Planck invokes a certain Neo-Kantian language (what he calls an even "more realist form of expression) with respect to this world picture. He does so, for example, at the end of the Leyden lecture, when he *equates that picture*, or indeed, some more perfect version of it to come, an "ideal picture of the future," *with the real world itself*.[367] In other words, since our world picture is constantly being developed, and since an ideal, future picture will presumably contain all of the permanent progress and none of the temporary errors, we can safely say that we will know the real world when we know our most advanced, unified, scientific theories to come.

Planck makes these brief suggestions in a concluding aside, so they are somewhat difficult to interpret. He does refer explicitly to Kant, however, stating that it was he who popularized the insight among intellectuals that there is "no method" by which we could identify a "knowable difference" between the "world," as discussed by the great scientists of the 17th and 18th Century and the "world picture of the future," as discussed in Planck's day.

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[366] *The Unity of the Physical World Picture* in {{32 Blackmore,John T. 1992; }}
[367] For a good explanation of (Marburg) Neo-kantianism in these terms, see Friedman's *A Parting of the Ways* {{80 Friedman,Michael 2000; }}

Planck recognizes that the compound term "world picture" is often used for cautionary reasons, to avoid and exclude "certain illusions from the start." He suggests that we could now return to the simple term "world" if only we could "apply the required caution" and remember that by world we simply mean the "ideal picture of the future." Mach, who would certainly affirm the need for a "required caution" when dealing with talk of a "world" represented by theory, would nevertheless reject the idea that when we speak, even as scientists, of the "world," that we mean our future theoretical-mathematical world picture, suggesting instead that the world remains our "customary sensory world," even if over time our familiarity with that world becomes progressively richer through science.

For Planck, such a difference in interpretation is important. As Vogel observes, Planck took an individual's understanding of science to be "an essential indicator of worldview." As we have seen above, Planck often stated in his polemical essays and lectures that only a metaphysical realism, with its unwavering "faith in a certain reality outside of us," was capable of recognizing the "mystic element" of physics and its "essentially metaphysical goal." Even if we now take his concluding remarks from the Leyden lecture as a signal that his "realism" at times gave way to a kind of neo-Kantian idealism, we are still dealing with a view that emphasizes the "construction" of the world in *mathematical-theoretical terms*, or, as Friedman puts it, one that "*replaces* the given manifold of sensations with the methodological progression of mathematical natural science."[368]

Both standpoints have the virtue, according to Planck, of situating physics on a path of infinite progress, thereby inspiring the "forward looking faith" that "guides all science," as well as the ethical resolve needed to work "steadily and without interruption towards an unattainable and ideal goal." We thus might characterize Planck's interpretation of the physical world picture under the conceptual heading of "totality," which is how he himself describes the scientific project.[369]

Understood in this way, these types of realisms (whether metaphysical or logical) are anathema to Mach's critical phenomenalism. With respect to faith and ethics, Mach saw the former as more of a danger to the latter than a support, and he took it as part of his philosophical task "to warn mankind against letting its way of life be dictated by any kind of faith." Regarding the identification of a mathematical world picture with the "real world" itself, this would be a strange idea to Mach indeed. For if any scientific rule or equation is capable only of highlighting "one aspect of a fact," then which aspect would a to*tal worldview* emphasize? It would seem that no single representation could capture the "infinite richness and inexhaustible manifoldness" of reality. On the contrary, a critical phenomenalism assumes from the start that no one

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[368] {{80 Friedman,Michael 2000; }}How such a view accounts for the coordination of theory with sensual experience, or the confirmation of the former by the latter, is an interesting and controversial question that would merit its own investigation. For our interest, it suffices to point out the way in which this type of view attempts to give some *priority* to the reality "constructed" by the mathematical natural science as opposed to that disclosed by the senses.

[369] Berlin Rector Address 1913, in Vogel, *The Philosophical Influence of Max Planck*

picture or rule could ever adequately represent the organic and interactive "whole."[370] It is in this way that Mach assumes the plurality of standpoints and the independent integrity of disciplines, with sobriety and collaboration as key ethical lessons.

But can this really be a satisfactory outcome of the debate over "scientific realism?" Ethically, are we ultimately to oppose resolve to sobriety and "forward-looking faith" to "historical-critical" candor? Is one simply to point out that Planck's father was a co-author of the Prussian legal code, while Mach's attempted (not wholly unsuccessfully) to raise silkworms in the family backyard in Bohemia, letting everything follow from that? Framed in this manner, the ethical debate within the context of science has made absolutely no progress beyond any other banal, contemporary accounts of the darkness of depths versus the superficiality of openness.

It appears that little progress will be made as long as realists and positivists understand their ethical commitments negatively, the latter warning of the potential cruelty of the former, and the former rejecting the latter's typical frivolousness. Even if these descriptions are appropriate for some individuals in some cases (e.g. Planck's excitement, both cruel and frivolous, at the outbreak of WWI- "what a glorious time we are living in" that unites "the physical and moral power of Germany" and thus "with the speed of lightning ignited a flame of holy wrath blazing to the heavens"), a truly well-articulated

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[370] For Mach on the concept of "the whole," see for example {{8 Mach,Ernst 1959; }}

ethical standpoint will demonstrate that in the modern world sobriety is itself a form of resolve, and that modern resolve necessarily includes responsibility.

But why are we dealing here with ethics anyway, let alone with a particularly vague and rhetorical form of ethical debate bound up with all sorts of metaphysical hot air? Let us bracket these considerations for a moment and re-examine where the issue has been left off epistemologically. We encounter a standoff between a realism m which focuses on the (potential) *totality* of a mathematical, unified, *physical* "world picture," and a critical phenomenalism with its conceptions of complex interaction and *psychic familiarity*, and thus an emphasis on the conditioned and limited aspect of knowledge as adaptation.

This one-sided opposition should not be difficult to overcome, for we have seen both that it is based mostly on extra-scientific, rhetorical commitments, and that beneath these commitments lies a substantial set of fruitful agreements on the nature of scientific praxis. What is needed then is a position that sets off precisely from these agreements on praxis, thus pushing epistemology forward from the center rather than fleeing off to either of the more ideological, caricatured stances. This is exactly what we will find in Cartwright's technological empiricism.

We can *provisionally* illustrate the possibility of this third option by examining each of the thinkers' interpretations of *scientific constants*, a theme upon which all three focus. Beginning with Planck and Mach, this issue provides a particularly good illustration of the traditional, knee-jerk rhetoric of the so-called realism-instrumentalism debate. We will then turn to a refreshingly open and direct examination of the subject of constants taken from one of Cartwright's middle works, *Nature's Capacities and Their Measurement*. We will see how by setting out not from a priori metaphysical assumptions, whether realist or strict positivist, but from scientific praxis itself, Cartwright is able to improve upon the more caricatured interpretation of constants of both critical phenomenalism and metaphysical realism. Eventually, we will see how this improvement is also achieved with respect to the more complex though deeply related issues of causation and theoretical entities, and finally, even for the aforementioned struggles at the borders of epistemology and ethics. There, in the spirit of the work of Otto Neurath, Cartwright's technological empiricism replaces vague assertions and accusations with suggestive insight into the boundaries of freedom and necessity, and thus strong justifications for social solidarity and ethical-political efficacy.

3.5 From Realism vs. Positivism to Technological Empiricism

3.5.1 Constants- Mach

We have already encountered Mach's interpretation of natural constants in Chapter I. There we cited Mach's appropriate view of scientific equations and formulae generally as useful tools or *recipes*, quoting the passage from the *Economical Nature of Physical Inquiry* where he writes that "all physical ideas and principles are succinct directions, frequently involving subordinate directions, for the emplyment of economically classified experiences, ready to use." This link of what is useful to what can be experienced is consistent with Mach's claim from *Knowledge and Error*, described above, that over time the entire conceptual edifice of each specialized science "resolves into characteristic sense reactions," or more precisely, into "instructions for clearly defined mental or physical activities that, if performed, can evoke in the imagination or present to the senses an object of equally circumscribed reactions."[371] For Mach, scientific constants represented the paradigm of these types of economical, labor-saving "instructions," uniting a great variety of particular cases and experimental trials into one term. His favorite example to invoke was the index of light refraction, which by itself gives us information on how to predict or reproduce an infinite number of single instances. Mach looked especially favorable upon "data tables" assembled in accordance with the constants, and he often commented that the "abridged descriptions" offered by these were really all that "natural laws are."

Mach thus offers a fairly typical "instrumentalist" interpretation of constants. They are tools, and they are valuable because they work, because they help us to make accurate predictions of the phenomena and thus to coax desirable behaviors out of the same. Indeed, once a constant is identified, it can be passed down through the generations, thus saving those to come a great deal of experimental trial, error and confirmation.

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[371] {{2 Mach,Ernst 1976; }} p.94

The question remains, however: *why* do they work? Or, in its epistemological form, when we have discovered a constant, *what* exactly is it about our world that we now know? Mach is unfortunately fairly quiet on this issue. He does write about the "relative stability of the world," how "everywhere the same fact expresses itself," and how if this were not the case science, and indeed all knowledge, would be impossible. For "thoughts," Mach writes, "can only adapt themselves to what is constant in the facts." However, when discussing the constancy of and recipes for phenomena Mach does not suggest to what we might attibute that constancy when and where we discover it, nor what it might be that makes those recipes work, nor how, for example, a particular ingredient is able to make a particular contribution to the finished dish.

3.5.2 Constants- Planck

Planck, on the other hand, was eager to explicitly draw the boldest of conclusions from the identification of natural constants. Heilbron tells us that of all of the evidence for his realistic worldview and his account of knowledge as "permanent" and "universal," it was "above all, the natural constants" which steadied his faith. In his philosophical writings, Planck often "cited the constants *h* and *k* that figure in his radiation law, and the gravitational constant, etc." in order to once again point out that "with their help we have the possibility of establishing units of length…which necessarily retain their significance for all cultures, even unearthly and nonhuman ones."

With the ideas of “independence,” the “absolute,” and validity for “non-human intellects,” Planck links constants with his programmatic vision of the “emancipation of science from anthropomorphic elements,” of a physical world picture “completely liberated…from the individuality of the creative mind.” This picture, whether as an *approximation* to the “real, external world” or taken at any given moment to describe *the world itself*, is thus valuable even, and indeed especially, in isolation from human concerns. And when we ask Planck what the discovery of natural constants teaches us about the world, he answers that it not only rekindles our faith in the ongoing construction of a unified and total world picture, but moreover that it helps to confirm some of our suspicions about what that picture must be like. In particular, as we will see, it recommends that we go much further than Mach’s passing recognition of a general “stability” of the factual world, adding weight rather to that assumption often described by Planck as “the essential foundation of every scientific inquiry,” namely that of “absolute determinism.”

3.5.3 Constants- Cartwright

And so we have a single group of scientific constants represented, on the one hand, as a set of adaptive tools and recipes, and on the other, as elements of and evidence for a deanthropomorphized, deterministic, total world picture. We now move on to Cartwright’s close case study of a particular kind of scientific constant (the parameter α of econometric equations) in *Nature’s Capacities and Their Measurements*, hoping to somehow break the stalemate. We will find that Cartwright does not start out with her own fixed assumptions about the universe nor the objects and aims of our knowledge of it. Rather, she follows closely the work of scientists themselves, only then asking what assumptions are built into inquiry as it is practiced, as well as which conclusions we may, and indeed which we are compelled, to draw from its results *and* applications. Perhaps unsurprisingly, what emerges is a fruitful and well supported amalgamation of realist and positivist ideas.

Cartwright starts out by producing the typical demand curve used in econometrics:

$$q = \alpha p + u$$

She then provides the traditional explanation of the symbolic terms: "q represents quantity demanded, and p, price; u is supposed to represent some kind of random shock which turns the equation from a deterministic relationship to a probabilistic one." One term is left out for special treatment and Cartwright tells us that "it is the fixed parameter α that is the focus of my interest," and indeed precisely because it "is treated as a constant or fixed parameter."[372]

And so how does Cartwright interpret the methodological and epistemological relevance of this constant? First, she asks about the broader relevance of constructing an equation in the first place, in this case one representing the relationship between supply and demand, and concludes

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[372] {{13 Cartwright,Nancy 1989; }} p.151

that its purpose is to reflect a "causal relationship." Changes in the variables represented on the right side of the equations serve as *causes* of changes, or *effects*, in the variable on the left. Cartwright does not arrive at this conclusion based on any a priori stance. Rather, in this case she looks to the accounts of the economists themselves, who state that "the methods aim to study the relationship between causes and effects," and in this case "the systematic influence of price on demand." Cartwright affirms this methodological realism about causes that she observes in praxis, and later in this chapter (in the section on "Strategies and Causes") we will see how she means to ground causal laws epistemologically through the practical, measurable (and thus "objective") distinction between effective and ineffective strategies of technical intervention.

But then what is the relevance of treating α, which represents the price elasticity of demand, as a relatively fixed constant, a coefficient which remains unchanged across a wide variety of circumstances? Changes in price could indeed be a cause of changes in demand even if the magnitude of the effect varied over the range of prices. By holding α constant, the economists have made the additional assumption of a *stable causal influence* of price on demand, an abiding tendency "of the system," one which could possess a "fixed and measurable strength." It is the tendency to have a stable causal influence of measurable strength in a wide variety of circumstances that Cartwright calls a "capacity," a crucial concept that we will examine in detail. For now, Cartwright tells us that the importance of these stable causal influences is that they allow the economists to "devise models" of target systems which have far greater explanatory and predictive power than mere probability distributions. In order to build a model, however, "some features must remain invariant with respect to some changes," for the point of the model is that in its equations it "expresses a commitment about what remains constant under change."[373]

Before we begin to analyze Cartwright's position, one might immediately object that Mach and Planck were commenting on *natural* constants, whereas here the issue is a sort of social constant of dubious validity. For Cartwright, however, who is concerned with scientific practice, and is asking here about the background assumptions built into *treating* any particular parameter as a constant, this is a non-issue. She could just as well be writing about "the systematic influence" of gravity on motion, and of models of the solar system.

And so there is much that is unique in Cartwright's discussion that now requires analysis. In the remainder of this chapter from *Nature's Capacities*, Cartwright looks at some of the conclusions of her interpretation of constants for some traditional epistemological standpoints. On the one hand, she rejects "radical empiricism" both because it dismisses "the whole fabric of causal concepts" and because the type of phenomenalistic "sense data" which it finds in the world are almost never addressed *in practice* by working scientists. At the same time, Cartwright offers "another version of

[373] {{13 Cartwright,Nancy 1989; }}

empiricism," an empiricism "of testing and measurement," which is, however, also critical of much of "modern theoretical science, which is prone to be driven more by the needs of mathematics than it is by the phenomena." As we will see, from the point of view of this empiricism of testing and measurement, it is not the "laws" of nature that are fundamental, "but rather the capacities."

And so what emerges out of Cartwright's discussion of constants? (1) An empiricism, though not a radical empiricism, that is nevertheless critical of pure theory and the overestimation of mathematics, demanding that scientific claims be "judged against the phenomena themselves." (2) An assumption concerning the stability of the world, and yet one that is limited to particular "systems" in that world, and thus that is addressed scientifically by representations of those systems, i.e. through the construction of "models." And finally, (3) a realism about causation which at the same time rejects the epistemological priority, and ultimately the practical necessity, of laws, as well as the assumption (as we will see) of universal determinism. These principles, for reasons that we will develop through the remainder of the chapter, suggest a standpoint consistent with a capacity realism, one that we will call *technological* empiricism, in part because it follows closely upon scientific practices and techniques, and in part because its crowning concept is that of the *nomological machine*. Technological empiricism is a position with both critical and positive commitments, and it is convenient to begin our examination with the former, since Cartwright's brand of empiricism shares many critical and pluralist features with Mach's critical phenominalism outlined above.

3.6 Mach and Cartwright I- The Critique of Fundamentalism and the Boundaries of Physics

It is fortunate that we began our study of Cartwright with *Nature's Capacities and Their Measurement*. From this middle text it is fairly easy both to trace themes back to early works like *How the Laws of Physics Lie*, and to move forward into the *The Dappled World*, the most mature and programmatic articulation of technological empiricism. Turning now briefly to *How the Laws of Physics Lie*, it is fairly clear from the provocative title that, as Cartwright confirms, we are dealing here with at least some "kind of anti-realism."[374] In particular, Cartwright is critical of the link between "fundamental explanations" and truth about the world. Indeed, the primary aim of *How The Laws* is to "argue against the facticity of fundamental laws." As we look closer at Cartwright's arguments for this claim and its metaphysical and epistemological consequences, we recognize many of the themes of Mach's critical phenomenalism.

Like Mach, who preferred "utterly simple descriptions" of the phenomena to "bold explanations," Cartwright believes that science can only make true claims about the world when it provides detailed "descriptions of what happens in concrete situations," and not through highly abstract and

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[374] {{31 Cartwright,Nancy 1983; }}

"powerful explanatory laws." These latter "theoretical laws" are "worse off" than their phenomenological counterparts *when it comes to truth* about the world because in order to achieve their high level of generality it is necessary that they describe behavior only in "simple, ideal circumstances," and not the "more complex and interesting situations of real life." This does not render the more abstract theoretical laws useless. On the contrary, as a common reference point for a vast number of local, particular phenomena, they possess a great "organizing power," they are, if not perfectly faithful depictions, highly *economical* and instructive shorthands. This is an evaluation that Cartwright sticks to throughout her work, and even in the *Dappled World* when she allows that at certain times and in certain domains conditions may be found in which a theoretical law does accurately describe behavior, and is thus "true," this in no way grants the law is in any way "universal." Rather, Cartwright will ultimately conclude that "nature is governed in different domains by different systems of laws not necessarily related to each other in any uniform way." And moreover, what a law is actually providing in any given case, according to Cartwright, is a "truth about capacities," but more on that later.[375]

Cartwright's preference for "the concrete" and "more complex and interesting situations of real life" over the "simple and ideal" conditions depicted by theory seems to provisionally brand her as some kind of phenomenalist, and if we listen closer we can indeed hear echoes of Goethe

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[375] {{86 Cartwright,Nancy 1999; }} p.24

and Mach throughout her work. This is especially true of the latter, whose critical views rejecting fundamentalism, mechanistic determinism, reductionism and inter-disciplinary domination by physics are mirrored in Cartwright's texts. Whereas Mach warns of "formula that are too rigid," Cartwright suggests that "there are no rigorous solutions for real life problems." With respect to mathematics, Mach's assertion that "math cannot prove how nature must be" is paralleled by Cartwright's to the effect that "nature is not governed by simple, quantitative equations." And whereas Mach challenges determinism by observing that "nature is like a machine, but not exactly like a machine" because in nature "more complicated relations obtain," Cartwright offers an "extreme metaphysical assumption," namely that the behavior of objects in nature are "constrained by some specific laws and a handful of principles, but is not determined in every detail, not even statistically."[376]

These criticisms of theory and mathematical fundamentalism are associated for Cartwright, as they were for Goethe and Mach, with a certain awareness of and emphasis upon the bountifulness of qualitative reality. Indeed, for Cartwright, this tradition goes back at least to the "Aristotelian belief in the richness and variety of the concrete and particular." And just as

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[376] {{31 Cartwright,Nancy 1983; }} p.49 Perhaps this raises worries about the point, made above, that Cartwright approaches epistemology without broad, a priori metaphysical assumptions. However, that point still holds for her positive views, especially about causation and theoretical entities, which follow closely on the heels of scientific and technological praxis. And while her bolder, critical passages do at time seem less grounded in experience, one can argue here that her "extreme metaphysical assumption" is equally as much the outcome of her sophisticated analyses of the limitations of physics and the "boundaries of science" generally as it is a matter of intuitive faith.

Mach points out the "infinite richness and inexhaustible manifoldness of the facts," Cartwright, observing how "nature tends to a wild profusion which our thinking does not wholly confine," imagines that "God has the untidy mind of the English."

A respect for this kind of variety is likely to yield a resistance to reductionism, which Cartwright describes as the re-description of all types of phenomena in the terms of one type, usually the "microscopic properties of physics." We saw above how Mach's elemental monism rejects the metaphysical reduction of experience to "something more basic," and how his methodological pluralism rejects explanatory reduction, primarily in the name of safeguarding the integrity of a partially autonomous psychology from the encroachment of physics. Cartwright, who also challenges the "imperialist tendencies" of physics, along with its claims to a "theory of everything," also rejects reductionism, though her justification is different.[377]

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[377] There is no space here for a detailed discussion of Cartwright's argument against reductionism. This argument, however, is related though independent of her claim that the laws of physics are not exhaustive or universally true, that they work "within walls," which is to say when conditions are "arranged just so." In order to question reductivist assumptions, Cartwright now takes us in from the other end, asking us not to evaluate the finished, law-like claims of physics, but to reflect upon how a particular body of physical knowledge gets built up in the first place, how the search for *predictive closure with respect to a given phenomena of interest* will admit only the "smallest set ot properties" that are "*ceteris paribus* closed…under prediction." Predictive success within this artificially prescribed domain does not at all underwrite the claim that the domain includes "all properties." On the contrary, the processes of specialized demarcation and knowledge gathering argue directly against claims for reductionism. In a dappled world, predictive closure is not property completeness. {{86 Cartwright,Nancy 1999; }}

Similar ideas about reduction, though more from a standpoint of biology and psychology, can be found in William Bechtel's essay, "Reducing Psychology While Maintaining Its Autonomy Via Mechanistic Explanations." Bechtel affirms "reductive explanations" insofar as they are understood as the *mechanistic* explanation of the behavior of a system in terms of its component parts and their organization. He affirms, however, the autonomy of the "higher-level" specialized sciences and thus rejects reductionist programs seeking "hegemony for the lower level." Indeed, Bechtel questions the traditional idea of 'levels' of phenomena altogether, preferring to talk about various *natural*

It is when we examine some of the motivations for Cartwright's negative, anti-fundamentalist positions that significant differences between the focus of Mach's critical phenomenalism, and that of Cartwright's more *constructive* phenomenalism begin to emerge. On the one hand, insofar as both Mach and Cartwright are working to limit the dominance of the special sciences by physics, there is much overlap. However, while Mach was especially interested in the relationships between physics, psychology and physiology, Cartwright tends to work more where physics confronts chemistry, economics, and all types of engineering. We will soon claim that this difference reflects a more basic one with respect to each thinker's understanding of what makes up a "concrete situation." In order to get closer to Cartwright's idea of the "concrete," however, we should quickly introduce a few of the ethical-political motivations behind her anti-fundamentalism.

Two points are central here. The first is that parallel to Cartwright's strong attention to scientific *practice* in her epistemology, the basic motivations for her epistemological work are not entirely scholarly but socio-political as well. Cartwright is not so much concerned with producing an abstract account of our scientific *representations of the world*, as she is in

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phenomena of interest, and the mechanisms that scientists can use to account for their behavior, mechanisms that may comprise elements from a number of "levels," understood traditionally. Talk of levels, Bechtel claims, must be "local," relative to the mechanism explaining a given phenomena, and, agreeing with Cartwright, Bechtel concludes that "we are not confronted by the prospect of a comprehensive lower level that is causally complete and closed." Moreover, with arguments similar to Mach's concerning evolution, culture, and introspection, Bechtel claims that knowing "the mechanism and its environment," independent of "the reductive account," is often relevant to fully understanding a given phenomena, and thus that mechanistic-reductionistic inquiries and "higher level inquiries" do not exclude but in fact "complement each other," that "neither on its own suffices and neither can do the work of the other." {{98 Schouten,Maurice Kenneth Davy 2007; }}

influencing our scientific *interventions in the world*, and thus with changing it. "I am interested in intervening," she writes, and this helps us to understand her ethical-political motivations, which are clearer than either Mach's or Planck's.

For example, the fundamentalist fervor to reduce medicine to genetics is worrisome not because it stifles the academic debate over nature versus nurture. Rather, as Cartwright's breast cancer example illustrates, because it may shift funding away from preventative education and screening and towards more "basic research," without even taking the time to compare the relative efficiency of these strategies for *fighting disease*. Likewise, without getting into the details of the debate over "structural adjustment" policies, Cartwright cites the longstanding problem of theory fundamentalism at institutions like the International Monetary Fund. Officials at the IMF, absorbed in the dictates of their economic models, have on several occasions "discouraged Third World countries form direct welfare expenditure," exposing a possible gap between the abstractions occupying their focus and the true "elements" of global development.[378] It is important that we acknowledge and cultivate a *dappled view of the world*, according to Cartwright, in order to avoid just this kind of abdication to a false and contrived necessity.

We will return to these issues later. For now, we can perhaps see that Mach and Cartwright are at the end of the day focused on different notions of

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[378] {{86 Cartwright,Nancy 1999; }} For more on "market fundamentalism" and the IMF, see {{99 Stiglitz, Joseph E. 2002; }}

the “world.” Recalling our discussion from Chapter II, Cartwright is more interested in Marx’s “cherry tree,” transported and planted by commerce and industry, while Mach leans toward Feuerbach’s, an occasion for immersion in the sensual present. Cartwright is well aware of this aspect of her work, and she cites it as the reason for her close affinity with a philosopher of biology like John Dupré, who despite his varying technical problems is also focused on “the material, cultural, and political-economic world of day-to-day and historic life.” It is partly based on this focus that “social engineering” and indeed *planning* in general become the key ethical-political concepts of technological empiricism.

But turning back to the epistemological side of the border, we are now in a better position to provisionally lay out some of the similarities and differences between the critical aspects of biological and technological empiricism. This is a task that we will finish in the conclusion to this thesis. For now, it is clear that Mach’s *world of elements* and Cartwright’s *world of capacities* share certain features. Neither, for example, is a completely deterministic nor mechanistic world. Both are best discovered and manipulated through *experience*. It thus makes sense that both of their respective philosophical treatments would have “staunch empiricist” commitments, even if Mach’s version, though not dogmatic, might lean closer to what Cartwright describes as “radical empiricism” while her own is best approached with an “empiricism of testing and measurement.”

Let us briefly consider the relevant distinction here. Cartwright calls her empiricism one of "testing and measurement" in order to distance herself from any kind of empiricist "foundationalism." The latter is typically described as a program that requires all scientific knowledge to be "built up" using reference only to the *given* "sense data." Cartwright, a close student of science as it is practiced, argues that the idea of "sense data" is too contrived and not used by working scientists, and that moreover "the thin texture of pure sense experience will never provide sufficient support" for building and testing scientific hypotheses. With respect to Mach, however, we have argued above that his empiricism is also not "foundationalist" in the traditional sense, that he is a methodological pluralist who makes significant concessions with respect to the working concepts and specialized languages of physicists and chemists, as well as to the so-called theory-ladenness of observation, a point to which we will return. Indeed, Mach strongly emphasizes the distinction between the work of specialists and that of critical epistemologists. The role of the latter with respect to the daily work of the former is fairly limited, a matter of encouraging the specialists to "from time to time purify the presentation of their research results" of "unessential, superfluous ingredients," and to remind them that "sense perceptions" not only make up the starting point of all knowledge, but that they are also used all along as "supports" for the development and correction of hypotheses. Mach thus calls attention to the priority of the "customary sensory world" in order to ensure that theory is evaluated according to its relevance to experience and to discourage the type of fundamentalism described above. This is consistent with what Chang has recently called a "humanist empiricism," one that declares that we "cannot, and should not try to, get away from ourselves."[379]

Indeed, there is much that Mach's empiricism (his "elemental monism") has in common with the "quality-based" empiricism, the "old-fashioned observability" standpoint advocated by Chang in his recent paper. There, Chang opposes his quality-based view to the "object-focus" of other, "constructive" empiricists. This type of opposition is linked to the one typically used to describe the two "aspects" of experience, i.e. the order of perceptions and the order of independent objects.[380] Can we then apply this distinction to Mach and Cartwright? Is the latter's "empiricism of testing and measurement" linked to an object-focused, as opposed to a quality or property-focused (or "elemental") empiricism?

The answer is yes and no. On the one hand, Cartwright's attention to methodology and praxis, especially in physics, leads her to talk plainly about physical objects (as well as their causal powers). On the other hand, Cartwright is fairly silent when it comes to ontological questions (what ultimately exists?) as well as foundational epistemological questions ("where do we get our concepts and ideas?"). When Cartwright engages in critical epistemology alongside her tracking of methodology, her aims are (1) to

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[379] Chang, Hasok *A Case for Old Fashioned Observability* {{*Philosophy of Science*, volume 72 (2005), pages 876–887}}
[380] See {{100 Hampshire,Stuart 2005; }} or {{101 James,William 1958; }}

oversee how “claims to empirical knowledge are judged,” and (2) to challenge fundamentalism, especially about scientific laws.

This is where Cartwright’s “empiricism of testing and measurement” comes in. On the one hand, it includes a sophisticated notion of testing that expects “a rich background of both individual facts and of general assumptions about nature before we can ever deduce a hypothesis from the data.”[381] On the other hand, by focusing on the idea of “measurement,” as opposed, for example, to “sense perception” or “observation,” Cartwright emphasizes the contemporary role of sophisticated instruments in reading nature, their ability, as Chang puts it, to not only “extend our sense organs” but to “create new observable qualities” through established, “operational” rules of interpretation.[382]

None of this, however, directly opposes Mach’s empiricism to Cartwright’s. What is more apparent is a disparity in focus and emphasis. Mach acknowledges but Cartwright stresses the sophistication of contemporary experimental set-up and the importance of sophisticated, measuring instruments for developing and testing hypotheses within the specialized sciences. Mach, on the other hand, adds an additional critical layer as well as a teleological component to his epistemology that are alien to Cartwright’s interests. These are, respectively, the stipulation that the psycho-physical “elements” are most basic, and the claim that the aim of the

[381] {{13 Cartwright,Nancy 1989; }}
[382] Chang, Hasok {{*Philosophy of Science*, volume 72 (2005), pages 876–887}}

sciences is that of psychic familiarity, of individual recognition and comfort amidst the sensual elements. Cartwright, unlike Mach (and Chang) is not interested in whether or not "physicalism is a gigantic program of interpretation," and her teleological ideal is closer to one of technical mastery and collective, social intervention.

This first difference (emphasis on sophistication of experiment and measurement) helps explain how Mach and Cartwright's visions of a "concrete situation" diverge. For the latter, the *concrete* in science is a technical and not a (strictly) phenomenal sphere. Cartwright is not interested in the way in which mathematical laws can be "resolved into characteristic sense reactions," not because she has abandoned the senses, but because she finds this type of description too passive and contrived. She is interested in how abstract laws and theories are tested and then deployed in experience through technical engagement and know-how, through "the judicious corrections of applied physicists for the research engineer" and the "prepared descriptions" of the capable modeler. This is especially true for the projects in which "different theories intersect" and different domains overlap, and she thus cites the great need for "articulated methodologies for interdisciplinary work." For Cartwright, the "phenomenological correction factor" does not refer to a psychic resolution of theoretical constructs, but an ongoing, constructive project of making local mechanisms work.[383]

[383] {{86 Cartwright,Nancy 1999; }}

Cartwright thus has good reason for pointing out the differences between her ideas and those of someone like Karl Pearson (whose *Grammar of Science* Mach unsurprisingly praises in his work). When Pearson suggests that the reporting of probability distributions should be "theory free," he is making an appropriate observation from his own critical phenomenalist standpoint. For Cartwright, however, who is not interested in the passive recording of probabilities but the active "hunting for causes," Pearson (and Mach's) characterizations simply will not suffice. It is thus that she dedicates a significant portion of her work to describing how we translate between these standpoints, i.e. the move from regular associations to causal laws.

Of course, none of this is meant to re-paint Mach as a passive or dogmatic phenomenalist. The formidability of his biological standpoint rests precisely in its additional, positive focus upon evolution and psychic *adaptation* as driving forces of both inquiry and ethical life, thus leading to his unique blend of life-affirmation and Buddhism.[384] Speaking even more broadly, there is a way in which we can understand Cartwright's methodological and practical focus as presenting the technical middle term to Mach's starting and finishing points, between the organic experience of the child and the total adaptive familiarity of the master.[385] Returning to details,

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[384] "Mach's is a Buddhism without the pessimism" {{32 Blackmore,John T. 1992; }}

[385] Mach presents his ideas about psychic familiarity as the end of specialization very nicely in Chapter XIV of the Analysis of Sensations, entitled "Influence of the Preceding Investigation on Our Conception of Physics." In section 24, Mach writes that a "self-confidence similar to that of the geometer is doubtless also possessed by the composer and the decorative painter, who have both gained, the former in the domain of sensations of tone, and the latter in that of the sensations of color, a broad and rich experience. To the one no space-figure will occur the elements of which are not well

however, let us now look closer at Carwright's praxis-based arguments for causal realism just mentioned, comparing them to Planck's position on determinism, and thus giving us a chance to examine technological empiricism's relationship to the other side of the realist-positivist polemic.

3.7 Planck and Cartwright: From Totality to Techniques

We have seen the way in which Cartwright's anti-fundamentalism is connected to her preference, in the tradition of Duhem and Van Fraasen, and indeed of Mach, for phenomenological descriptions in science that "save the phenomena" as opposed to "fundamental, explanatory laws." Like these other thinkers, she believes that theoretical explanations of phenomena are often underdetermined by the data, and that most forms of explanation are thus able to "proliferate," for example in theoretical physics, where it is "usual to give alternate treatments of the same phenomena." There is one type of explanation, however, about which no such claim of superfluity or arbitrariness can be made, and that is concrete causal explanation. These can not proliferate in the same fashion as high level theories, and Cartwright believes them to be absolutely fundamental to scientific inquiry and our knowledge of nature.

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known to him, and the two others will meet with no new combinations of tone or of color that are unfamiliar to them. But the inexperienced beginner in geometry will be no less surprised by the results of his activity than the young musician or decorator." {{8 Mach,Ernst 1959; }} p.347 Mach's inclusion of the musician here is surely meant to challenge, as Chang does, what the latter calls "ocularism." {{*Philosophy of Science*, volume 72 (2005), pages 876–887}}

Cartwright sees causal explanations operating everywhere is science, describing such an explanation as a description of the "concrete caual process" by which a phenomenon is brought about. The adjective "concrete" here is supposed to oppose Cartwright's account to top-down "governance" stories about more universal causal claims. Cartwright rejects these. The causal stories that interest her are local and guide our technical practice, shaping both our experimental investigations and policy interventions.

In fact, it is upon the *successes* of the latter, and indeed those of scientific interventions generally, that Cartwright bases her causal realism. Cartwright's search after the "concrete causal processes" which bring about a phenomenon sounds like an epistemologically filled out version of Mach's "recipe" concept. Her causal realism provides an epistemological foundation to the somewhat hollow accounts of instrumentalists. To see how this works, we can look, for example, to the section in *How The Laws of Physics Lie* entitled "Causal Laws and Effective Strategies."

There, Carwrtight argues back from successful practice to a realism about causes, claiming that "insofar as we agree that there is a real difference between effective and ineffective strategies, we must ground that difference by believing in causal laws."[386] In other words, if a claim of effectiveness can be true or false, as seems to be the case in medicine, agriculture, engineering, etc. (e.g. if mosquito nets work in fighting malaria but burying

[386] {{31 Cartwright,Nancy 1983; }}p.22

'infected' blankets doesn't) then this must be so because of some truth about our world, specifically because of the "causal laws of our universe."

Some might object that Cartwright's position that "the objectivity of strategies requires the objectivity of causal laws" simply adds metaphysical baggage and epistemological hubris where neither is necessary. However, Cartwright has two replies. First, her causal and capacity realism is *practically* superior to instrumentalist accounts, which cite "effectiveness" as the only criterion of truth, because it allows us to produce more accurate accounts of what we already know, to devise novel deployments of that knowedge, and to design experiments meant to augment it. Second, there is nothing superfluous or contrived about discussing causes in the context of science. In fact, a close analysis of scientific practice- of experimental set-up, abstraction, idealization and the analytic method- teaches us that *not* talking about causes is the true act of self-delusion.

To see why this is, we can begin by looking at Cartwright's treatment of Simpson's paradox in her analysis of the transition from probability distributions to causal claims mentioned above. The paradox points out that there are situations in which an increase of a purported "causal factor" actually coincides with a decrease in the phenomena that is supposed to be its effect, or symbolically, in which :

$$P(E \mid C) < P(E)$$

This being the case, some commentators propose that it is illegitimate to try to infer causal relationships from purely associational data. However, Cartwright replies that in these types of situations, for example when people who smoke during breaks in marathon training manifest lower instances of heart disease than the general public, it is not the purported cause (smoking) that is reducing the effect (heart disease) but some other causal factor related to it (marathon training). The lesson is thus not that we should do away with causal claims, which would be crippling for scientific experimentation and intervention, but rather that we "seek situations that hold other causal factors constant." These are the crucial "test situations," which are also formally representable as partial conditional probabilities, and which do away with the problem proposed by Simpson's paradox. Among marathon runners, smoking is once again able to *manifest* its consistently deleterious causal influence, its capacity to cause heart disease. But we will return to capacities shortly. For now, we have at least observed that in making causal or other lawlike claims, "much depends on the description of the background situation." So too, as we will now see, when we perform the experiments meant to test such claims.

If we move from working with data to experimenting directly on phenomena, then we move from the ideal notion of a "test situation" to the concrete procedures of abstraction, idealization and experimental design that attempt to artificially create such conditions in the real world. Cartwright's close focus on these procedures and their metaphysical and epistemological interpretation is what allows her to build upon the sound practical observations of both Mach and Planck without taking along the one-sided polemical excesses of either. It is also in this way that she arrives at the concept of the capacity, the central concept of her epistemology.

Cartwright begins *Nature's Capacities* with the following three claims: (1) "science is measurement," (2) "capacities can be measured," and (3) "capacities are real."[387] Recalling the coefficient α from the econometric demand curve, Cartwright defines a capacity as the tendency to deliver a "causal influence that is stable across a wide variety of background situations." We imagine, for example, that the smoking habit described above might still be producing its ill effect on the runner's heart, even if that effect is outmatched or overshadowed by the salubrious effects of running.

By turning not to the polished, "articulated theories" of science, but to real techniques of "method and praxis," Cartwright has become convinced that "our typical applications and methods belong to a world governed by capacities," and that the concept of causation, justified above in terms of the objectivity of strategies, is itself "already a concept of capacity." And once again, as with causal claims generally, while some might frown at the "higher level" metaphysical commitments involved with ascription of capacities, including certain assumptions concerning "the extent of regularity in nature," it is just these types of assumptions that Cartwright thinks are built into normal scientific inquiry and intervention.

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[387] {{13 Cartwright,Nancy 1989; }} p.1 Carwright is quick to qualify this last claim by writing that she does "not want to become involved in general issues of realism, instrumentalism, or idealism." Indeed, when Cartwright states that "capacities are real" she is simply re-stating her claim that "science cannot be understood without them." This is consistent with Cartwright's close attention to practice and methodology, to the "day to day conduct of science" that we have been discussing. Ibid. p.199

Cartwright is thinking in particular of attempts at "abstraction" here rather than "idealization" as it is traditionally conceived. The latter involves approximating away the "inconvenient features" of a model in order to make a generalized claim, whereas abstraction involves the deliberate *deletion* of alternative causal factors in order to isolate a single factor of interest and thus to measure its influence.[388] The aim of abstraction is to concretely realize a test situation by setting up "ideal circumstances." What we then discover by taking measurements in these specially prepared set-ups, Cartwright concludes, are not the "laws of nature," in the sense of rules for behavioral regularities expressed in the real world, but rather facts about capacities. Now, if "behavioural regularities expressed in the real world" is what we are after, then it will sometimes be possible for us to re-apply our knowledge of various capacities, in concert with technical know-how and highly specialized and shielded conditions, to *engineer* such behaviors, i.e. to construct a *nomological machine*. But before turning to this idea, the conceptual endpoint of technological empiricism, let us make sure that Cartwright's claim about the link between scientific experiment and capacity realism is clear.

If experiments are conducted "inside walls," and if the conditions inside those walls are produced in accordance with a design that excludes certain causal factors in order to isolate another, then what happens in these "ideal

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[388] "In idealization we start with a concrete object and we mentally rearrange some of its inconvenient features—some of its specific properties—before we try to write down a law for it. The paradigm is the frictionless plane…Since we are using these planes to study the inertial properties of matter, we ignore the small perturbations produced by friction. But in fact we can not just delete factors. Instead we replace them by others which are easier to think about, or with which it is easier to calculate." {{13 Cartwright,Nancy 1989; }} p.187

circumstances" can only tell us something, albeit something very important, about that isolated causal factor.[389] Our attempts to then re-apply what we learn in order to understand real, concrete situations or engineer artificial ones is a second step only partially based on the first.[390] As Cartwright puts it, "the logic that uses what happens in ideal circumstances to explain what happens in real ones is the logic of capacities." These ideas recall those of Volkmann quoted by Mach in the *Mechanics* ("…it is accordingly one of the duties of science to conceive phenomena as made up of sets of partial phenomena and at first to study these in their purity…thus gaining a command over the whole.")

These ideas also help us to understand Cartwright's conclusion that "the conventional idea of law will not due at all," because they help us to distinguish between a stable causal influence and a stable, observable behaviour. As was just described, the ideal circumstances fabricated by scientific experiments allow us to discover and measure the former. As for the latter, according to Cartwright they are relatively hard to find in nature and

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[389] Cartwright follows Nowak here and writes that "basic scientific laws do not literally describe the behavior of real material systems. They are instead to be taken as abstract claims…the fundamental laws of science give the essential behavior of a factor, or, in Mill's terminology, describes its tendencies." {{13 Cartwright,Nancy 1989; }} p.204

[390] This is what Cartwright calls the problem of "material abstraction," namely that although "capacities are real," "no amount of theory will ever allow us to complete the process of concretization." With the possible exception of mechanics, which claims that "all changes in motion are due to the operation of forces," the theorists of other branches, though they may be able to appeal to a variety of principles, will require "the engineers know how to extend, correct, modify, or sidestep those principles" to suit varying concrete needs and situations. Ibid. p.211 Compare Cartwright's ideas about the inadequacy of the abstract description, "an inversion in a population of atoms causes amplification in an applied signal," for constructing a laser with Bechtel's observation that an account of the molecular mechanisms that occur inside of yeast during fermentation provides insufficient knowledge to actually produce fermentation." {{98 Schouten,Maurice Kenneth Davy 2007; }} p.183

require a great deal of know-how to engineer on our own. This is why the search for the "laws of nature," conceived as universally valid descriptions of regular, observable behavior is a program doomed to failure.[391] There is no valid, universal law declaring that "smoking leads to heart disease," because often in the real world, in concert with exercise, red wine, "good genes" or a fatal car accident, it doesn't.

In other words, natural laws, insofar as they claim to describe real behavior, are *ceteris paribus* laws, and the reason why this is so is that real behavior, (and consequently the knowledge of it) is *local*, a result of the operation and interaction of capacities set against infinite background conditions and mitigating influences. Naturally or by artifice, these conditions will sometimes become aligned in particular ways to produce particular behaviors. Provided that this alignment becomes stable, and that the stable alignment is properly shielded from outside disturbances, regular behaviors can result. Cartwright calls this particular alignment of capacities brought together in fortunate circumstances and shielded from external disturbances a *nomological machine*. As we can see from its rather lengthy description, the chance of any one abstract, "universal law" being able to explain the behaviour produced by the machine is quite small. Rather, precise knowledge of the inner workings of a nomological machine, which is the only

[391] For a related critique of the ability of laws to explain concrete phenomena, one made from the standpoint of the biological sciences, see Bechtel's essay, "Explanation: The Mechanist Alternative." Indeed, Bechtel's position shares much in common with both Mach's and Cartwright's, and it would be interesting to explore these relationships in a different context.

precise knowledge of regular behaviours in the real world which is possible, is regimented "within a highly articulated, highly abstract schema."

The "schema" referred to here can either take the form of a *representation*, one that fills out the concrete meaning of an abstract theory by *depicting* that theory's prescriptions within ideal, well shielded conditions, or of an actual, real world *embodiment* of that representation. The latter case, as we have seen, is a nomological machine. The former is a scientific *model*, and it is thus no wonder that Cartwright thinks of models as "blueprints for nomological machines." These "blueprints" are the analogue within technological empiricism of Mach's "instructions for clearly defined mental or physical activities that, if performed, can evoke in the imagination or present to the senses an object of equally circumscribed reactions." In both cases, abstract, articulated theory is presented in a concrete form, whether as "circumscribed sense reactions" or "the regular operation of a nomological machine." The difference, as we have discussed, is one of scope. Mach's more critical and psychological resolution focuses on the relationship between the specialized sciences and the "customary, sensory world," while Cartwright stays largely within the province of the former, suggesting that we rethink the relationship between the abstract and the concrete *within the sciences* themselves. Cartwright would be likely to find the "purity" of Mach's rendering (it's omitting of all unnecessary, explanatory content) to be contrived, purchased at the cost of comprehensibility and practical workability. It is thus no wonder that her resolution of abstract theory represents the "objective" or "technical" aspect of Mach's more "subjective," "psychological" version. But before drawing any further conclusions of Cartwright's capacity realism, especially the related ethical and political lessons, let us quickly compare her metaphysical position to Planck's.

Planck, like Cartwright, was also a causal realist, but of a very different kind. The many treatments of the question of causation that appear in his philosophical writings focus on the issue of universal *determinism*, of whether or not scientists should regard *every* natural event as being completely determined by prior conditions and causal laws. Planck often raises the question in the context of certain well-known problems in 20th Century quantum physics such as how to account for "interference phenomena" without moving from a deterministic to a probabilistic worldview. Although aware of the difficulties and convinced that the phenomena do indeed demand that scientists once again "scrutinize the concept of causality," he nevertheless believes that science must not abandon the view that nature herself is fully determined. It is for this reason that Planck was partial to Schrödinger's general wave mechanics , for it allowed one "to maintain the role of determinism within the world image." He similarly rejected the Copenhagen interpretation of quantum phenomena as a frivolous resurrection of positivist complacency, and likely would have agreed with Einstein's characterization of it as “the Heisenberg-Bohr tranquilizing philosophy, or religion.”[392]

Planck spoke about causal determinism in his own, very different language of faith, especially where he believed that fixed limitations on measurement would permanently block the uncovering of decisive evidence, In these cases, Planck either appealed to his own sort of “demon,” an “ideal intellect” that knows the “real world” perfectly and thus understands all of its deterministic laws, or simply declared that “the concept of causality is something transcendental,” and thus to be decided upon as part of an a priori stipulation or worldview. Planck believes that the best scientists of history took the former approach, and that the postulation of an ideal intellect was once a “matter of faith” for “great men.” He sees the contemporary question of causality in terms of the second description, as an ongoing and irreconcilable debate between “transcendental” and “positivist” philosophers on whether or not to understand the scientific world picture as deterministic.

On the one hand, it is clear that Planck and Cartwright both possess an “objective concept of causality,” that both think that causes are real and exist in the world. However, whereas Planck is concerned with the total, transcendental worldview of scientists with respect to determinism, Cartwright is uninterested in this type of speculation and rejects the “pseudo-rationalist

[392] Indeed, Planck would have likely preferred Einstein’s own faith, his “cosmic religion,” which based itself on strict metaphysical recognition and mathematical realism

idea of universal determinism."[393] Her interests, as we have seen, are not in questions of "totality" but in those of *techniques*, the practical methods through which particular causal knowledge is discovered and deployed. Cartwright "knows of no guide to principal except successful practice," and while the latter must have as its basis certain truths about our universe it does not seem to lead to any particular, systematic picture of that universe. Indeed, for Cartwright, following Neurath, "the system is the great scientific lie."[394]

This is why Cartwright is less likely to write about a *unified world picture* constructed by science and more likely to describe a number of independent scientific disciplines which provide a great *variety of models* representing a great variety of target systems. This is the meaning of her "metaphysical pluralism," and it justifies its locally realistic account of a "patchwork of laws" by pointing out the highly specific domains and conditions in which both natural laws obtain and in which we are able to successfully deploy our knowledge of capacities. Ironically, on one occasion Planck provides a response to Goethe's wholistic criticism of the theory of light waves that sounds much more like it should be coming from Cartwright, namely that despite his objections Goethe would probably "not have minded having a light bulb on his desk built according to that physical theory."[395396]

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[393] For Cartwright's own discussions of quantum physics and causation, see Ch. 6 of *Nature's Capacities and Their Measurement*
[394] {{86 Cartwright,Nancy 1999; }}
[395] {{40 Planck,Max 1936; }} p.12

For indeed, that working light bulb is an example of a nomological machine, a combination of capacities, conditions and proper shielding. But the world as a whole is not like a light bulb, nor like a vending machine. One of the crucial achievements of Cartwright's technological empiricism is that it puts into question the boundaries of freedom and necessity, demonstrating the wide spaces of the former by providing a precise account of the latter. This precise account maintains that, for the most part, the stable regularities we encounter in the world are those that we have set into motion ourselves, or as Carwright puts it, that "regimented behavior results from good engineering." This account contradicts the very powerful, everyday notion of a law-governed universe, as well as a great deal of public and political rhetoric which appeals, in particular, to the laws of physics and the laws of economics. By calling into question the pseudo-necessity contained within the latter, Cartwright's philosophical position suggests that we have a responsibility to re-shape the conversation at the border of science and politics.

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[396] Some might object here to Cartwright's characterization of the sources of necessity, arguing that in fact there are *many* examples of naturally occurring "nomological machines." This position is represented most importantly by the popular contemporary branch of the philosophy of science committed to the study of "mechanism," particularly as a crucial paradigm under which to understand biological phenomena. However, far from finding grounds for a new opposition here, it is important to see the great similarity that exists between the concept of a nomological machine and the concept of a mechanism. In many ways, they highlight two aspects of the same position, and if Cartwright's concept stresses the extent to which these machines or mechanisms are artificially engineered, it is likely because she is working closer to the border of epistemology and politics than her colleagues. These latter are not as interested in criticizing the political consequences of the pseudo-necessity that follows from a law-based worldview, but rather with exchanging the explanatory paradigms inherited from physics for ones more appropriate to the complex, organic world of living things. (see Bechtel, "Explanation: The Mechanist Alternative") Mach for one would certainly have been in favor of both projects.

Following her view, political factions would no longer by in a position to take recourse to scientific expertise concerning what *must* happen. Rather, the body politic is forced to convene in order to discuss what it is that we want to happen, what kind of society we want to design and what kind of nomological machines we want to construct.[397] In Chapter IV we will see that a standpoint very similar to Cartwright's was held in the first half of the 20th Century by thinkers like Otto Neurath and Alexander Bogdanov, particularly with respect to the science of economics. It is no coincidence that Neurath is cited as the "hero" of the *Dappled World*, and as he was himself a leading member of the "Ernst Mach Society" and the Vienna Circle, Neurath is one of the figures who will help us to further define the relationship between technical and biological empiricism.

Before moving on to that discussion, let us once more examine the ethical-political convictions and relevance of technological empiricism, for it was suggested above that these incorporate and in fact improve upon the rather vague ethical caricatures of Planck and Mach. We will develop the themes mentioned here in the next and final chapter. In the *Dappled World*, Cartwright illustrates her "ultimate concern" with real world examples representing the struggles for *welfare* and *justice*. She writes, "my ultimate concern in studying science is with the day-to-day world where SQUID's can be used to detect stroke victims and where life expectancy is calculated to

[397] For a presentation of the work of Otto Neurath as making similar arguments see O'Neill and Uebel, "Horkheimer and Neurath: Restarting a Disrupted Debate" in (European Journal of Philosophy: 2004)

vary by thirty-five years from one country to another."[398] Cartwright's focus on welfare as one of the most important ends of science is consistent with Mach's biological-economic account as discussed in Chapter One. Her account adds to Mach's, however, in that it gives a more sophisticated picture of how welfare can be technologically produced, of "what we can achieve with our knowledge." The paradigms of plasticity and engineering indeed have different ethical scopes, and these will be the subjects of the conclusion of this thesis.[399]

With respect to Planck's attempt to link scientific worldview to the cultivation of *resolve*, Cartwright's technological empiricism would likely exchange the latter, which has a rather mystical and individualistic character, for the promotion of *solidarity*. These are similar concepts in that they both involve focused activity and commitment to something greater than oneself, and yet the latter is more appropriate once we have moved from the heroic age of physics to a social and collaborative ideal. As for the manner in which a technological empiricism might promote social solidarity, we will study this in detail by examining the work of Otto Neurath and Alexander Bogdanov in the next chapter.

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[398] {{86 Cartwright,Nancy 1999; }} p.6

[399] One can argue that *welfare and justice* were "ultimate concerns" of both Cartwright and Mach, but with different connotations. With respect to welfare, Mach's is a humble but comprehensive ideal of science "satisfying biological needs," while Cartwright envisions more sophisticated, technical interventions (like the use of SQUID's in diagnosing stroke victims) capable of improving our quality of life. With respect to justice, Mach's epistemology works more at the personal, psychological level (i.e. justice as 'perspective') aiming to promote sympathy, candor, and a sense of belonging, while Cartwright's ideal of justice (though worked out more explicitly by other technological empiricists like Bogdanov and Neurath) is more social, a matter of collaborative activity and socio-economic planning and reform.

Chapter 4

(Anti)Metaphysics and Popular Emancipation

4.1 Overview

In the last two chapters, we have interpreted the relevance of Mach's doctrine of elements for traditional problems in metaphysics and epistemology. In both cases, Mach's doctrine was shown to have a purpose other than that alleged by a prominent detractor. With respect to metaphysics, it was argued that Mach was not a "subjective idealist," as Vladimir Lenin charged, but that his elemental monism offered a "third way" between rigid idealism and materialism, in particular by advocating a non-reductive, developmental psycho-physiology.[400] With respect to epistemology, the fixed and caricatured categories of "realist" and "positivist" were shown to be misapplied by Max Planck in his own anti-Mach polemics. Indeed, Mach's doctrine of elements aimed not to reject the theoretical constructs of the specialized sciences, but only to challenge fundamentalism by describing adaptive, psychic familiarity within the "customary sensory world" as the common end of scientific research.

Mach's standpoint was ultimately described as that of a *biological empiricism*, and in the context of the discussion of Mach and Planck it was argued that a second and related standpoint, that of *technological empiricism*,

[400] For more on the "third way" offered by Mach, in particular in the context of the debate over the role of the idealism-materialism opposition within Marxism, see {{54 Stadler,Friedrich 1997; }}

represents its counterpart within a *pluralist philosophy of science*. Technological empiricism also describes adaptation as a primary goal of science, but it stresses technical mastery over the elements of experience, i.e. the organization of individuals (objects or persons) and their causal or creative powers into helpful machines and desirable institutions. Whereas biological empiricism focuses on the border between physics, physiology, and psychology, technological empiricism studies the relationship between physics, sociology, and economics. In the last chapter, the work of Nancy Cartwright was discussed as a contemporary exemplar of technological empiricism.

Having explored metaphysics and epistemology, we turn in this fourth and final chapter to the relevance of Mach's philosophy of science, and indeed the pluralist philosophy of science in general, to politics. Political issues have already been mentioned several times in this dissertation. We have seen how *Materialism and Empirio-criticism* was in many ways a politically-motivated work, especially through an analysis of Lenin's concept of "fideism," and his attempt to oppose that "reactionary" standpoint (alongside idealism) to the truly emancipatory one of "materialism." We have also discussed in broad terms the ethical-political aspect of Mach's life and work. This included the association of biological empiricism with principles of candor and sympathy, Mach's own efforts on behalf of adult education, his pacifism and anti-nationalism, and his close friendships with Viktor Adler, a founder of the Austrian Social Democratic party, and the well-known social reformer Josef Popper-Lynkeus.

As we now turn to a more detailed study of the political relevance of both biological and technological empiricism, we will find that their influence played out historically within the debate over the nature and future of Marxism that took place during the first half of the 20th Century. This chapter, like the two that proceeded it, begins with the framing of a rigid opposition. The author of the opposition in question is once again Vladimir Lenin, and we will introduce his attack on "revisionism" (as opposed to traditional, "dogmatic" Marxism) and the way in which he formulates that attack in terms of the issues of "free criticism" and the *relationship between theory and practice* within the socialist movement. Countless volumes have been written on the "dogmatism-revisionism" debate amongst Marxists, and our task here in not to re-hash these analyses. Rather, we are interested in the influence of Mach's thought on the controversy, and moreover on the actual role that a pluralist philosophy of science has played (and might continue to play) with respect to questions of politics and social justice.

More specifically, if Kant's transcendental standpoint is often associated with liberal, democratic political values (individualism, autonomy) and Marx's dialectical one with "scientific socialism" (the laws of history, proletarian revolution) than we are interested in the way in which Mach's elemental monism is related to what we might call a *social democratic* *philosophy of science*.[401] Historically, such a connection is real enough, and Friedrich Stadler names Mach, alongside Carl Grünberg, as a forefather of "Austromarxism," the intellectual foundation of Austrian Social Democracy during this period.[402] We will thus review the way in which leading Austromarxists, especially Friedrich Adler, attempted to integrate Mach's ideas with those of Marx. The resulting synthesis, from a socio-political standpoint, emphasizes pluralism, candor, and collaboration in the pursuit of socio-economic enlightenment.[403] Such a standpoint is consistent both with Edgar Zilsel's description of a "Marxist orientation that values freedom of thought," and to what Jon Blackmore describes as Mach's "half-individualism, half-socialism."[404]

We will argue that biological and technological empiricism play unique roles in the development of a social democratic philosophy of science, the former through its concepts of pluralism and *plasticity*, and the latter through those of pluralism and *engineering* (or planning). As was suggested at the end of the last chapter, both standpoints are focused on human welfare as an end of scientific knowledge, and given their shared pluralism, we will see how both stress the freedom of thought. With respect to justice, however, Mach's

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[401] In Volume III of his *Empiriomonism*, Bogdanov himself refers to "epistemological social democracy" as the socio-political aspect of his "new monism." For an extended discussion of Bogdanov's views of the relationship between various understandings of the "world" and various socio-economic conditions and relations, see Yassour, Abraham, "The Empiriomonist Critique of Dialectical Materialism" Studies in East European Thought, Volume 26.
[402] {{59 Stadler,Friedrich 1982; }} p. 96
[403] For a description of the "Scientific World Conception" of Neurath, Frank, et al. as a typical expression of this synthesis, as well as Mach's influence on their ideas, see Dvorak, Johann, "Otto Neurath, 'Proletarian Democracy' and Social Planning" in "Encyclopedia and Utopia,{{102 Nemeth,Elisabeth 1996; }}" or {{59 Stadler,Friedrich 1982; }}
[404] {{59 Stadler,Friedrich 1982}} {{96 Blackmore,John 1983; }}

ideas about plasticity and familiarity work more at the personal, psychological, and educational levels (i.e. justice as 'perspective') by promoting sympathy, candor, and perpetual learning. By focusing on engineering and planning, on the other hand, Bogdanov, Neurath and Cartwright present justice (to paraphrase Marx) as a historical and not a mental act. They stress the need both for collaborative interventions within the social world and for significant economic reform and re-organization (including through a critique of the science of economics itself).

Finally, in this chapter we will see how the work of Alexander Bogdanov and Otto Neurath provide historical examples of the way in which the goal of "solidarity" can play a more explicit role within technological empiricism than it does, for example, in Cartwright's writings. These two figures are important, moreover, in that they were both directly and significantly influenced by Mach.[405] Bogdanov's work in particular (as well as his struggle with Lenin) will help us to explore the subtle points of what he himself called "epistemological social democracy," of the "new monism" which he saw as rooted in a social world marked by "collective human practice."[406]

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[405] For extended discussions of Mach's influence on Bogdanov, see "Alexander Bogdanov and the Origins of Systems Thinking in Russia," {{20 Biggart,John 1998; }} For Mach's influence on Neurath, see, for example, {{102 Nemeth,Elisabeth 1996; }} or {{59 Stadler,Friedrich 1982; }}
[406] Yassour, Avraham, "The Empiriomonist Critique of Dialectical Materialism: Bogdanov, Plekhanov, Lenin" Studies in East European Thought 26 (1983) 21-38

4.2 Framing the Opposition- Theory vs. Practice?

In this chapter we once again begin with a fundamental opposition framed by Vladimir Lenin, though now with respect to an explicitly political theme, namely the fate of European socialism at the outset of the 20th Century. In "What Is To Be Done," Lenin writes that "two trends have formed in contemporary international socialism." Closely mirroring the metaphysical debate in the philosophy of science that was discussed in Chapter II, Lenin is again concerned with the question of which "elements" are to be considered primary, now however with respect to the socialist movement. On the one hand, Lenin describes the "revisionist" position, which privileges the "workers struggling in the here and now" as the fundamental, "objective element" of the movement. On the other hand, there are the "dogmatists" who highlight the role played within Marxism by "complete and well thought out theory," by clear, conceptual formulations of the "laws of history" and the "ultimate aim" for the future.[407]

The daily concerns and immanent struggles of workers for piecemeal reforms and concessions, which are supposed to preoccupy the horizon of the first group, are described by Lenin as the "spontaneous elements of development." There is thus an important parallel here to the positivist elements of experience and knowledge attacked by Lenin in M&EC, for both are alleged to focus on the content and concerns of the present moment at

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407 {{68 Lenin,Vladimir Ilich 1970; }} p.41

the expense of more theoretical approaches to reality.[408] Lenin's criticisms likewise follow a similar pattern. The everyday phenomena of social reality, he argues, are themselves products of a more fundamental ruling ideology and power structure. As such, the failure to formulate and propagate an advanced socialist vision of society and its varied relations will not result in the advent of some more basic, neutral stage upon which perpetual, progressive interventions can be made, but rather will lead the majority to "fall back into the bourgeois ideology." It is for this reason that Lenin rejects the motto of the well-known German revisionist Bernstein, who claimed that the "movement is everything, the ultimate aim is nothing."[409] According to Lenin, the "ultimate aim," along with the historical, economic, and philosophical justifications for it provided by "young revolutionaries and social democratic intellectuals," are necessary not only as the "spirit hovering over the movement," but as the leading force which "lifts the movement to the level of its own program."[410] In the absence of this theoretical transfiguration, Lenin argues, solidarity founders and the movement itself, lacking self-consciousness and *no longer able to draw a line* "in principle between

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[408] Lenin quotes R. Willy in M&EC ("things outside men are…bits of fantasy fabricated by men with the help of a few fragments we find about us…Need the philosopher fear the stream of life, the moment which alone can bring happiness?") {{83 Lenin,Vladimir Ilich 1964; }} as a typical representative of the "immanentist" position. The parallel here arises insofar as Lenin opposes both sensualist idealism and spontaneous revisionism to "realist" positions that argue for the priority of metaphysical (the independent, material world) and theoretical (the laws of historical development) constructs

[409] {{68 Lenin,Vladimir Ilich 1970; }} p.40 For an extended look at Bernstein's influential views, see *Evolutionary Socialism, {{27 Bernstein,Eduard 1961; }}*

[410] {{68 Lenin,Vladimir Ilich 1970; }} p.80

liberalism and socialism," deteriorates into fragmented trade unionism and misguided efforts to join and influence the "parliamentary swamp."[411]

Thus the fate of those who are "satisfied with the spontaneous elements of development," who "worship spontaneity" and view the movement as an "organic" whole.[412] Similar again to the criticisms of the immanentists and positivists in epistemology that we reviewed in Chapter II, Lenin catalogues the ethical vices that accompany the absence of a unified appeal to an independent, fundamental basis of political reality, and thus the inability to draw "firm and definite lines of demarcation."[413] Again one hears charges of "muddleheadedness," "eclecticism and lack of principle," and of a complete absence of the "iron discipline of the proletariat" amidst the "waverings and weaknesses" of the petit bourgeoisie.

In this chapter, we will argue that Lenin's framing of a debate between socialist theory and praxis, i.e. of cultural, educational and ideological initiatives as opposed to practical political and economic programs, is generally one-sided and specifically questionable in light of the dynamic positions of leading "revisionists," in particular Alexander Bogdanov, with respect to these approaches.[414] Bogdanov, working from a pluralist standpoint, was eager to engage cultural, ideological, and educational as well as economic methods to promote socialism, and it is through his ideas, as

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[411] Ibid. p. 41
[412] Ibid. p. 79
[413] "Spontaneity and Social Democratic Consciousness," in {{68 Lenin,Vladimir Ilich 1970; }}
[414] Many scholars have characterized Bogdanov as *the* leading "revisionist" (i.e. the leading intellectual and political opponent to Lenin) and Sochor even suggests that it was the struggle with Bogdanov that inspired Lenin to first formulate the concept of "revisionism." {{73 Sochor,Zenovia A. 1988; }}

well as those of Friedrich Adler, a leading Austromarxist, that we will introduce Mach's role in the next section.

Ultimately, one might conclude that the main issue at stake here is not theory vs. praxis but rather the "revisionist" demand for "freedom of criticism" within the movement, particularly the desire of an in fact very diverse group of thinkers to revise and develop Marx's ideas with respect to self-knowledge, technological advancement, and social justice.[415] This freedom of criticism is the political analogue of the pluralism advocated by Mach, and we will see how, integrated into the domain of political theory, a social democratic philosophy of science likewise rejects reductionism and theoretical fundamentalism. Lenin dismisses this type of "freedom" as nominal and in fact often invidious, associating it with the frivolous disorder and exploitation that accompany "free trade" and "free markets."[416]

Despite the interesting historical circumstances and consequences associated with Lenin's attitude towards "free criticism," we are as unable here to draw any determinate conclusions about Lenin's own political theory as we were in Chapter II concerning his epistemology.[417] We are interested rather in Mach- in his influence on the socialist movement, and on leading technological empiricists like Alexander Bogdanov and Otto Neurath, who

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[415] For a good background of these disputes, see {{73 Sochor,Zenovia A. 1988; }}, or Williams' "The Other Bolsheviks," although the latter is criticized by Burbank (see Burbank 1988) for being oversimplified.

[416] {{63 Lenin,Vladimir Ilich 1970; }}

[417] Indeed, we are only able here, as in Chapter II, to make certain suggestions concerning Lenin's position and its consequences. On the one hand, we will (briefly) see how Bertrand Russell and Maxim Gorky criticized Lenin's attitude towards free speech, and on the other, we will see how Lenin himself often wrote of the crucial importance of practical work and planning in the here and now, about avoiding theoretical rigidity in favor of quick, tactical maneuvers in "the crux of the present."

despite this influence nevertheless focused on methods of socio-economic enlightenment more consistent with their own distinct emphasis on social experience and technical knowledge. Lenin's framing of the dogmatist-revisionist opposition is thus relevant to our discussion only insofar as it, on the one hand, represents yet another one-sided caricature aimed at a critical position associated with Ernst Mach, and on the other, insofar as it provides a framework within which we can explore the actual political relevance of the ideas of Mach, Bogdanov, and Neurath, i.e. of a social democratic philosophy of science.

With respect to the one-sidedness of Lenin's opposition of practical, progressive considerations to theoretical ones, one might ask why the debate Is not overcome by simply recognizing the obvious value of both positions. This is the view that Otto Bauer, a leading Austromarxist, takes in an essay entitled "Class Struggle and Ideology," published in *Der Kampf* in 1928. Bauer aptly re-formulates the "dispute" as one between "interest socialism" and "intellectual socialism," the former concerned with attaining a better standard of living for working people, and the latter dedicated to utopianism, to establishing "a higher social and cultural order." Appealing to Marx, Bauer argues that both aspects are crucial to the socialist movement, that in fact the central achievement of Marx and Engels was to unify the concerns of the workers' movements with certain European, utopian, cultural ideals, in particular by demonstrating the impossibility of addressing those concerns within the capitalist framework. Bauer thus chastises those utopian socialists, such as Max Adler, who marginalize the needs (and the gains) of the present struggle. Adler had argued that strikes, rallies, and workday reductions had at most "symbolic value" for the coming "transition of the social order." Bauer responds that Marx was himself always vigilant in dragging intellectuals down to the "here and now," in reminding them that there task was not to mold workers to abstract principles, but rather to serve and educate the proletariat as they were, to assist them in their concrete campaign for "more free time, more money, more respect, etc."[418]

At the same time, Bauer also criticizes those like Karl Renner, who demanded that one "keep ideology away from the workers," instead leaving them "to their instincts." Bauer responds that, first of all, instincts often inspire tactically poor action, for example the destruction of machines that have become a cause of unemployment. Advanced ideology teaches workers not to destroy machines in an impossible bid to turn back the "wheel of world history," but rather to appropriate those machines to their own benefit. Also, agreeing with Lenin's point, Bauer argues that ideology is a necessary source of self-consciousness and group solidarity, that just as the "Enlightenment ideology" organized the bourgeois revolutionaries against the feudal lords and nobles, so too would the socialist worldview "strengthen the resolve and solidarity of the working classes."[419] Ultimately, Bauer's position is that neither extreme is tenable in its one-sidedness, that the goal of Marx was to

[418] {{49 Mozetič,Gerald 1983; }} p.101
[419] Ibid. p.107

perpetually maintain the "synthesis of the intellectual and the worker," thus attending to the present, but indeed to an informed and inspired present.

Lenin does not acknowledge this type of resolution in his polemical writings. As was suggested above, we will find that Lenin's rigid opposition of socialist theory to praxis is baseless, that it neither applies as a characterization of his own ideas versus those of his political opponents, nor serves as a reasonable conceptual opposition. On the contrary, we can see that 'revisionists' like Bogdanov, in the course of criticizing the metaphysics and aura associated with the system of Marxism, at the same time identified precisely a combination of cultural-pedagogical work and political-economic planning and organization as the methodological paths towards Marx's vision of socio-economic enlightenment. Ironically, Bogdanov paid much closer attention to the former, to the development and propagation of a "socialist worldview" than Lenin himself, and we will conversely find that despite his strong claims about the primacy of theory and the 'ultimate aim," Lenin himself often stressed the importance of flexible, pragmatic socialist work and strategy guided by experience and the dictates of the present moment.[420]

A key figure of this chapter is thus Alexander Bogdanov, who we remember as one of the Russian 'Machists' singled out for attack by Lenin in *Materialism and Empirio-criticism*. In fact, it is widely acknowledged that Bogdanov was Lenin's primary target in M&EC, and when Lenin re-published the book in 1920 as part of their ongoing struggle, he added as an appendix

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[420] {{73 Sochor,Zenovia A. 1988; }}

an extended criticism of Bogdanov's thought composed by Nevskii.[421] Indeed, much has been written on the "Lenin-Bogdanov controversy," believed by many to have been instrumental in shaping the fate of socialism in Russia after the Revolution.[422] Our main interest is in its relevance at the borders of philosophy of science and politics, and in particular in the ways in which a discussion of Bogdanov helps us bring out the political relevance of both biological and technological empiricism.

This is possible because, on the one hand, Bogdanov was strongly influenced by Mach, as seen most clearly in his three-volume philosophical work entitled *Empiriomonism.* In the next section, we will look at the influence of Mach's pluralism and empiricism on Bogdanov's approach to Marxism, finding that it closely parallels the work of several leading Austromarxists who also turned to Mach for guidance, including with respect to their concern for education and culture. On the other hand, we will find that the constructive component of Bogdanov's thinking, as expressed in his other major work, *Tektology*, focused not on developments in the "new psychology," as Mach had, but rather on concerns with technology and engineering, with the *organization* of nature and society that closely resembles the focus of Cartwright's 'technological empiricism' outlined in Chapter 3. The political relevance of these views, especially with respect to their focus on the "unity of

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[421] Ibid. p.152

[422] see {{73 Sochor,Zenovia A. 1988; }}, {{20 Biggart,John 1998; }}

science," will be discussed in the third section, where the work of Otto Neurath, the "hero" of the *Dappled World,* will also be of great importance.

Finally, the last two sections of this chapter will survey the legacy of these debates over 'revisionism' and the theory and practice of socialism. With respect to the former, we will first review some of the protests against the Bolshevik crackdown on free expression and criticism that immediately followed the Revolution. With respect to the latter, we will seek out the extra-revolutionary consequences of an opposition between progressive theory and practice by examining the Horkheimer-Neurath debates, in the course of which "critical theory" and physicalist sociology were dubiously (though influentially) opposed. But first, let us now turn to Mach's role in influencing the debates over social justice at the beginning of the 20th Century.

4.3 Machism, Austromarxism, and Bogdanov: The Biological Standpoint and Culture

In "Machism and the Materialist Conception of History,"(1918) Friedrich Adler, a leading Austrian Social Democrat and close friend of Albert Einstein, argues that Mach's natural philosophy and Marx's social philosophy may be fruitfully synthesized into a unified worldview. He also describes certain insights of Mach's new philosophy of science that may be applied directly to the development of Marx's theory of society. In both cases, Adler highlights the preference of Mach and Marx for experience and practical progress over rigid, mechanistic theory.

Adler begins by recalling the achievement of Marx as a great breakthrough in the study of history, and in particular the history of human society. No longer would historians focus exclusively on the thoughts and actions of isolated “great men” in explaining the course of human events. Rather, new generations of Marxist historians would bring to the fore the previously ignored background conditions of history, particularly the make-up of the various social classes, their relative interests, and the resulting struggles, of which those great men would now appear as fleeting representatives.[423] The insights collected from these alternative depictions of specific historical events could furthermore be formulated into general “scientific laws” of this perspective on human history, providing a vital part of a total worldview.

And yet, according to Adler, the relationship of Marx’s history of society to natural science and the “history of nature” is understudied. How may one apply decades of scientific progress and discovery to the improvement of Marx’s philosophy and, in general, to that of the materialist conception of history? Adler provides two suggestions.

First, in light of the above, Adler concludes that Marxism is not itself a total world-view. Rather, given its methods and subject matter it should be considered as a “special science,” one dealing with the history of human and societal development, what Max Adler, another Austrian social democrat,

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[423] {{49 Mozetič,Gerald 1983; }} p.114

referred to as “historical-dialectical social science.”[424] As such, a complimentary or “supplementary” standpoint, one addressing the development of natural science and our conception of nature, would be needed to complete a unified world picture.[425] Adler considers some possibilities and concludes that a historical-evolutionary conception of nature harmonizes better with Marx’s work than any “mechanistic materialism.” The latter is fundamentally “metaphysical,” according to Adler, and given “the importance of experience and development” for Marx and Engels, it is clear to him that “Mach’s is the conception of nature which corresponds to Marx’s conception of history.”[426]

Furthermore, according to Adler, certain of Mach’s insights in the philosophy of science can be fruitfully applied to Marx’s understanding of society itself. This claim is reasonable, Adler argues, because Marx modeled his conception of history after natural scientific and physical concepts, in particular on what Adler calls “the old physics,” with its rigid notions of law, natural necessity, and cause and effect. Since it was Engels who argued that historical materialism should change its own form along with “every epoch-making discovery in the realm of natural science,” Adler attempts to adapt Marxism to the “new science” of which Mach was an important representative.

In particular, scientists at the time were in the process of reviewing their concepts of substance and causality. Unlike Lenin and many of the

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[424] {{49 Mozetič,Gerald 1983; }}

[425] Adler is working here in explicit agreement with Engels’ position that there is only one science, namely *history*, and that it is divided into the history of man and the history of nature.

[426] {{49 Mozetič,Gerald 1983; }} p.119

Russian positivists, Adler does not find the debate over substance and matter to have any relevance to historical materialism or the project of popular emancipation. “The refinement of the concept of causality,” on the other hand, is found to be a crucial development with far-ranging consequences. Mach plays the central role here, since it was he who fully “brought to consciousness” this longstanding process of refinement and clarification. In particular, Adler is referring to the shift away from a notion of cause and effect bound up with “natural necessity,” and towards a more precise form linked to the concepts of “triggering,” “function,” and “transparency.”[427]

Consistent with what we have said above, Adler finds Mach’s unique contribution to lie in the combination of this refinement of causality with the attempt to partially replace physical categories with biological ones, especially in those instances where the target system is so complex, and our knowledge so limited, that an exhaustive mechanistic account is impossible. By provisionally exchanging the notion of “determination” for one of “adaptation,” for example, Adler argues that we will “no longer grasp desperately to physical concepts,” but will rather be satisfied with biological ones. The most important application of this principle to Marxism, one crucial to any understanding of a distinctively “Austro”-Marxism, takes place with respect to the interaction between the so-called economic “basis” of society and its ideological “superstructure.”

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[427] Ibid. p.123

In "The Practice and Theory of Bolshevism," Bertrand Russell defines the "materialist theory of history" as the view that "all the mass-phenomena of history are determined by economic motives."[428] Thus the idea that for Marx "economics," the contemporary state of the means of production, relations of production, division of labor, etc. constitutes the "real basis" of society out of which all other ideology, all other "theoretical products" grow and from which they receive their form. We find Marx expressing this type of view, for example, in the following excerpt from the *German Ideology*: "This conception of history depends on our ability to expound the real process of production…as the basis of all history…to explain all the different theoretical products and forms of consciousness, religion, philosophy, ethics, etc., and trace their origins and growth from that basis."[429]

Russell is relatively sympathetic to this view as long as one approaches it not with metaphysical absolutism but with the "skeptical practicability of modern science." In that case, he argues, they will find an important "approximation" yielding "large measure of truth," especially alongside other insightful models which emphasize the roles of sex, pride, and climate, for example, in shaping human history.

This is also the view that Adler takes, and he believes that the "skeptical practicability" advocated by Russell can be achieved by exchanging the notion of an economic basis that "determines" consciousness with one

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428 {{65 Russell,Bertrand 1954; }} p.79
429 {{93 Marx,Karl 1998; }} p.164

that describes consciousness as "adapting," in part, to the economic facts. From this perspective, Adler observes, "thought can not be presented as a uniform function of the relations of production," for there is no longer the "one-way relation" implied by the concept of "determination." On the contrary, we are able to admit the sensible truth that "changes in thinking are possible even when relations of production remain constant."[430]

This is not to say of course that economic forces and conditions become irrelevant. On the contrary, Adler agrees with Marx that thought is ultimately derivative, that it grows out of the facts of life, and that among these facts, "those of economic relations are probably the most important." Indeed, Marx successfully shows that through the course of history human attention, once dedicated primarily to "fruit, tree, sun, and body," has become significantly attached to "machines, production, social class, etc."

However, the standpoint of the *adaptation* of thought to facts allows us, in fact obliges us, to pursue and identify other major influences on consciousness as well. This pursuit, according to Adler, embodies the very definition of Austro-Marxism, and so we see that Mach's most significant contribution again lies in his dedication to pluralism. Adler takes over Mach's position that, given any system, "until all the interrelations and functional dependencies are identified," it is safer to utilize broad, biological categories. These categories serve not only a negative function, i.e. the admission of ignorance, they also open up (and keep open) large, unanswered questions

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[430] {{49 Mozetič,Gerald 1983; }} p.124

which can, over time, be answered with more exact causal and mechanical explanations.[431] So too with respect to the study of consciousness within mass industrial society, and as such the Austromarxists, as well as other sympathetic thinkers like Bogdanov and Gorky, searched hard to identify a plurality of sources of popular enlightenment and methods towards expanding it, highlighting especially the role of science, public information and education, and in general the concept of *culture*.[432]

And indeed, the views of Bogdanov closely paralleled those of Austromarxists like Adler. According to Sochor, Bogdanov too sought out out a philosophical system that combined “the best of Mach’s and Avenarius’ theories with the best of Marx’s,” one that might “fill in the gaps” of the latter.[433] Trotsky agreed with this appraisal and wrote not only of his own approval of Bogdanov’s work, but of Lenin’s early enthusiasm for the same, at least until Plekhanov, a more ‘orthodox’ Marxist, warned him that Bogdanov had strayed from true materialism.[434] Bogdanov, who was interested neither in true materialism nor orthodox Marxism, and indeed who expressed his concerns that the works of Marx and Engels had become akin to “holy

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[431] Mach expresses such views especially in Ch. 5 of the *Analysis of Sensations*, (“Causality and Teleology”) {{8 Mach,Ernst 1959; }}
[432] For Gorky, culture is “free art, experimental science, and technological industry.” For more on Gorky’s ideal of culture as part of the transition to socialism, see his “Untimely Thoughts.” For a discussion of Gorky’s relationship with both Bogdanov and Lenin, see {{73 Sochor,Zenovia A. 1988; }}. For a fictional depiction of the three, see the well-known passage from Bogdanov’s utopian science fiction novel “Red Star,” in which he contrasts Leonid, the “Old Man of the Mountain,” and “the Poet,” as representations of, respectively, himself, Lenin, and Gorky.{{70 Bogdanov,A. 1984; }}
[433] {{73 Sochor,Zenovia A. 1988; }}
[434] {{66 Trotsky,Leon 1971; }}

scripture," forged ahead in his own, "unaligned" analyses of the fragmented nature of modern social and scientific life.[435]

Bogdanov came to these analyses from a number of standpoints and with a great deal of technical expertise. Born in Tula in 1873, Bogdanov trained as a physician, and also worked throughout his life as a political economist, a philosopher, and a successful novelist, best known for his works in utopian science fiction. Active in politics from his youth, Bogdanov was elected to the Bolshevik Central Committee in 1905, 1906, and 1907, serving as party representative to the St. Petersburg Soviet during the 1905 Revolution. After his ouster from the party center by Lenin, Bogdanov continued his political work by different means, for example by founding the *Novaya Zhizn* [New Life] newspaper (in which Gorky later published his fierce criticisms of Lenin's repressive policies) and as a leading member of major cultural initiatives such as *Vpered* [Forward] and *Proletkult.* As we now turn to the importance of these latter programs, we should keep in mind Vucinich's claim that Bogdanov was one of the "most original, productive, and accomplished social philosophers of his generation."[436]

Like the Austromarxist Adler, Bogdanov claimed that although Marx was the first to account for the "dependence of ideology on the relationships of production," he had nevertheless "left the objective role of ideology in society and its indispensable social function unexplained." Rejecting the

[435] {{73 Sochor,Zenovia A. 1988; }} p.7, {{66 Trotsky,Leon 1971; }}
[436] {{73 Sochor,Zenovia A. 1988; }} p.7, 56

reductivist concepts of base and superstructure, Bogdanov believed that culture and ideology represent an important “organizing instrument of society,” and that a crucial task of the social democrats was therefore to enact a “program of culture” meant to “transform the way of life of the people” by focusing on the habits and conditions of everyday life (which Bogdanov did in fact call the “elements of socialism in the present”). Sochor concludes that, in general, “Bogdanov drew far greater attention to ideology and values than Marx ever did,” and it is at least clear, as many scholars have observed, that Bogdanov’s views on cultural fragmentation, alienation, and liberation jibe much more closely with those of the younger Marx (of the *Manuscripts of 1844*, for example) which of course were still undiscovered at the time.[437]

Bogdanov thus claimed that the “elimination of class distinctions cannot be achieved through violent revolution…but rather by education of members of society in organizational skills; that is, through mass organization and proletarian culture.”[438] His own contributions to these latter tasks came in the form of the *Vpered* (Forward) movement, which prior to the Revolution founded two party schools in Italy, and more importantly, the *Proletkult* movement, a massive educational campaign for the development of “proletarian culture” that, from 1917-1921, engaged hundreds of thousands of workers in a variety of scientific, artistic, and labor workshops centered around proletarian “studios.” Throughout his career, Bogdanov supported

[437] see {{20 Biggart,John 1998; }}
[438] {{25 Bogdanov,A. 1980; }}

both the establishment of proletarian universities and the publication of a new encyclopedia, which would re-present crucial scientific concepts and historical events in an accessible manner from a socialist standpoint.

And so it is clear that Bogdanov, who was not only often labeled a ‘revisionist’ by Lenin, but whose struggles with the latter may have been the original motivation for the introduction of a “notion of philosophical heresy in Marxism” in the first place,[439] was, contrary to his label, wholly dedicated to cultural and ideological programs, to the formulation and propagation of a “total socialist worldview.”[440] Ironically, over time Lenin himself cooled to these ideas and programs, and generally to what Marot calls Bogdanov’s “intellectual and pedagogical concept of politics,” suggesting instead that the political struggle of socialism should not be “dissipated in pedagogics.” In fact, recycling the language of M&EC, the Politburo passed a resolution in 1921 claiming the need to cleanse Proletkult of “attempts to substitute for the materialist worldview the surrogates of bourgeois-idealist philosophy.”[441]

But if Bogdanov’s ‘revisionism’ did not actually represent a fetishistic attachment to daily economic struggles at the expense of broader issues of culture and worldview, then how are we to interpret Lenin’s construction of the opposition in these terms? Many scholars have addressed this question historically.[442] Their discussions, however, lie for the most part outside the

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[439] {{73 Sochor,Zenovia A. 1988; }}
[440] Marot, 252
[441] {{73 Sochor,Zenovia A. 1988; }} p.152
[442] Suffice to note that some scholars, like Kelly, for example, see the real controversy as one of the empiriocritical premise of “free will” held by Bogdanov and his supporters versus the “mechanical

scope of this philosophical investigation. Our own task with respect to the polemical oppositions that have appeared in these chapters is to provide a philosophical analysis that exposes the one-sidedness of their attacks on pluralist, 'positivist' positions associated with the thought of Ernst Mach. As to the framing of the political opposition that we are discussing in this chapter, it is at least clear that, as Sochor reports, "it was more often than not Lenin who drew the distinctions between himself and Bogdanov as 'stark opposites.'[443] At the close of this chapter, we will briefly consider the effects of this one-sided opposition in political philosophy. For now, we can continue to expose the misrepresentation associated with the opposition by pursuing our main goal, an examination of the actual beliefs of the thinkers involved.

Just as in the case of the leading Austromarxists like Adler, Bogdanov's standpoint shares many of its important features with Mach's.[444] Indeed, Bogdanov also attempts to 'go beyond' the metaphysics of both idealism and materialism by redirecting our attention to a *common realm of experience* and demanding the "constant practical verification" of scientific assertions. Like Mach, Bogdanov was concerned in particular with reductionism, and his "empiriomonism" rallied against what he called

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materialism" of Lenin and Plekhanov, with the strict philosophical orthodoxy of the latter expressed politically by an undemocratic willfulness and strict disciplinarianism. Marot, on the other hand, denies the existence of such a neat and simple connection between philosophy and politics, claiming that, despite traditional arguments, "Lenin did not write M&EC in order to bring to heel political opponents by enforcing philosophical orthodoxy in the RSDLP," that the political substance of the Lenin-Bogdanov controversy had more to do with evolving strategies and beliefs on both sides with respect to the "tutelary role" of intellectuals, as well as tactical disagreement on practical issues such as party participation in the Duma. {{104 Marot,John Eric 1990; }}

443 {{73 Sochor,Zenovia A. 1988; }} p.183

444 For a historical account of Mach's influence on Bogdanov, see {{20 Biggart,John 1998; }}

"materialistic substitution," namely the "representation of the world of actual experience, or phenomena, in terms of a "material world."[445] We will soon see that Bogdanov, like Mach, believed that one of the advantages of privileging experience in this way is that it facilitated the use of a "common scientific language" that would help resolve the "mutual lack of understanding" prevailing between the scientific disciplines as well as within society at large.[446]

With respect to the latter claim concerning society as a whole, it is important to understand that for Bogdanov, the prevailing metaphysical and epistemological worldview at any given time is deeply connected to the prevailing state of social relations. He thus understood metaphysical dualism to be a remnant of traditional, authoritarian societies, and philosophical materialism as a one-sided and essentially revolutionary worldview, one that "emerges amidst the anarchic, contradictory division of labor in mercantilist society." Bogdanov believed that his "new monism" of experience, on the other hand, represented a fully socialist worldview rooted in the "collaborative labor form" of the working class.[447]

And so Bogdanov, like Mach, rejected the rigid metaphysical dualism between "spirit" and "matter," arguing that these terms are in fact "fluid and vague" and that we should instead focus our positive research on the various,

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[445] Sadovsky, in {{20 Biggart,John 1998; }} p.44
[446] To fully acknowledge Mach's influence on Bogdanov, it is important to recall that the latter both served as the Russian edition of the *Analysis of Sensations* and co-authored a volume on "Ernst Mach and Marxism."
[447] Yassour, Avraham, "The Empiriomonist Critique of Dialectical Materialism: Bogdanov, Plekhanov, Lenin" Studies in East European Thought 26 (1983) 21-38

actual juxtapositions of “physical and psychical experience.” As a social scientist and a student of Marx, however, Bogdanov attempted to “find parallels between forms of knowledge and forms of production,” and argued that “the foundation of our conception of the world…is an ideological derivative of our most basic social conditions,” i.e. our work relations, vital and technological relations, and forms of collaboration.[448] Such modes of explanation are rare in Mach, who, as we have seen, tends to think of the problem of worldview psychologically, as part of the individual’s progression from naïve and practical considerations to critical and “theoretical” ones.[449] Before turning to the other ways in which Bogdanov’s views differed from those of Mach’s, we should briefly review some of Mach’s own political views and activities, especially insofar as they represent an extension of his philosophical commitments to pluralism and plasticity, and thus express the contribution of biological empiricism to a social democratic philosophy of science.

Blackmore claims that the cornerstone of Mach’s social philosophy was “his belief in the moral progress of mankind,” and indeed, as a close friend of Victor Adler, the founder of the Austrian Social Democrat party, and a lifelong participant in Vienna’s adult education movement, it is not difficult to identify Mach as a progressive. His unique version of “half-individualism half-socialism,” as Blackmore describes it, first of all rejected every type of political

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[448] Ibid. p.29
[449] see the “Introduction to the Elements” in Chapter 1

fundamentalism or dogmatism, and Mach is quoted as saying that "free-thinking Germans stand closer to free-thinking Czechs, Jews, Frenchman and Italians than to numerous other Germans."[450] Mach's fierce opposition to nationalism and clericalism are also well documented. Hoffman thus cites a letter from Mach to his daughter Carolina, in which he writes that "I hold that the conception of nationalities proves deplorable narrow-mindedness and is a terrible relapse. It was under the influence of this plus the pretext of religion that the worst brutalities of the 17th Century were committed."[451] We furthermore recall that it was in the name of an unwavering commitment to the "freedom of thought" that Mach rejected the "Church of Physics" that he saw forming around the movement towards atomism.[452]

In addition to his staunch advocacy of the freedom of thought, we have already seen how Austromarxists like Friedrich Adler applied Mach's pluralism to Marx's social thought, and thus to the search for a plurality of influences on consciousness in modern, capitalist societies. When it comes to the political questions of welfare and justice, we recall from our discussions of Mach's principle of economy that he regarded the "meeting of biological and material needs" as a fundamental goal of scientific inquiry. And with respect to justice, we have suggested above that Mach, despite a number of isolated protests against prevailing inequalities, tended to approach the

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[450] {{96 Blackmore,John 1983; }} p.223
[451] Hoffman, Dieter, "Ernst Mach in Prague," in {{32 Blackmore,John T. 1992; }}. In a letter to Ostwald, Mach further relates how he made revisions to a sort of working obituary for himself to be published by Paul Carus in an attempt to "not allow the clerical-reactionary period of Austrian history which [he] experienced to remain unmentioned." p.88
[452] {{32 Blackmore,John T. 1992; }}

question of social and moral progress, of "enlightenment," from a psychological point of view, in particular through his famous claim that the "ego cannot be saved." Mach believed that through this "simple truth," which itself is the "immediate outcome of psychological analysis," mankind would slowly "arrive at a freer and more enlightened view of life, which would preclude the disregard of other egos as well as the overestimation of our own."[453] It is no wonder that Buddhist monks in what is now Sri Lanka translated the *Analysis of Sensations* into Singalese as "educational material" around 1900.[454]

It is not that Mach was blind to broader social and economic realities. He acknowledged "the battle of existence" and the narrow-minded, practical attitudes necessary to survive or thrive in such a context.[455] However, he believed that in the *long run* "practical conduct cannot resist theoretical understanding," and that the latter would eventually lead "the fully developed human individual" to adopt a more peaceful and sympathetic attitude towards other human beings.[456] Central to Mach's claim here is his emphasis on the concept of plasticity, the ability of human beings to *learn* to recognize, and thus become familiar with, ever new combinations and associations of the elements of experience. Mach's vision of historical human progress, as we

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[453] {{8 Mach,Ernst 1959; }} p.25
[454] {{32 Blackmore,John T. 1992; }} We will not have the opportunity to respond to charges that Mach's ethical view is will-negating, "timid," or "retrogressive," (Cohen) or that political standpoints that make appeal to his ideas are bound to be swept away in the historical clash of forces, see {{96 Blackmore,John 1983; }}
[455] see, for example, {{8 Mach,Ernst 1959; }} p.23
[456] {{8 Mach,Ernst 1959; }}

have seen several times above, is one of ever-increasing recognition, familiarity and comfort in the world.[457] In *Knowledge and Error*, he leaves the question open-ended as to how far we might take this "power of associative flexibility" and yet he was generally committed to the idea that it would inevitably bring with it the "greater enlightenment" associated with the "falling away of the apparent bounds of a person."[458]

When it came to issues of poverty and distributive justice, however, although Mach did speak out against the "robbery of the many by the few," he offered no programmatic solutions. With respect to the more detailed, technical questions of economic planning and re-organization, Mach was more than happy defer to experts like his close friend and ally Popper-Lynkeus. Indeed, the latter's "Universal Alimentation Service," a monumental attempt to "solve the social question" by providing a "positive, intuitively clear, quantitatively precise program" for the universal distribution of a minimum level of existence, was a guide to the generation of progressive economists who would follow. Mach himself described it as "spadework for the millennium to come."[459]

Bogdanov's own constructive work, like that of Popper-Lynkeus, also focused on practical matters of planning and organization. Like Cartwright, Bogdanov on the one hand follows Mach in affirming the primary roles of experience and verification in science, and on the other distances himself

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[457] see, for example, *Transformation and Adaptation in Science* in {{39 Mach,Ernst 1898; }}
[458] {{2 Mach,Ernst 1976; }}
[459] Letter to Ostwald, in {{32 Blackmore,John T. 1992; }}, p.88

from any radical empiricism, which, by highlighting the "individual sensations and perceptions directly given to a subject," represents for him a "perversion of actual experience." For Bogdanov, actual experience not only includes both "things and perceptions," it is primarily social and thus "objective." As opposed to Mach, Bogdanov does not tend towards the psychological aspect of experience, but rather towards physical objects, their interactions, and their technical manipulation. The world of Bogdanov's constructive focus is a world of "activities" and their *organization* into machines and mechanisms. In this way, his work directly parallels what we have called the technological empiricism of thinkers like Nancy Cartwright, and we will shortly turn once again to the political relevance of such a standpoint, especially its promotion of a collaborative and organizational "unity of science."

But first let us briefly review Mach's contribution, and indeed that of biological empiricism, to what we are calling a social democratic philosophy of science. First of all, such a standpoint challenges all forms of political absolutism and dogmatism, and argues for the central importance of the *freedom of thought*. With respect to social theory, reductionism is rejected and a pluralist investigation into human nature and the sources of social consciousness (though with an emphasis on economics and physiology) is prescribed. On the question of the relationship of science to society, biological empiricism stresses the obligation of the former to contribute to the latter's project of human adaptation, both by "satisfying biological needs" and by "providing the fully developed human individual with as perfect a means of orienting himself as possible." Finally, with respect to moral and social progress, Mach provides a primarily psychological account of "enlightenment," one based on the plasticity of the human mind and the related ability of critical philosophy to influence an individual's practical conduct. For Mach at least, the point is to change the world *by* interpreting it. For a more traditional understanding of Marx's famous aphorism, we can now turn to the political thought associated with technological empiricism.

4.4 The Unity of Science and Socio-Economic Enlightenment

We have previously described Mach's vision of the unity of science as a combination of pluralism and inter-disciplinary collaboration with an emphasis on invigorating research horizons in developmental psycho-physiology. The critical component of such a program of unification, its "anti-metaphysics," challenges the reduction of psychology to physics, and indeed dissolves the entire question of the priority of "the Physis or the Psyche" by rejecting metaphysical dualism.[460] In general, such a conception of unity is based on common experience and praxis, and not on the development of a grand 'theory of everything' or a completed scientific 'system.'

We now turn to another understanding of the unity of science, one that is however both historically and conceptually linked to Mach's own. It is likewise concerned with communication and collaboration between the

[460] {{8 Mach,Ernst 1959; }}

sciences, and drawing from Mach it focuses on issues of scientific transparency and the development of a common scientific language. However, whereas Mach's work was concentrated on expanding mutual understanding and autonomy at the borders between physics, physiology, and psychology, this other movement of unification, promoted by thinkers like Bogdanov and the Austromarxist Otto Neurath, focused on disciplines like economics and sociology. As such, these thinkers took a special interest in the relationship between science and society, and indeed, as we will see, between science and socio-economic enlightenment. We get a glimpse of such a standpoint in Gorky's statement that "science is social in the broadest sense of the word." This claim is consistent not only with Bogdanov's constructive attention to the technical and social side of phenomena just discussed, but likewise with Cartwright's standpoint outlined in the last chapter. In general, we will thus examine the way in which this ideal of scientific unification is linked to the contribution of technological empiricism to social democratic philosophy of science, and for a deeper explanation of its principles and motives we turn to the work of one of its leading proponents, Otto Neurath.

Neurath was an economist and social scientist, the organizational and motivational leader of the 'Unity of Science' movement, and a tireless editor, contributor, and advocate of the encyclopedia project associated with that movement. He was also a founding member of the Vienna Circle, who, according to Friedrich Stadler, provided the philosophical and political counterpoint to the other “dominant adversary thinker” of the group, Moritz Schlick.[461] The fruitful tension between these two, and likewise their considerable differences in motive, method, and character, are unfortunately often overlooked in monolithic presentations of the received view of “logical positivism.” In addition to these roles, Neurath was also the director of the Social and Economic Museum in Vienna, and an important official for the massive public housing projects undertaken by the Social Democratic leadership of that city during the 1920’s.[462]

Elizabeth Nemeth, a leading Neurath scholar, has described Neurath’s conception of the unity of science as one whose goal is for “science to become a transparent and socially available whole,” the latter end achieved especially through the “evaluation and integration of scientific activity into the current social movements and their effect on the future.”[463] Concerning the goal of transparency, we have already seen in Chapter One the way in which Mach too regards science in large part as a phenomenon of communication, of the transmission of knowledge between generations and the sharing of expertise between crafts, one marked by its extreme candor. In the course of his life’s work Neurath would take this commitment to new levels, most notably in his successful efforts to devise and deploy the ISOTYPE system, a universal picture and statistical language designed to impart accessible

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[461] {{58 Stadler,Friedrich 2001; }}
[462] {{16 Cartwright,Nancy 1996; }}
[463] {{38 Uebel,Thomas E. 1991; }} 290

economic and scientific information to the public.[464] Concerned that people be able to comfortably navigate public spaces, indeed internationally, Neurath hoped to deploy ISOTYPE in train stations, civic offices, “social museums,” etc., and thus added an explicitly public and political component to Mach’s epistemological emphasis on familiarity.

From a standpoint of public transparency and social concern, a critical campaign against metaphysics becomes a struggle with obscurantism. For Neurath especially, anti-metaphysics had little to do with pedantry, i.e. with analytic clarity for clarity’s sake. Rather, he saw the extent to which vague, metaphysical references could be used as reactionary tools of manipulation and distraction, how “violent recourse to forms of thinking once held to have been overcome are but part of the violence by means of which a redundant social system intended to remain victorious over the progressive forces of the revolution.” And so for Neurath, “the fight against metaphysics is a practical, political activity,” one part of a lifelong dedication, shared with (and party shaped by) Popper-Lynkeus, to help solve the social question and bring about a more “just order.”[465]

Indeed, in describing Neurath’s “intellectual socialization,” Friedrich Stadler reports that he was “formed by liberalist, social-reformist, economical and visual elements which raised the problem of a just social order,” and thus in general, by “a conception of enlightenment which comprehended theory

[464] see, for example, “From Vienna Method to ISOTYPE,” in {{15 Neurath,Otto 1973; }}
[465] {{102 Nemeth,Elisabeth 1996; }} p.290

and practice." His main influences along these lines included Popper-Lynkeus as well as his own father, Wilhelm Neurath, a political economist and staunch critic of the excesses and injustices of a money economy. One can detect the impact of these thinkers on Neurath by noting, as Stadler does, "how strongly he was impressed until the end of his life by the idea of collective work and planning in society and science for the purposes of humanization and democratization."[466]

Neurath combined this focus on *planning*, to which we will shortly return, with an unwavering dedication to *pluralism*, described by him as the "backbone of my thought." Indeed, Neurath describes his "skeptical pluralism" as one eager to "reject anything that smacks of the absolute." He preferred the model of a scientific "encyclopedia" to that of a "comprehensive world picture," and Cartwright quotes Neurath's claim that "the system is the great scientific lie." Neurath's pluralistic empiricism, like Mach's, is meant to free science of aura and mysticism, consistently asking "what do you mean?" and "how can you test it?"[467] It is thus that Neurath turns away from Pythagorean "god seekers," those thinkers who "find satisfaction in the mystery of the boundless," and prefers the Epicurean type, who "are glad when their sober glance meets a multiplicity free from magic." Again like

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[466] {{58 Stadler,Friedrich 2001; }} p.162
[467] {{41 Neurath,Otto 1983; }} p.48

Mach, Neurath associates this type of candor and tolerant "humanism" with thinkers like "Voltaire and Zola."[468]

Neurath's commitments to pluralism and planning are expressed side by side in statements such as: "I also stress planning for freedom. I mean by planning for freedom the orchestration of variety."[469] Neurath's program of "orchestrating variety" should lead us to recall Cartwright's image of organized pockets of order within a "dappled world," and we can provisionally establish the concepts of pluralism and planning as two main features of technological empiricism. Once we have explored the ways in which both Neurath and Bogdanov describe the type of scientific unity which follows from these commitments, including its political aspect, we will offer a more complete definition of the standpoint.

Elizabeth Nemeth, a leading Neurath scholar, describes Neurath's vision as one of an "organizational unity" of science, one focused upon the collaborative, interdisciplinary deployment of technological capacities towards the widespread implementation of well-conceived social planning. There is a strong historical basis for these ideas, for Neurath was at the height of his powers in the period following WWI, during which, as Peter Galison has observed, the concept of *Aufbau* pervaded the German-speaking intellectual world.[470] The idea (behind at least one prevalent use of the term) was to consciously re-"construct" the postwar European societies, to engineer a

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[468] {{15 Neurath,Otto 1973; }}, 286, 239 For more on the influence of Voltaire on Mach and Popper-Lynkeus, see {{59 Stadler,Friedrich 1982; }}
[469] {{38 Uebel,Thomas E. 1991; }} p.162
[470] {{112 Galison,Peter 1990; }}

more just and peaceful order from the ground up. Paradigms of praxis, technology, and transparency were widespread and influential, and it was along these lines that Neurath and other representatives of the "Vienna Circle" forged strong bonds with the progressive architects of the Bauhaus.[471]

And indeed, Neurath himself observed, as late as 1931, that "everywhere we find a growing sense of technical organization," and that "planning is becoming almost universal…as a characteristic of the new pattern of society." For Neurath, socialism itself can be understood simply as a society "based on planning."[472] The driving forces behind Neurath's vision of social transformation were, unsurprisingly, the "social engineers," who along with mechanical and chemical engineers, as well as physicians, would "replace magicians and priests" as chief, social functionaries. Neurath was consistent in his pluralism, however, and he did not wish to anoint a "cult of organizers" as a new aristocracy- a modern, technological answer to Plato's guardians (this very charge was actually levied against Bogdanov in Russia[473]). Rather, as we will see when we turn to questions of the association of this technical unity of science to economic planning, Neurath understood the role of these expert planners as one of proliferating possibilities, of providing a variety of social and economic models and blueprints. These then become the content of a new branch of science, a

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[471] {{112 Galison,Peter 1990; }}
[472] {{15 Neurath,Otto 1973; }} p.329
[473] {{73 Sochor,Zenovia A. 1988; }} p.180

"comparative utopistics," while the choice for implementation from among them remains a matter of open, democratic deliberation.

Alongside Neurath's ideas, the nature and purpose of Bogdanov's major constructive work, *Tektology*, should now seem less foreign. Bogdanov saw *Tektology* as providing the foundation of a new meta-discipline, a "general organizational science" that would identify and classify paradigmatic organizational forms across the domains of nature, society, and ideology. Viewed by many scholars today as a significant predecessor to cybernetics and systems theory, Bogdanov, like Neurath, also believed in the importance of planning and organization for the cause of socio-economic enlightenment in the first part of the 20th Century. Indeed (with a characteristic tendency for hyperbole) Bogdanov declares in *Tektology* that "mankind has no other activities except organizational activities, there being no other problems except organizational problems."[474] Bogdanov saw the immediate applicability of his work in "state economic planning and the progress of pedagogical methods," and in direct agreement with Neurath he envisioned socialism as "the organization of the whole."

Despite the systematic aspirations of *Tektology*, i.e. Bogdanov's hypothesis that the same organizational forms govern the phenomena of nature, society, and the realm of ideas, he is at the same time quick to disavow any tektological attempt to construct a "unified world picture." Indeed, following Marx, Bogdanov rejects "scholastic epistemologies,"

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[474] {{25 Bogdanov,A. 1980; }} p.3

preferring, like Cartwright and Neurath, perpetual and collaborative intervention to grandiose and "contemplative" representation.[475] It is thus the "practical mastery of organizational forms" that Bogdanov describes as the goal of *Tektology.* Far from erecting a new epistemological *system*, Bogdanov makes it clear throughout the work that what he offers is a new, or at least renewed, *standpoint*, namely the "universal, organizational standpoint."[476] For Bogdanov, the goal envisioned from such a standpoint is nothing less than the "self-organization of mankind."[477]

In their focus upon cooperation, technological advancement, and socio-economic enlightenment, the influence of Karl Marx on Neurath and Bogdanov seems clear. Both thinkers acknowledge this intellectual heritage, and we thus acknowledge the importance of Marx's ideas within technological empiricism. Neurath calls Marxism "the foundational basis of all social engineering," and Bogdanov names Marx as "the great precursor of organizational science." Both agree with Marx's characterization of modern, social life as fragmented and alienating, completely lacking, as Marx put it a "conception of the whole." Bogdanov, in his own terms, describes this condition of myopic specialization and isolation as "the organizational experience of the bourgeois world," and both he and Neurath see it not only as an economic problem but one prevailing amongst the scientific disciplines

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[475] {{25 Bogdanov,A. 1980; }} p.60
[476] Perhaps we can see the parallels with Kant's *Critique of Pure Reason* and its pioneering attempt to promote the "transcendental standpoint." Bogdanov, however, is less interested in transcendental autonomy and noumenal faith, and more in technical education and advancement, and social solidarity.
[477] {{25 Bogdanov,A. 1980; }} p.1

as well. We will return to the former issue shortly when we discuss both thinkers' associations of the unity of science with the move to a planned economy. For now, we turn to the problem of scientific specialization and the need for unity amongst the disciplines, and thus back to Mach as the other major influence on the epistemologies of Neurath and Bogdanov, and likewise on the contribution of technological empiricism to social democratic philosophy of science.

Like Mach, Bogdanov believes that the rampant specialization of modern sciences limits "cooperation and communication between the branches," and that the "narrowing of the horizons of specialists undermines organizational creativity."[478] Bogdanov sees this situation as largely resulting from a proliferation of specialized vocabularies and conceptual frameworks which generate a widespread "mutual lack of understanding." He complains that "things which are quite homogeneous receive different names," and that the result is not only the increasing "complexity of language" but also the corresponding growth in the "expenditure of energy." We can thus see a connection to Mach both when Bogdanov promotes a "common, scientific language" to overcome this isolation and promote interdisciplinary collaboration, and moreover in his focus on maximizing the economy of effort, his view that the goal of science is to help us "orient ourselves within experience with as little effort as possible."[479] Neurath too considers himself

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[478] {{103 Biggart,John 1998; }} p.17
[479] {{73 Sochor,Zenovia A. 1988; }} p.146

to be a part of the Machean tradition that promotes translation and collaboration between the sciences, which "tries to pass from chemistry to biology, from mechanics to sociology, without altering the language applied to them." It is thus the "Machean suggestion of a common scientific language" that Neurath describes as the "backbone of [his] attempt to do something for the 'unification of our scientific enterprises.'"[480]

And yet as was described above, thinkers like Bogdanov and Neurath stress a *unity of social and technical*, rather than psychological, experience. In this way Cartwright shares many of their concerns. For Neurath, this means in part the choice to recommend a 'physicalist' as opposed to a 'phenomenalist' language as the common, unifying language of science. Neurath is quick to remind us, however, that the 'physicalist' standpoint "has nothing to do with 'mechanism' or anything like that," nothing to do with the reduction of the world to matter and motion nor universal determinism. Rather, its promotion of a "universal jargon" suitable to all of the sciences merely suggests that "we can use the everyday language which we use when we talk of cows and calves throughout our empiricist discussions."[481] Like Bogdanov, Neurath believes that the language of empiricism is always already an "intersubjective language," a language that treats of things, of the objects of experience.

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[480] {{41 Neurath,Otto 1983; }}, p.232
[481] {{41 Neurath,Otto 1983; }} p.233

Bogdanov, as we have seen, is in full agreement here, and again the ideas of Cartwright match. He stresses that it is not just the objects themselves that are of interest, but also the organization and arrangement of their powers and "activities" into machines and mechanisms. Bogdanov describes the subject matter of *Tektology* as "elements and their combinations" into "organizational complexes." He describes these "elements" as "activities" and there is here a parallel to Cartwright's "powers" and "capacities" discussed above. Bogdanov stresses the fact that these complexes are always arranged against a backdrop of environmental conditions and "resistances" within a "world of variety," and once again Cartwright's views are similar.

Bogdanov thus contrasts tektology to mathematics, or more precisely, he sees the latter, insofar as it is also an "abstract and universal" study, (of magnitudes and their relations) as a special sub-discipline of tektology, one concerned with "neutral complexes," in which the elements themselves are viewed as "indifferent."[482] For Bogdanov, mathematics is thus a necessary but not sufficient tool to account for physical, chemical, and social systems, which all play out in a world of force and interaction, one in which organizational form directly influences quantifiable behavior.[483] Insofar as we are not "neutral" with respect to these changes in results, Bogdanov concludes that we are in need of tektology to guide our projects of

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[482] {{25 Bogdanov,A. 1980; }} p.46, we might think in this context of the "reine Beziehungslehre" (pure theory of relations) with respect to "formal space" that Carnap advocates in his doctoral dissertation "On Space"

[483] {{25 Bogdanov,A. 1980; }} p.47

mechanical, chemical, and social engineering. It is thus not surprising that Bogdanov defines physics and chemistry not in terms of the pure mathematics of nature in herself, but rather as "the sciences concerning the resistances and activities of external nature encountered by any human exertions."[484]

Within his discussions of "activities" and their arrangements, Bogdanov presents us both with an account of the analytic method, which Cartwright's resembles, and ultimately with an anticipation of the latter's central concept of the "nomological machine." With respect to the analytic method, Bogdanov writes that "any decomposition of the whole into elements, actual or mental, is disorganization… undertaken in order to lessen the opposition of things to our practical and cognitive efforts…this aids us later to organize elements into new and desirable combinations."[485]

These consciously organized complexes are called "machines" by Bogdanov, and because their organization is "carried out by people," their mechanism "is principally known." Bogdanov does not deny the existence of natural mechanisms in favor of artificial ones, i.e. he does not at all argue that all regularities in nature are the results of human engineering. Rather, he does suggest, again anticipating Cartwright, that we bring focus to the great many regularities that are the result of deliberate artifice, and that by doing so we may learn more about how to more accurately model complex, natural

[484] {{25 Bogdanov,A. 1980; }} These ideas about mathematics, force, and interaction will again be relevant when we discuss Spinoza in the conclusion
[485] {{25 Bogdanov,A. 1980; }} p.42

target systems, thus moving away from the ideal of a few, general, explanatory 'laws of nature.' Bogdanov thus writes that "mechanisms are, firstly, those organized complexes which are systematically built by people themselves, and then all of those systems in nature whose structures have been learned to the same degree."[486]

As was also suggested in the discussion of Cartwright's work in Chapter 3, Bogdanov's prioritizing of machines to mechanisms, while not ignoring the latter, tends towards a corresponding focus upon the relationship between science and society, and more specifically on the project of socio-economic enlightenment. Both Neurath and Bogdanov understand their promotion of the unification of science in precisely these terms. Indeed, they provide almost identical 'historical' accounts of the need for and emergence of their unification movements. Paralleling Mach's accounts of the *development of individual psychology* from "the child of the forest" to the "civilized man," Bogdanov and Neurath provide stories of an *evolution of society* from aura and ignorance, through specialized isolation and alienation, and finally into technical precision, transparency and collaboration.

For both thinkers, this chronology of social enlightenment begins with an age of magic and authoritarianism. Bogdanov observes that "the authoritarian framework once unified and organized the entire universe," and that the power associated with the leader's word led to both a general "fetishism" of magical language and the associated hierarchical metaphors of

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[486] {{25 Bogdanov,A. 1980; }} p.52

soul and body, and god and subjects. Some latent technical knowledge was of course mixed in with this prevailing worldview, and so Bogdanov regards ancient holy books as, in part, "encyclopedias of organizational experience."[487] Neurath agrees with these observations, and describes the ancient world as one united by a standpoint of "magic," i.e. a certain, highly regimented and ritualistic "habit of keeping order" combined with the "poor, hard-won techniques of primitive people."[488]

We have mentioned above that both Bogdanov and Neurath describe the subsequent, modern stage of society, which emerged and continues to emerge after a series of hybrid stages, as one in which both great advances and setbacks are observed. On the one hand, as Marx agreed, the age of capitalism brings with it both the staggering achievements of "bourgeois science and technology," as well as a general liberation from both "tradition and superstition" and the rigid hierarchies of "Oriental despotism." At the same time, Bodganov describes the new fetishisms of individualism and wealth which emerge, and both he and Neurath lament the scientific, social, and economic isolation and anarchy characteristic of the modern age. It is in response to these conditions that Bogdanov justifies the need for a "new monism, which is scientific and progressive," and Neurath suggests that "unified science is the substitute for magic which also once encompassed the whole of life." Both suggest that organization and planning will play a key role

[487] {{25 Bogdanov,A. 1980; }} p.29
[488] {{15 Neurath,Otto 1973; }} p.320

in re-introducing a sense of ‘the whole’ into modern society. Bogdanov believes that tektology will be able to review and digest the results of the special sciences form a “universal, general, and holistic point of view,” and Neurath describes the unity of science as a “planned synthesis” of all of the scientific knowledge which we have so far gained.

For both thinkers, then, *a collaborative movement to consciously synthesize and deploy our technical knowledge* replaces religion and superstition as the organizing principle of our society and a source of our social solidarity. Indeed, not only are shamans and priests found to be superfluous in the new age, but speculative philosophers as well. Both Bogdanov and Neurath believe that “work on unified science” itself will be able to identify gaps in knowledge and thus direct research and “stimulate new scientific questions.” Since at the same time, all assertions are to be evaluated with respect to their meaningfulness in experience, “philosophy as an independent system of definite doctrines” becomes “superfluous” (Bogdanov) or “obsolete.” (Neurath) We will interpret these ideas in greater length when we examine the Horkheimer-Neurath debate in the final section.

But first, in order to complete our analysis of technological empiricism and its own contribution to a social democratic philosophy of science, let us briefly review the way in which Bogdanov and Neurath apply their ideas about organization, planning, and the unity of science to the question of how to reform both modern economies and the ‘economic science’ that purports to study them. This will furthermore give us a chance to expose (as we have in the previous two chapters) the ways in which the actual views of a thinker who frames a caricatured opposition, in this case Lenin again, tend to approach the actual ideas of their supposed opponents.

For both Bogdanov and Neurath, the market economies of industrial, capitalist societies are anarchic, exploitative, and wasteful, resulting in various "social conflicts and catastrophes." The project of socio-economic enlightenment, then, is one of exchanging this situation, to a certain degree, with one of "planned, organizational activity." For Bogdanov, this includes both pedagogical and economic initiatives, which are actually deeply interrelated. Of the former, Bogdanov, who to a greater extent than Marx anticipated the "managerial revolution" and the emergence of the "new middle class" of technical functionaries in the 20th Century, argued that society must "prepare the working class as organizer."[489] Having observed the "psychological distinction" that existed between managers and workers in contexts of production, Bogdanov concluded that it was the former's relative mastery of the "organizing function" which created the gap. In order to now close it and to thus empower the working classes, the methods and science of organization would have to be disseminated throughout society. It is interesting to note the way in which these ideas are anticipated by Mach, who in *Knowledge and Error* acknowledges a planning and organizing function as one of the few palpable advantages of modern "self-consciousness."[490] For

[489] {{73 Sochor,Zenovia A. 1988; }} p.63
[490] See "The Concept" in {{2 Mach,Ernst 1976; }}

Bogdanov then, in contrast to certain other progressive philosophers, the coming-to-self-consciousness and subsequent emancipation of the masses is not a question of the development of a general critical or "reflective" faculty, but rather a specific *organizational capacity*.

What applies to the individual for Bogdanov also applies to society as a whole, and in 1921 he published his "Organizational Principles of the Single Economic Plan," which envisioned "an economy in which all parts are harmonized on the bass of a methodically worked out economic plan." Bogdanov reasoned that the "goal of a social economy is first and foremost the satisfaction of needs," and that therefore an economic science would busy itself with designing plans to meet these needs through cooperative labor and the efficient deployment of productive forces. However, consistent with his pedagodical and psychological concerns, Bogdanov did not believe that these plans should be overly centralized or hierarchically administered. Rather, he advised "a broad system of scientific and statistical information about all aspects of society's life, with the active participation of collectives and specialists in the adoption of decisions."[491] Many, though surely not all, of Bogdanov's ideas were later adopted by Soviet planning authorities.[492]

Neurath too objected to the "fractured and wild" economic situation prevailing in industrial, capitalist societies. In a bid for humane reform and empowering control, Neurath engaged in a sweeping, though thoroughly

[491] {{20 Biggart,John 1998; }} p.170-176
[492] {{20 Biggart,John 1998; }} p.176

pluralistic critique of market economies. In reviewing Neurath's strategy, we will again find, as we did in the case of Cartwright, that the political relevance of technological empiricism stems in part from its ability to critique the pseudonecessity associated with mechanistic thought and theory fundamentalism. For indeed, Neurath's critique of both modern economies and economics attempt to illustrate and advocate a variety of organizational possibilities that are ignored or overlooked out of a fatalistic abdication to the status quo.

In particular, according to Nemeth, Neurath criticizes the deployment of a "unitary measure" with respect to all economic calculations of activity and value made in a market economy. This unitary measure, namely money, obscures the "diverse considerations" and measures to which a planned economy takes recourse, specifically the "available quantities of productive means and of needs." According to Neurath, by conducting the conversation in the terms of this "natural calculation," patterns of production and distribution, which are ignored in the rigid and arbitrary inertia of the market, are now proposed, elaborated and debated upon in the context of a flexible and deliberate "organizational unity."[493] Neurath concludes that the goal of utilizing a plurality of measures is to facilitate the "broadest comprehension of technological possibilities." Indeed, this goal lies at the very foundation of a technological empiricism.

[493] Of course for Neurath, like for Bogdanov, there is an added assumption here that the purpose of a social economy is to meet human needs, and in general, that society aims at achieving the common welfare

In his essay on "Empiricism and Sociology," Neurath laments that economics as a science has not yet achieved a pluralistic return to these original functions, and comments on some of the reasons behind the stagnation. He writes:

> economic theory to this day is not elastic enough to encompass various economic orders at once…theoretical economics, moved by unclear analogies from the natural sciences, have often tried to construe one specific economic order as *the* economic order, and to regard the various empirically encountered ones as unimportant variants. Many were seeking a theory of economics in a way in which one might seek a theory of astronomy. It would in many regards have been much more fruitful to compare the various economic orders with different types of machines which could be as alien to one another as a steam engine and an electric generator.[494]

It is interesting to again find a contrast made to astronomy.[495] And while Mach promoted the step from celestial mechanics to the depths of psychology, Neurath contrasts the goals of astronomy, explanation and unification, with the genuine aims of economics, construction and deliberation. The key concept of Mach's resulting biological empiricism was *plasticity*, and in the preceding discussions on Cartwright and Bogdanov, as well as in these comments of Neurath concerning economic "machines," we can observe in technological empiricism a paradigm closer to *engineering*.

Neurath believes that a reformed economics will no longer be forced to track a single, paradigmatic market mechanism, one driven solely by the "automatism of the profit motive," through abstract theories and algorithms with dubious real world applicability. Rather, consistent with Mach's

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[494] {{15 Neurath,Otto 1973; }} p.129

[495] see Chapter II, "From Subjective Idealism to Biological Idealism"

description of all of the positive sciences, economics will regain its truly appropriate character as "good housekeeping," specifically by turning its attention back to its *true elements*- production and its capacities, needs and their satisfaction, and ultimately the common good.[496]

Neurath's attempt to re-cast economics from the ground up, to replace theoretical fundamentalism with the authority of the dappled sphere of praxis is consistent with what Peter Galison has called a "transparent construction," similarly defined by him as a "manifest building up from simple elements to all higher forms that would, by virtue of the systematic constructional program itself, guarantee the exclusion of the decorative, the mystical, or metaphysical."[497] Within this context, as Nemeth reports, theory loses its autonomous authority and becomes "embedded in praxis and organization," in Neurath's words it becomes a "tool for life." All aspects of economics, including what we measure and with what units, can be legitimately based only on conscious decision, decision that is then perpetually open to revision. The goal of Neurath's pluralistic critique of mechanistic capitalism, is to demonstrate that "everything is open to intervention."

As for the nature of the positive economic plan favored by Neurath, the general features and not the details are relevant here. As in the case of Popper-Lynkeus' *Allgemeine Naehrpflicht*, Neurath finds that a system based on a "natural calculation" of goods "in kind" is capable of achieving a more

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[496] {{38 Uebel,Thomas E. 1991; }} p.277
[497] {{112 Galison,Peter 1990; }} p.710

well-ordered production, as well as a more just and humane distribution. In order to facilitate such a calculation, and consistent with his belief in the central importance of good planning and "organizational unity," Neurath envisions the establishment of a "great central organization" responsible for compiling up-to-date statistics and overseeing appropriate responses, for leaving behind the chaos and exploitation of the previous system. The authority of such an institution would only be temporary, however, and as the economy, and indeed the society as a whole, moved through a series of "transitional stages," Neurath believed that there would eventually arise smaller, locally-governed cooperatives acting in collaboration with one another. Throughout such a transition, moreover, Neurath observed that solidarity would have to be "the first rule."

Neurath's "ultimate aim," to use Lenin's expression, seems fairly consistent with that of other socialists, which is to say one that is fairly utopian. Neurath did not shy away from this description. Rather, in his characteristic fashion he embraced it and even attempted to raise it to the level of a science- which is to say, to make it transparent and precise. He identified the importance of utopian thinking in the need we have to "know how the new life order looks which we will bring into existence." However, Neurath adds to this vision his fundamental concern for pluralism, and the result is the emphasis on a branch of thought that he calls "comparative utopistics." Our efforts for progress and socio-economic enlightenment are not to be governed by a single conception of the future regarded as an "inevitable" consequence of the past. Rather, a wide collection of blueprints for a just order are to be commissioned and reviewed, they are to inform one another and to evolve with time and in light of contingency.

And so we find in various Austromarxist positions, and other "revisionist" writings, especially that of Bogdanov, neither the "worship of spontaneity" nor the neglect of theory and vision at the expense of purpose and solidarity. Rather, we find a pluralistic account of social progress that both searches for a variety of ways to bring about the liberation of popular consciousness and actively promotes organization, planning, and solidarity. It seems neither muddled nor incoherent. On the contrary, activity, efficiency and good administration are privileged over every sort of mysticism and aura. Before we now briefly turn back to Lenin to see how he at times shared some very similar, very pragmatic views, all of the conceptual pieces are now in place for a formal review of the main aspects of technological empiricism:

<u>Technological Empiricism:</u>

<u>Critical</u>:

(1) Anti-metaphysics- a staunch empiricism that consistently asks "what do you mean?" and "how do you test it?" Speculative philosophy, as an independent discipline with an independent body of knowledge, is rejected.

(2) Anti-fundamentalism and determinism- a focus on the richness of reality and the plurality of research methods. Pseudonecessity, resulting from a

fundamentalism about laws and theories, is especially targeted in the name of facilitating “the broadest comprehension of technical possibilities.”

<u>Constructive:</u>

(1) A Focus on the *Physical, Social and Technical Aspect of Experience*- i.e. individuals and their causal powers

(2) A Focus on *Organization*- the *engineering* of these causal powers (‘capacities,’ ‘activities’) into desirable, nomological machines, and the *modelling* of naturally occurring, local mechanisms

(3) A Focus on *Adaptation* as the Goal of Science- now as *technical mastery*

(4) A Focus on *Intervention* and a *Collaborative Unity of Science*- interdisciplinary methods are promoted for addressing complex local problems of, for example, public health and urban planning.

<u>Political</u>

(1) *Transparency*- a rejection of all mysticism and obscurantism in public life and public speech.

(2) Economic regulation and *Planning*, as well as a return of economic science to its original elements of human needs, productive possibilities, and, ultimately, the common good.

(3) Social *Solidarity*

(4) An account of *social evolution* from conditions of authoritarianism, aura and ignorance, through isolating and alienating specialization, to ‘unified

science' as political transparency, solidarity and technical, inter-disciplinary collaboration

With respect to the contribution of technological empiricism to a social democratic philosophy of science, we can thus, unsurprisingly, identify both similarities and differences with that of biological empiricism. Both appeal to transparency, favor the identification of plural possibilities over reliance on rigid formulae, and see the promotion of human welfare and adaptation as a central obligation of scientific inquiry. With respect to their vision of welfare and adaptation, however, we saw in our discussion of Cartwright that technological empiricists stress not psychic familiarity but technical mastery, along with the complex interventions necessary to improve the quality of human life in a sometimes hostile environment. Furthermore, with respect to justice, whereas Mach stressed the importance of learning, familiarity, and *individual psychological development* in advancing our ethical life, Bogdanov and Neurath focus on the *evolution of social and economic enlightenment*, and the role that an epistemology that stresses technical mastery and precision, transparency, planning and collaboration can play in such an evolution. Finally, with respect to ethical ideals, technological empiricists often stress solidarity (or at least free deliberation and collaboration) as opposed to merely sobriety (which would likely be considered necessary but not sufficient) or merely resolve (which on its own would likely be considered vague, individualistic, and fetishistic).

4.5 Lenin on Theory *and* Praxis

In this section, we very briefly review, as we have in previous chapters, the way in which some of Lenin's actual views contradict the rigidity of his polemical opposition, in this case that between socialist theory and praxis. We examine for example Lenin's pamphlet entitled "Left Wing Childishness and the Petty Bourgeois Mentality." The essay concerns, among other things, the decision to sign the Brest-Litovsk peace treaty with Germany and her allies in March, 1918, thereby ending Russia's involvement in the First World War. Lenin defends the necessity of the move against the outcries of certain "left communists" eager to continue the war and thus Russia's battle against "international imperialism." Lenin dismisses his opponents' claims to be able to "predict the necessary collapse of imperialism" during the coming summer as mere "childishness," as "playing at science." He argues that "no serious politician will ever say *when* this or that collapse of a 'system' must begin," that they would prefer instead the approximate formulation that this collapse is now "nearer" than it was before.[498] With respect to Russia's need for an end to the fighting, Lenin chastises the Leftists both for their "ostentatious" phrasemaking and their lack of sympathy for the "toiled and exploited masses" who have a great "need for respite from war." As a substitute for their vacuous slogans and empty predictions, Lenin advises a pragmatic

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[498] {{76 Lenin,Vladimir Ilich 1968; }} p.7

"calculation of the balance of forces" as they stand *here and now* in the "crux of the present."

Given these polemical remarks that appeal to both pragmatic flexibility and transparency, we are not surprised to find that many aspects of the positive program outlined by Lenin in the remainder of the pamphlet closely resemble the ideas of Neurath and Bogdanov. Just as Neurath described the prevailing market system as "fractured," "wild," and exploitative, Lenin observes the "anarchy" of the capitalist economy, amidst which "vast and widespread profiteering" pervasively fills the void. His proposed resolution to this situation, appropriately enough, is to replace this chaos with a well ordered economic plan, to "calculate and distribute properly." In the spirit of positivism and its passion for gathering data concerning the present state of affairs, Lenin's plan is to be constructed by "explicitly enumerating the state of each element." In place of Neurath's "Great Central Organization," Lenin seeks in his pamphlet to justify the temporary necessity of large scale "state capitalism" in order to facilitate "national accounting and control of production and distribution."

Once again, as in Neurath's work, this period of central oversight and authority is described by Lenin as temporary, as a "complete material preparation for socialism" that will establish "large scale engineering and planned organization" in order to move society through a number of transitional stages, a "series of varied, imperfect, concrete attempts." "Organization and solidarity" would be crucial throughout, and once the widespread masses of society have "become accustomed to observing the elementary conditions of social life without violence and without subordination," once an advanced, popular "economic and moral" cultivation is established, a genuine community will emerge, one governed by Marx's principle of social justice, "from each according to his abilities, to each according to his needs."

Lenin thus shares with Neurath's technological empiricism both a utopian vision and a pragmatic method focused on *planning and solidarity*. Following Bogdanov (at least on paper) Lenin sensibly advices a level of compromise with the former capitalists in an effort to integrate their management skills and advanced cultural and economic knowledge into the movement. Furthermore, with arguments that sound much like Bauer's and even Bernstein's, a kind of ad-hoc pluralism emerges out of Lenin's fully tactical standpoint. He attacks blind dogmatism, criticizing the Leftists for "devoting more effort to learning by heart and committing to memory revolutionary slogans than to thinking them out." And in "What Is To Be Done,?" Lenin writes that one should not confuse the recognition *in principle* of all means of struggle, all plans and methods, provided they are expedient, with the demand to be guided at a *given political moment* by a strictly pursued plan." Both *pluralism and resolve* are supposed to inform the "crux of the present situation" according to Lenin, and we thus find a (potential) point of reconciliation of the debate between "revisionism" and "dogmatism." In the following section, we will briefly consider the historical consequences of the failure to pursue this reconciliation, i.e. of the continuing opposition of resolve to freedom and pluralism, and the eventual suppression of the latter.

4.6 *Pravda* and *Novaya Zhizn*: "Truth" vs. "The New Life"

A reconciliation of the alleged dispute over the basic elements of socialism, i.e. daily struggles and progressive reforms vs. self-conscious transformation and theoretical vision, might have been pursued through a shared commitment to education, planning, and solidarity. However, similar to Lenin's caricatured conception of "fideism," his portrait of "revisionism" was misleading, overstated, and very influential. In both cases, a potentially fruitful collaborator was turned into a straw man, and in the process Lenin's own positions, "philosophical materialism" and "orthodox Marxism," assumed more one-sided, dogmatic forms- forms unlikely to benefit the cause of popular emancipation. We will now very briefly consider some possible historical consequences of Lenin's rejection of pluralism and its political analogue, "free criticism," from the point of view of a number of leading positivists and pluralists with direct ties to Mach and Bogdanov.

For Lenin, "free criticism" was nothing but a "fashionable slogan" of the revisionists, and moreover a potentially harmful innovation linked to other exploitative freedoms, such as those of "free trade" and the "free market." Lenin rejected the claim that open dispute within the socialist movement was acceptable since all were ultimately working "for the class interests of the proletariat and its class struggle for political and economic emancipation." On the contrary, he claimed that such criticism would “destroy solidarity,” deterring the movement from the “way of struggle” and towards the “way of conciliation.” When certain reformers demanded the ability to criticize freely without the restraint of “party bonds,” Lenin replied that this was misguided and irresponsible “in a country where 999 out of 1000 people are corrupted to their marrow by political subservience and lack of any conception of party honor and party bonds.” What was needed instead was unity and resolve, the latter described as being “guided at a given political moment by a strictly pursued plan.” Free criticism, which according to Lenin provides no plan of its own, but rather means “freedom from any theory that is complete and well thought out,” cultivates the exact opposite of this resolve, namely “eclecticism and lack of principle.”[499]

For Lenin, no amount of chatter and “phrasemaking” would be sufficient to drive a successful revolution, one which requires a well-defined “revolutionary theory,” indeed an “advanced” theory, i.e. a “tremendous store of theoretical strength” necessary to guide the “vanguard fighters” of the movement.[500] Success and solidarity are all that counts, the encouragement of free and open opposition does not. Lenin makes this clear when he states that “we do not recognize any other point of view than that of the socialist proletarian and its struggle for emancipation.” This struggle is indeed a war, a

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[499] Lenin, *Dogmatism and Freedom of Criticism* in {{63 Lenin,Vladimir Ilich 1970; }} p.56 We recall here Planck’s notion of realism as that of “incessantly striving towards an ideal aim,” and his claim that positivism threatened such resolve with frivolous relativism.
[500] ibid, p.58

war “to defend and expand socialism,” and according to Lenin any such war is not only justifiable, it can be described as a “holy war.”[501]

It is this kind of unflinching resolve that has earned Lenin both praise and criticism, sometimes from the same observer. In his biographical notes on Lenin, Trotsky puts it this way: “It is impossible to sum up a man in one word…But if I were to attempt briefly to define what sort of man Lenin was, I would stress that his whole being was geared towards one great purpose. He possessed *the tenseness of striving toward* his goal.”[502]

Similarly, when Bertrand Russell returned from his visit to the Soviet Union in 1920 and wrote “The Practice and Theory of Bolshevism,” he described Lenin, with whom he met briefly, as an “embodied theory.”[503] Russell meant this both as compliment and accusation. The former shows in his respect for Lenin’s resolve and the effects it seemed to have on the Russian population, who, according to Russell, were handling the hardships that followed the revolution with grit and dignity. He writes of Moscow that “everybody works hard,” and that his “whole impression was one of virtuous, well-ordered activity.”[504] However, along with Lenin’s fierce dedication came, according to Russell, absolutism, the repression of individual freedoms, and, it seemed, the quick re-subjugation of the “masses,” now with respect to the Communist Party.

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[501]{{76 Lenin,Vladimir Ilich 1968; }} p.11
[502] {{66 Trotsky,Leon 1971; }} p.169
[503] {{65 Russell,Bertrand 1954; }} Russell’s point of view is interesting because he, alongside Mach, is widely considered to be one of the inspirations of 20th Century positivism.
[504] {{65 Russell,Bertrand 1954; }} p.56

According to Russell, Lenin's attachment to revolutionary theory made him "narrowly orthodox," and in the course of the October Revolution and its aftermath, Russell claims that Lenin's Bolshevism had become a religion, which is to say "a set of beliefs held as dogmas, dominating life, contrary to evidence, and inculcated by emotion and authority, but not by intellectual means."[505] Within such a context, Russell reports that Lenin had abandoned "the conviction upon which English life had been based since 1688- that kindness and tolerance are worth all the creeds in the world." Russell's reference to English tolerance is in fact quite typical of 20th Century positivism generally, and we can find similar praise of the sober decency of the English people, and indeed of the English language, in the writings of Mach, Carnap and Neurath.[506]

With respect to intolerance, Russell reports that "no independent press was permitted" in the Soviet Union, and that in general Lenin possessed "no love of liberty." With respect to the masses, he writes that "the village peasants complain that they are not at all represented in higher forms of government," and that in fact "all real power rests in the hands of the Party," a total of six hundred thousand persons in a country of one hundred and twenty million.[507] And although Russell is as impressed with the dedication of the

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505 {{65 Russell,Bertrand 1954; }} p.74

506 see for example the *Mechanics,* in which Mach praises the English language for its clarity and lack of unnecessary grammatical contrivances, or in "Orchestration of the Sciences," where Neurath contrasts the English, who are concerned with the "little happiness of all little men in a human environment," and who simply "want their weekends," with the Germans, who are full of "exaltation" and all too often picture themselves as "permanent commanders of guard formations."

507 {{65 Russell,Bertrand 1954; }} p.41

Party members as with that of Lenin, calling them "young, energetic, and capable of command," he sees their situation as one similar to the isolated guardians described by Plato in the *Republic*, and objects to their "lack of consideration for the plebs," a paradoxical attitude for socialist leaders to possess.[508]

Russell's reactions were shared by the famous Russian writer and journalist Maxim Gorky, who Russell actually met with during his trip, and who was a close friend of both Lenin and Bogdanov.[509] During the ongoing and deepening controversy between the latter two men, Gorky sided with Bogdanov for a lengthy period. Gorky was outspoken in his rejection of Lenin's policies that suppressed pluralism and free criticism, and for a while he expressed these views in articles written for *Novaya Zhizn,* ("New Life") the newspaper that Bogdanov founded, Gorky edited, and which was shut down permanently by the Bolsheviks in the summer of 1918 due to its scathing critiques of the regime, and after a long series of polemics with Lenin's own official daily, *Pravda* ("Truth").

After the shutdown of *Novaya Zhizn*, Gorky established his own society for "Culture and Freedom," through which he published a series of essays on the present and future of socialism in Russia entitled "Untimely Thoughts." Within both forums, Gorky attacked Bolshevik repression from the first day. He accused Lenin, Trotsky, and others, of having "no conception of the

[508] Ibid. p.29
[509] For more on Lenin, Bogdanov, and Gorky, see {{73 Sochor,Zenovia A. 1988; }}

freedom of the individual or of the rights of man," of becoming "poisoned with the venom of power" and developing a "shameful attitude towards freedom of speech, the individual, and the sum total of the rights for the triumph of which democracy struggled." Gorky ultimately charged that "Lenin's attitude towards free speech is no other than that of tyrants and other half-humans." He declared that "we struggle for the freedom of speech in order to speak the write the truth."[510] Regarding the freedom of the press, Gorky described Bolshevik restrictions as "physical coercion…unworthy of democracy." In general, he compared the silencing of opposition in 1918 to that committed by the tsars before the Revolution, asking if "Lenin's government, as the Romanov government, does not seize and drag off to prison all those who think differently."

With respect to a constructive vision, Gorky's ideas about promoting culture echoed those of Mach, Bogdanov, and Neurath. Rejecting an excess of vague and polemical, political writings, Gorky argued that Russians did not need to be exposed to "scholastic exercises in word mongering," but rather should be provided with "instructive books" concerning "women's rights, America, fighting syphilis, migration laws, etc." In general, Gorky followed Mach and Bogdanov in emphasizing intellectual and moral development, particularly through the cultivation of the sciences and popular scientific education. Gorky was committed to establishing a "scientific community" in Russia, and he celebrated, along with Bogdanov, the establishment of the

[510] {{64 Gorky,Maksim 1995; }} p.97

"Free Association for the Development and Dissemination of the Positive Sciences"

These brief comments are not meant as an attempt to reduce the extraordinarily complex history of the early Soviet Union to the philosophical question of one-sided, conceptual oppositions. In fact, in a well-known letter to Gorky, Lenin asserted that such philosophical arguments and disagreements should not be used to create real rifts in the social-democratic movement, weakening its essentially "practical and political" aim, concluding that "to hinder the application of the tactics of revolutionary Social-Democracy in the workers' party for the sake of disputes on the question of materialism or Machism, would be, in my opinion, unpardonable folly."[511] Despite these remarks, however, such rifts became real enough historically, and the goals of our discussion of Lenin were (1) to review the role that Mach's ideas played in the surrounding debates, especially with respect to Lenin's attacks on "idealism," "fideism" and "revisionism," (2) to suggest that the metaphysical debate over the former is actually focused on the ethical-political questions of sobriety, resolve, and pluralism, and (3) to show how metaphysical and epistemological questions in the philosophy of science are related to these latter issues, and to suggest that one-sided rejections of pluralist, 'positivist' positions can lead, for example, to the endangerment of free expression.

In general, the late 19th and early 20th Century witnessed numerous attempts to "go beyond" metaphysics. Many diverse thinkers praised praxis

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[511] *Lenin Collected Works*, Progress Publishers, 1972, Moscow, Volume 13, pages 448-454

and progress, claimed to "serve life" and value action, observation, and experimentation over scholastic contemplation and accepted values. How then were the types of one-sided disagreements described above possible? How did "materialism," a supposedly emancipatory position, become the ideological foundation of a society exhibiting as sharp a distinction between the few and the many as any that came before it? We have just considered, as a partial response, the historical, political legacy of the abandonment of pluralism and free criticism included in Lenin's caricatured polemic against "revisionism." We will now make some brief suggestions concerning the consequences of the other major aspect of Lenin's opposition (which sets socialist theory against practice) for the history of the intellectual debate over social progress in Western Europe and America.

4.7 Observation, Reflection, and *Intervention*: Physicalist Sociology "vs." Critical theory

In "Horkheimer and Neurath: Restarting a Disrupted Debate," John O'Neill and Thomas Uebel provide an excellent historical account of the rift between logical empiricism and "critical theory" that took on a definitive form in the late 1930's and which is still relevant today (for example with respect to the much maligned though still influential distinction between "analytic" and "continental" philosophy). O'Neill and Uebel take as their focal point Volume 6 of the *Journal for Social Research*, the house journal of the *Institute for Social Research,* which was led at the time (1937) by Max Horkheimer, and which later became known as the Frankfurt School of Critical Theory. This particular volume is interesting in that it contains of a kind of philosophical ambush. Otto Neurath, representing the Vienna Circle, had enthusiastically accepted an invitation from Horkheimer to contribute to the journal, sending in an "unassuming" critique of prevailing methods of determining the standard of living, one consistent with his longstanding, pluralist attack on purely monetary economic calculations described above. Neurath had been excited at the prospect of collaboration between logical empiricism and Horkheimer's group, and so he was "rendered speechless" when he read Horkheimer's own contribution to Volume 6, a "savage critique of positivism" entitled "The Latest Attack on Metaphysics." The content of this polemic, as well as the subsequent fate of both sides of the conflict, help illustrate the effects of polemics within socialism that, like Lenin's, (dubiously) oppose theoretical to practical work. However, in order to fully understand them, we must first, following the lead of O'Neill and Uebel, examine the early context of agreement and potential reconciliation between logical empiricism and critical theory.[512]

O'Neill and Uebel divide Horkheimer's work into stages, and they emphasize that it is only in the second stage that his critical theory begins to identify itself, and indeed to *define* itself, as "anti-positivist," i.e. as committed to securing an autonomous role for "reflective" philosophy over and above the

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[512] For the remainder of this section "logical empiricism" will also be used as a broad proxy for those positions which we have described as biological empiricism and technological empiricism.

"technocratic," "instrumental," "uncritical" work of the Vienna Circle. Before this, however, throughout the 1920's and the early 30's, they describe Horkheimer's project, with its significant indebtedness to Marx, as a kind of "interdisciplinary materialism," one that possessed "many actual and potential points of contact" with the "radical physicalist sociology of writers like Neurath." Engaging in a mix of philosophical criticism and empirical social-scientific research, the early Horkheimer, like Neurath, rejected metaphysics, and was skeptical of all "statements that attempt to embrace all reality." Instead, seeking to expose and remedy specific injustices existing in the current society, to provide immediate sympathy and relief, Horkheimer recommended as the starting point of materialist social philosophy the *fact* of widespread "deprivation and humiliation."[513] He thereby stressed knowledge and intervention in the here and now and rejected every attempt to "turn man's attention to a supposedly more essential order," to potentially justify the suffering of individuals (and exploited groups) through appeals to a transcendent reality. O'Neill and Uebel point out the affinity here with Neurath's own guiding commitment to politics on "the earthly plane." Given this apparent agreement with respect to the basic "elements" of social philosophy (as well as Horkheimer's early flirtation with "an empiricist criteria of cognitive significance") we should not be surprised to find out that as late as 1929 Horkheimer was in the process of writing his own extended response

[513] John O'Neill, Thomas Uebel (2004) "Horkheimer and Neurath: Restarting a Disrupted Debate" European Journal of Philosophy 12 (1), 75–105.

to *Materialism and Empirio-criticism* in which he too defended Mach against a series of Lenin's charges.

The early Horkheimer was thus in broad agreement with Neurath's understanding of Marxism as a form of social Epicureanism. Representation and intervention, social philosophy and sociology, are united in a common mission to ease suffering in the present, and to promote the social conditions conducive to, as Neurath put it, "happiness, friendship, life as it is really lived on Earth."[514] Such a view requires no distinction between philosophy and science, and in fact frowns upon any such division as vacuous. This is no surprise with respect to Neurath, who, as we have seen, denied throughout his life that there is such a thing as "philosophy with its own special statements," but given Horkheimer's later position, which we will now turn to, it is important to remember that as late as the early 1930's he wrote that "materialism requires the unification of philosophy and science."[515]

Horkheimer's change of position, and the resulting rift between the Vienna Circle and the Frankfurt School, was announced most clearly in two articles written for the Journal for Social Research, "The Latest Attack on Metaphysics" and "Traditional Theory and Critical Theory." As these titles suggest, these essays reject some of the most important principles of Horkheimer's former "interdisciplinary materialism," including his anti-metaphysics and his belief in the unity of philosophy and science. According

[514] Ibid. p. 86
[515] Ibid. p.87

to O'neill and Uebel, the second stage of Horkheimer's thought is based upon an attempt to cordon off an autonomous task for critical philosophy, namely the "comprehension of social totality." Far from being unified with empirical research, philosophy now takes an often adversarial stance with respect to natural science, in particular to its function within industrial, capitalist societies. It is within this context that Herbert Marcuse calls for the emergence of a "new science," one that regards nature as "a totality of life to be protected and cultivated."[516]

Furthermore, no longer faced with the burdens of empirical control, Horkheimer and company's search for the "comprehension of social totality" leads them towards more and more esoteric, apolitical pursuits, seeking to become "mankind's memory and conscience," and adopting the task of "calling things by their proper names." Such aims result in works such as Horkheimer and Adorno's "Dialectic of Enlightenment," which attempts to predict the collapse of bourgeois civilization based on the "indefatigable self-destruction of enlightenment."[517]

Horkheimer bases his claim to a special task for an autonomous, "critical" philosophy on its deployment of a unique method, namely "reflection." Therefore, in conducting his self-definition, he is forced to show that other brands of *scientific* philosophy do not have recourse to this powerful tool; he is forced, like so many before him, to become "anti-

[516] Ibid. p. 94
[517] Ibid. p. 90

positivist." And so the charges that Horkheimer brings against Neurath et al., which unfortunately continue to have an enormous influence on the general reception of logical empiricism even today, follow along these lines, describing their work as shallow, "uncritical," "unreflective," and "incapable of distinguishing between accident and essence." This inaccurate caricature reminds us of Lenin's dispute with the "revisionists." In that case, an alleged dearth of theoretical vision and self-consciousness was associated with a failure to emphasize the "ultimate aim" of the movement, an ultimate aim which was subsequently used to conceal and sanction tremendous cruelty. Now, farther away from the Revolution and the front lines of the movement, the emphasis is on "reflection," and we will make some suggestions below about the possible subsequent consequences of such a one-sided emphasis.

Let us take a brief look at Horkheimer's charges, as well as the relatively simple and powerful responses which O'Neill and Uebel provide on behalf of Neurath. On the issue of accidents and essences, Horkheimer claims that the positivist reliance on observations alone makes them unable to describe the deeper cause and nature of certain social realities. According to Horkheimer, we might, everyday, be walking around "systematically unfree and deceived," and the "fact-finding mechanism of science" would be none the wiser. We might recall here the declaration of Husserl in the *Crisis of the European Sciences*, another work with traces of anti-positivism, to the effect that “merely fact-minded science makes for merely fact-minded people.”[518] Horkheimer provides another illustrative example when he reminds us that “the vivisector can change appearances of suffering by cutting the vocal chords of animals so that they cannot express their pain,” thereby rendering the empiricist, who does not “go beyond experiences…blind to what is taking place.”

In response, O’Neill and Uebel remind us that Neurath (like Mach) advocates a “robust” version of empiricism, one willing to make inquiries into the “powers,” “capacities,” and “natures” of things, so long as these investigations are “open to empirical control.” Furthermore, in direct reply to Horkheimer’s vivisection example, Neurath reminds us that there are indeed differences in the “appearance” of an animal whose vocal chord has been cut, but that these differences might not be noticed by the untrained eye. He thus makes the all-important (if not painfully obvious) distinction between superficial and trained, incisive observation, and asks if in deciding the question of the animal’s condition we would prefer to rely on an empiricist trained in veterinary surgery or a critical philosopher schooled in reflective dialectics. If the point of Horkheimer’s objection is that people generally require more training and awareness, then there is no reason to suppose that Neurath would not immediately agree to the need for skilled and dedicated ecologists, neurologists, criminal and developmental psychologists, structural

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[518] Husserl presents an interesting, analogous case here, since in his early days he too was closely associated with Mach and with positivism, and had admitted that his “phenomenology” in many ways grew out of Mach’s “phenomenalist” position.

engineers etc.. If, however, the goal is the development of a special branch of knowledge whose task it is to make broad, unverifiable statements concerning the "social totality" with little or no policy handle, then we can assume that he would be skeptical and uninterested.[519]

With respect to Horkheimer's claim that logical empiricism was "unreflective and ahistorical," was incapable of assuming a "critical stance" towards society, and in particular of seeing science as a tool of ruling interests, O'Neill and Uebel respond that Neurath's notion of the "scientific world-conception" described precisely the kind of comprehensive, reflexive standpoint from which science could evaluate itself with precision and circumspection. We recall the work in the sociology of science conducted by Neurath, Zilsel, and many others, work which sought to *demonstrate* the "strong social element of determination behind scientific belief." Far from a rigid view of an apolitical, rational science progressing in isolation, Neurath emphasized the role of historical circumstances on scientific knowledge and indeed even stressed their ability to alter our basic observations themselves as expressed in the stock of so-called "protocol sentences."

To fabricate caricatures and terminate dialogue is to tempt the emergence of those caricatures in real life. This is precisely what we find in the case of the break between critical theory and logical empiricism. Instead of building upon their initial common ground, i.e. the amelioration of everyday

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[519] If by "essence," however, we mean the development of human potential in the context of a virtue or perfectionist ethics, as Marcuse often discussed the problem, then there indeed might be grounds for a dispute with a more Epicurean position. This type of ethico-aesthetic question, however, lies outside of our scope, and would be more appropriate to a comparison of Mach and Nietzsche, for example.

human suffering through coordinated research and intervention “on the earthly plane,” they allowed a fruitless rift to develop over the relative importance of theoretical “reflection” and direct observation. What followed was the isolated development of each side without the crucial input and constructive criticism of the other. In time, both ‘stepping back’ (reflective self-consciousness) and ‘squinting’ (anti-metaphysical observation and, later, ‘analysis’) strayed into one-sided excess.

On the one hand, O’Neill and Uebel report on the descent of critical theory, now completely “removed from the practical sphere,” into “conservative political quietude and pessimism.” And indeed, even in those instances in which critical theorists have attempted to take an active part in contemporary affairs, for example with Marcuse’s proposal of a new, “pacified science,” or Habermas’ descriptions of ideal communicative institutions, these visions have remained “opaque” and rather impractical in the absence of robust, technically-informed contributions from frontline investigators of scientific and political practice. The ‘step back’ taken by many contemporary philosophers is simply too great.

On the other side, if only in passing, O’Neill and Uebel describe the sad fate of logical empiricism, especially in America, where it took root after many of its leading proponents were forced to flee Europe. Having begun as a dynamic and socially conscious movement for the extension of enlightenment against the forces of ideology and injustice, in time the “philosophy of science” (as it came to be known, and later “analytic philosophy") took on many of the same characteristics which Horkheimer had falsely attributed to its predecessors. By the 1950's "logical empiricism had lost even the mediate concern with the socio-political dimension of their Enlightenment heritage which had been critical to its founders in Vienna."[520] Lacking spiritual renewal, squinting at injustice quickly became scrutinizing symbols and their arrangements.

4.8 Conclusion

Almost all of the thinkers whose work we have examined so far- e.g. Mach, Lenin, Marx, Neurath, Bogdanov, Gorky, and Horkheimer- were explicitly committed to popular emancipation and socio-economic progress. Their vision of justice was consistent with the aim, prevalent in modern philosophy since the Enlightenment, of dissolving "the masses" in a bid against nationalist ideology, religious demagoguery, and economic exploitation. Despite this agreement, however, we uncovered an alleged dispute over method. On the one side, what was stressed was revolutionary theory, or, in the absence of a revolution, a sort of highbrow cultural criticism. On the other side, the focus was on public health and education, as well as progressive labor reform. The former camp stressed *self-conscious conversion*, utilizing world-historical analysis to expose the still incomplete projects of freedom and justice in the present, and to awaken the masses to a

[520] John O'Neill, Thomas Uebel (2004) Horkheimer and Neurath: Restarting a Disrupted Debate European Journal of Philosophy 12 (1), 75–105.

sense of that dignity which they are thus denied. The later camp stressed *conscious activity*, utilizing pluralistic criticism of prevailing mechanisms of production, distribution, accounting, and reporting to reveal an open and transparent platform upon which a new order could be freely constructed.

Nothing could be more obvious than the necessity of both sides to any successful movement for social progress, and it is clear that in the work of the most comprehensive thinkers, for example in Marx himself, such a unity was emphasized and maintained. It was only in the 20th Century that one witnessed the "parting of the ways" between positivism, phenomenology, and critical theory.[521] The unified campaign against "metaphysics," meant in all cases to emphasize the *elements* of the present, fragmented and became metaphysical once again when it became clear that the present itself possessed a plurality of elements. Instead of holding together theory, observation, ethical-aesthetic development and scientific candor, groups formed themselves, resulting in one-sided philosophies and ultimately in a series of injustices on a scale never before known. The full spectrum of unjust behaviors, from cruelty to frivolousness, was summoned, and thus the 20th Century, far from an age of popular emancipation or continuing enlightenment, became the age of the destroyed and destroying masses.

It is perhaps in response to these abuses to dignity that the philosophy of science has, to a certain extent, abandoned politics over the last fifty

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[521] The phrase is borrowed from Michael Friedman's book, which focuses on the rift between "positivism" and "phenomenology" {{80 Friedman,Michael 2000; }}

years.[522] This aim has been unsuccessful for two reasons. First, there is no way to convincingly disassociate questions of knowledge, reality, human nature and truth from those of fairness, freedom, education and community. Silence on these issues is itself a statement of passivity and thereby a tacit acknowledgement of the status quo. Secondly, in the absence of a conscious awareness of the history and the historical purpose of metaphysics and epistemology, many contemporary thinkers have fallen into the same one-sided positions, and thus the same fruitless controversies, of their predecessors.

This dissertation has outlined a number of deeply related standpoints, namely biological empiricism, technological empiricism, and social democratic philosophy of science, all of which offer a vision of a philosophy of science deeply concerned with issues of human welfare and social justice. Each is connected, both historically and conceptually, to the work of Ernst Mach, and we have attempted to show how each is able to overcome traditional oppositions in metaphysics and epistemology, for example those between materialism and idealism, and realism and positivism. In their promotion of translation and collaboration between the scientific disciplines, their emphasis on the scientific representation of and intervention within both the sphere of the organic and the socio-economic sphere, and their related focus on the ethical values of sobriety, sympathy, and solidarity, the thinkers described

[522] There are of course notable exceptions, for example the writings of John Dupré or Phillip Kitcher. The latter laments the move of the philosophy of science away from political questions over the last 50 years in his {{113 Kitcher,Philip 2001; }}

above demonstrated their commitment to a particular type of connection between scientific knowledge and enlightenment. Indeed, to the extent that research and policy programs in, for example, climate science, urban development, cognitive neuro-science, and public health have recently been receiving increasing attention, it seems that their vision of that connection is shared by many scientists and observers of science today.

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