

Some remarks on Mach's philosophical doctrines

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1

If we take seriously the idea that humans are part of the natural world, that their capacities were fashioned in the constant struggle for survival and reproduction, then the whole body of their practices must be thought of as a product of their practical engagement with the material environment. Occasionally practitioners of different disciplines might entertain a pleasing thought that their own activities pursue more elevated goals. Truth and beauty would be among the most prominent candidates. It is entirely plausible that people can be motivated better to engage in science and art by setting themselves goals couched in those nobler terms. While this is never more than a pretence, it can lead to a false speculation. A critical reflection on the nature of a particular practice should be able to reveal its roots and do away with the metaphysics born out of excessive ambition.

2

Take literature. Save for a few genres on its extreme fringes, no writer and no poet would think of its output as having primarily a practical purpose, or any practical purpose at all. Writers write simply because they have an irresistible urge for writing, or perhaps because they are driven by the desire to discover the 'logic of life', as Marquez put it. Regardless of the individual inclinations of the writers, the readers do not normally approach works of prose and poetry with a hope of being taught how to solve practical tasks in their lives. Aesthetic curiosity and aesthetic pleasure, the desire for aesthetic education, are their more usual motives. In what sense, then, can we talk of literature being practical? Perhaps in this: as the modern sophisticated genres evolved from ancient storytelling, they share among them the purpose of delivering pleasure to the readers. In turn, our capacity to derive pleasure from storytelling evolved to promote bonding between members of the community. Certainly, hardly any literature practitioner, a reader or a writer, is expected to approach novels and poems with the aim of bonding with his fellows. No matter: literature as a cultural component came to occupy its place due to its bonding capabilities. And it will cease to be a cultural phenomenon as soon as it stops playing that role. This is its ultimate cause, and it acts as a constraint on the practice of that particular activity. The individual attitudes of its practitioners are the proximate causes of the continued practice of literature. They need not be reduced to the ultimate ones.

3

The scientific enterprise can be subjected to the same examination. The activity of science, so far as it can be located within a natural history of mankind, should be assigned practical goals. Indeed,

it will be assigned the pre-eminent such goal, physical survival. Scientific activity, at its origins, has the purpose of recording and processing observations in the most efficient way, its efficiency judged by the contribution it makes to our survival. It really goes all the way down to our most basic capacities for interaction with material environment. Our minds are bombarded with different sensory impressions, coming in different shapes and colours. It is an elementary scientific activity undertaken by our minds to isolate similar impressions to form a conception of a material body. Instead of recording the similar manifold impressions we experience on two different occasions, we simplify the task by labelling them 'the body X'. No longer do we need to track the similarity of those temporally separated sets of impressions, and a major economy of effort and notation is the obvious benefit.

There is more to come. Survival is not served until prediction is mastered. Discovery of regularities, assisted by observation and memory, is a starting point for the formulation of natural laws. Of course the idea that there can be a real repetition of events is fanciful. All events are unique. We pretend that there are event-types only because we choose to attend to some aspects of their similarity, while our choice is in turn guided by practical concerns. In any case, in formulating laws we simply record our observations in abbreviated form. Our expectations will accordingly be preserved in thought with a lesser effort. And moreover, few of our predictions are of our own making. Most are the product of learning and instruction. Formulating natural laws enables communication between individuals, a vital condition of survival.

As with literature, science satisfies intellectual curiosity. First there is the desire of knowing the nature of the world we live in, the what-question. And then there is also the desire for explanation, asking and answering why-questions. Two obstacles apparently stand in the way of satisfying both desires. On one hand, the external bodies are constructions of our own thought. On the other hand, we do not have any insight into the relations in the world external to our senses. But we have to ask the right questions. Once the description of the fact has been provided, in all of its relevant particularities, there is nothing more to say about what there is. To say what an earthquake is is to assemble in thought all the different experiences associated with an earthquake. More precisely, and even more radically, the term 'earthquake' stands for all of these experiences. To explain an event is not to identify its causes, some other events located in the external world. It is to derive the ideas representing these events from other ideas. Which ideas will perform the explanation? Those that are experienced with greater constancy—that is, those that are experienced on a greater number of occasions. These ideas at the same time are also more familiar to us. In explaining the unfamiliar is replaced with the familiar.

4

I hope you have recognised in the above brief remarks a partial reconstruction of some of the threads of Mach's reasoning. There are some very intriguing suggestions here, explored in later discussions in the philosophy of science. Among them is the idea of explanation as reduction to the more familiar phenomena, and the idea of explanation as unification. I do not want to dwell on these subjects here. Instead I propose to look at the larger doctrines embraced by Mach. Here is a

summary:

Economy of science. The primary, perhaps the only legitimate goal of scientific theories is to achieve the economy of thought. Instead of recording many facts, science codifies them under the heading of laws. Instead of attending to individual diverse sensations, science postulates the existence of bodies:

It is the object of science to replace, or *save*, experiences, by the reproduction and anticipation of facts in thought. Memory is handier than experience, and often serves the same purpose. This economical office of science, which fills its whole life, is apparent at first glance; and with its full recognition all mysticism in science disappears.

Science is communicated by instruction, in order that one man 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. (*Science of Mechanics*, 481)¹

The grandest principles of physics, resolved into their elements, differ in no wise from the descriptive principles of the natural historian. The question, “Why?” which is always appropriate where the explanation of a contradiction is concerned, like all proper habitudes of thought, can overreach itself and be asked where nothing remains to be understood. (*On the Economical Nature of Physical Enquiry*, 199)²

Evolutionism. A man is a biological product of evolutionary development. Human activities must ultimately be understood in terms of Darwin’s theory. And not only human activities: history of knowledge and of ideas is only intelligible by the lights of evolutionary theory:

For the human being, with his thoughts and his impulses, is himself merely a piece of nature. (*Analysis of Sensations*, 334)³

Man is governed by the struggle for self-preservation: his whole activity is in its service and only achieves, with richer resources, what the reflexes accomplish in the lower organisms under simpler conditions of life. Every recollection, every idea, every piece of knowledge has a value originally only in so far as it directly furthers man in the direction indicated. (*Wärmelehre*, 336)⁴

[K]nowledge, too, is a product of organic nature. And although ideas, as such, do not comport themselves in all respects like independent organic individuals, and although violent comparisons should be avoided, still, if Darwin reasoned rightly, the general imprint of evolution and transformation must be noticeable in ideas also. (*On Transformation and Adaptation in Scientific Thought*, 217–218)⁵

¹Cited from Mach (1919).

²Cited from Mach (1898).

³Cited from Mach (1959).

⁴Cited from Mach (1986).

⁵Cited from Mach (1898).

Phenomenalism. Sensations are denizens of the world, whereas bodies (material substances) are symbols constructed in thought, chiefly to serve the purposes of economy:⁶

Nature is composed of sensations as its elements. Primitive man, however, first picks out certain compounds of these elements—those namely that are relatively permanent and of greater importance to him. The first and oldest words are names of “things”. (*Science of Mechanics*, 482)

[B]odies or things are compendious mental symbols for groups of sensations symbols that do not exist outside of thought. Thus, the merchant regards the labels of his boxes merely as indexes of their contents, and not the contrary. He invests their contents, not their labels, with real value. The same economy which induces us to analyse a group and to establish special signs for its component parts, parts which also go to make up other groups, may likewise induce us to mark out by some single symbol a whole group. (*On the Economical Nature of Physical Enquiry*, 201)

[T]here is no such thing as a specific *electrical* fact, that every such fact can just as well be regarded, for example, as a chemical one, or as a thermal one, or rather that all physical facts are made up, in an ultimate analysis, of the same sensuous elements (colors, pressures, spaces, times), and that we are merely reminded by the term “electric” of that particular form in which we first became acquainted with the fact. (*On the Economical Nature of Physical Enquiry*, 168)

At the first sight, these views appear to be in harmony. The thesis of economy fixes the essentially practical goals of science. Theories are charged not with discovering entities in the external world or worldly relations, but only with assisting our activities. That this should be the case is strengthened by reflections on the genesis of knowledge. Human theorising emerged as an instrument for self-preservation. Human species honed their intellectual tools in order to better adapt to their environment, to survive and reproduce. As for phenomenalism, we find no evidence for the existence of substances. Our experience furnishes us only with sensations. Yet the introduction of substances has its salutary role in aiding the economy of thought.

On a second look, things are a little more complicated than that. Begin with evolutionism. Why should anyone, at the end of the nineteenth century, accept Darwin’s theory? Not because it congrues with one’s ordinary experiences. If anything, ordinary experiences tell against it. When originally proposed, and at the time of Mach’s writings, very little concrete evidence could be cited in its support. Rather, the reasons for its acceptance were for the most part pragmatic: better explanations, increased generality, greater simplicity. Mach, on the other hand, is on most occasions content with assuming, enthusiastically so, the truth of Darwinism. This acceptance—e.g., in the *Analysis of the Sensations*—is essentially naturalistic. By the end of the nineteenth century the

⁶Recent scholarship has largely challenged the attribution of phenomenalism: see, e.g., Banks (2014). I recognise the force of its arguments, but remain unconvinced. The least one can say, it seems to me, is that there are many passages in Mach that one would expect to find in Berkeley. It is true that Mach explicitly denied the affinity with Berkeley in Mach (1891), but the denial is as passionate as it is cryptic. At all events, the present discussion proceeds on the assumption that phenomenalism, broadly conceived, can be ascribed to Mach. The assumption, I think, even if stands in conflict with *some* of Mach’s claims about sensations and complexes, is not altogether fanciful.

theory of evolution has come to dominate the field of biology. Mach simply follows the practitioners of the discipline in endorsing its leading theory.

The case is very different with the thesis of the economy of science. Though discussed on several occasions, notably in the *Science of Mechanics* and in the *Popular Scientific Lectures*, it receives hardly any substantive defence. And what kind of defence would be possible to offer even in principle? It is not a scientific claim: the economy of physics or mathematics cannot be established by mathematical or physical means. It is a meta-scientific, methodological claim. But is it empirical or normative? If it is a merely empirical claim, then we have to turn to the history of science to substantiate it. It is very unlikely though that every scientific enterprise was deliberately created with the purpose of 'economy'. Much more plausibly, the claim is a normative one with a direct link to evolutionism already sketched. Man is part of organic nature. Human knowledge evolved as an adaptation to assist people in improving their biological fitness. Ease of expression, efficient management of experiences contributes to achieving that purpose. Relative to this purpose it becomes a norm.

One immediate problem with this conclusion is that it relies on a rather narrow understanding of fitness. Bonding, curiosity, honour, pleasure, fighting boredom are other factors capable of improving fitness. Scientific activities can and indeed do play a role in each one of them. It is not clear why economy of thought must be given an overriding significance.

There is another concern too: it seems we are moving in circles. We adopt the evolutionary approach guided by the principle of economy. But that principle itself is defended by appeal to the workings of evolution. The authority of the evolutionary knowledge is as strong as any other theory's authority, that is, it is evaluated by its success in the economy of thought. The latter criterion of success is established by tracing the evolutionary origins of science, and the circle resumes. The circularity is damning only if we hope to cling to some one fixed principle arrived at by pure speculation. But if the hope is abandoned, the circularity is virtuous and necessary. I return to this issue in §9.

5

Turning to phenomenalism, one argument given by Mach (and strongly reminiscent of Berkeley) is the rejection of the distinction between primary and secondary qualities. Mechanical physics, as well as mere 'habit', incline us toward believing in greater permanence and higher reality of spatial and temporal relations, as compared to odours, sounds, and colours. But a proper analysis of the physiology of perception should dispel the illusion of ontological difference: spatial and temporal relations are sensations no less than colours and sounds are.

Notice two features of this argument. First, it ensures that the most fundamental intellectual curiosity will never be satisfied. We do not only want to manipulate the environment we are in. We do not only want to have an elegant and efficient arrangement of our sensations. We also desire to know where the sensations come from. The discovery of their source will never be warranted either by reason or by senses. Hume welcomed this conclusion, while Berkeley escaped it at the cost of arbitrary theology. Mach believes that nothing is left to explain when the most complete

description of fact is given and the economy of thought is achieved. But one is left wondering whether this misses the point.

Secondly, we observe that science, along with mathematics, uniformly adopts realist vocabulary. Then, if phenomenalism is correct, much of science, perhaps all of it, when taken literally is in error. What conclusion are we supposed to draw from this fact? One might propose to reform scientific discourse based on his own metaphysical preferences. Physical theories, for them to be true, will no longer speak of bodies. Their statements will have to be paraphrased into statements about complexes of sensations. We are in the terrain of the *Aufbau*, and one supposes the project will not carry us very far.

I did not see evidence that Mach himself would be sympathetic to this strategy. And there is, I think, no reason for him to be so sympathetic. If science's purpose is to serve the economy of thought, if its purpose is essentially practical, why should there be a *concern* about the literal truth of scientific statements in the first place? Science emerges as an especially effective way of arranging our interactions with external reality. It is not a way of discovering what that reality consists in. Nor is it even a way of tracking our sensations. Its ultimate all-justifying purpose is in improving our chances of survival.

6

The proposal, then, is to approach science as craftsmanship, as skill. Whatever gets the job done is legitimate. There is no other source of legitimacy. But there are signs that Mach did not take up this proposal. At the heart of his critique of various branches of science, notably mechanics and thermodynamics, is the conviction that metaphysical notions should be cleared away. The Newtonian concept of mass, for example, is said to be not properly based on experience: the 'quantity of matter' used in its definition is obscure. And absolute time is dismissed because it cannot be measured by any actual motion.⁷ No indication is given how these notions damage the economy of thought, or how they hinder the practical purposes of physics. More plausibly, the motivation of these criticisms comes from the commitment to phenomenalism, the demand that every fundamental notion is traced to experiences, or sensational complexes.

Similarly with atomism.⁸ Atoms are not constituents of phenomenal reality. As any other theoretical entity, they are convenient symbols useful in the economy of thought, heuristic devices, on a par with mathematical symbols. But they can never be used in explaining psychological phenomena. The reason, as far as I can see, is not in any special disability of the atomic theory in physics and chemistry. It is in the insistence that those 'devices' of physics and chemistry not be used in explaining psychological phenomena. The reason seems to be that, if they are so used, then physics and psychology are of a piece, and reduction is under way—which is unacceptable. This ban on atomism is especially bizarre, since at the same time Mach envisages a future convergence of physics and psychology.

⁷See *Science of Mechanics* II.v–vi.

⁸See *Analysis of Sensations* XIV.1–2 and especially page 313. Mach's engagement with atomism is confusing and multifaceted. See Banks (2003) and Banks (2014) for some details. I only attend to a particular discussion in *Analysis of Sensations*.

Some metaphysical notions, on the other hand, escaped the purge. The concept of material body was admitted, as was the concept of cause.⁹ Presumably the reason was that, while they failed the strictures of phenomenalism, they could still be paraphrased into a language meeting those strictures. But would such a paraphrase be necessary? If the economy of thought is served by a theoretical discourse containing reference to bodies and causes, this discourse should be admissible. We should not be reminded of the possibility of paraphrase, and we should not care about it, since from the outset we do not approach our theory as a source of knowledge of what there is. We approach it as a useful instrument in bookkeeping, with the ultimate goal of aiding our survival.

With the same sleight of hand the previously purged Newtonian concepts, as well as ‘atom’, should also be restored. If the complaint were about their bungling of our experiments or about some other undesirable *practical* consequence ensuing from their use, then fair enough. But the complaint does not seem to be about these matters, or if it was, it was never sufficiently developed.

7

On a very central issue, phenomenalism leaves our curiosity unsatisfied. As phenomenologists, we begin with sense-data, with introspective examination of our phenomenal experiences, and we further insist on the irreducible reality of the content of these experiences (that is, sense-data, sensations, or ideas). *But we cannot stop there.* We must recognise the existence of some other kinds of entities beside the phenomenal content. This move is very clear in Berkeley. Ideas do not generate themselves. They come from some independent source. So we have to postulate the existence of minds, whose sole function intelligible to us is production of ideas.

Berkeley’s testament was a grand mystery. We can investigate the relations of ideas with other ideas. The operation of spirits, however, is unfathomable, beyond the scope of any human enquiry. It is peculiar how we can be absolutely certain of the existence of spirits, of their production of ideas, but unable to say anything at all about their ways of existence and operation. This mystery accompanies us daily. We do not need to direct our thoughts to exotic and esoteric questions of the divine intelligence: our own minds are destined to remain locked from us forever.

Does Mach allow a similar mystery? It seems so. Indeed, there is not one mystery, but several. In the first place, his putative version of phenomenalism simply leaves out the question about the origins of sensations. Matter is not such an origin, since it is nothing but a symbolic construction of our thought.¹⁰ And if not matter, it is hard to see what else it could possibly be, given the positivist tenor of Mach’s theorizing.

Whatever the origin of sensations, can we at least investigate the workings of our brain with the methods of physical science? The aim of every science, physical or psychological, to serve the economy of thought. One thinks that physical methods at least might, one day, be proven useful in describing neurophenomena. Not so, Mach sternly warns us. The methods of physics are to be restricted to the domain of physics.

This situation is ironic. It is ironic, first, given Mach’s own critique of Newtonian physics. A

⁹See, e.g., *Wärmelehre* XXX.

¹⁰See, e.g., *Analysis of Sensations* XIV.14.

major motive of that critique was Newton's ostensible failure to respect the available evidence and his willingness to engage in metaphysical speculations. Of course here the situation initially seems to be reversed: phenomenism pretends to draw its conclusions strictly upon observation. But, in the conflict between a scientific practice and a metaphysical belief, the belief wins. It is also ironic because of the integration of the methods of physics and chemistry in the neuroscience research. Thirdly, it is ironic because of the prominence of the specifically mechanistic explanations in neuroscience.

8

Unrepentant phenomenism, combined with Mach's methodological scruples, produces one other mystery. If man is part of the natural world, and more specifically, of the animal kingdom, then his abilities must be explained in the way continuous with the explanation of the abilities of other members of that kingdom. At the very least this means that his mental abilities are subject to evolution. His consciousness is an evolutionary adaptation, just as any other ability. Presumably, however, all the concepts of the evolutionary theory are there for the economy of thought, not unlike atomistic concepts. Thus, again, they will be deemed inappropriate for the analysis of sensations. We have already been deprived of the physical methods in investigating the proximate causes of psychological phenomena. We are now also deprived of a proper understanding of their ultimate causes, of their evolutionary history.

9

Of the three doctrines mentioned Mach's weakest commitment, judging by textual evidence, is to the theory of evolution. We have now seen how Darwinism may directly clash with phenomenism. Perhaps then we should simply abandon, on Mach's behalf, the commitment to Darwinism. Among other reasons why this should be a bad move I want to highlight this one: Darwinism may offer the strongest support for the thesis of the economy of thought. I have already gestured earlier at the reasons why that might be the case; let me now restate the idea.

All elements of our intellectual life, just like the biological capacities of our organism, are adaptations. Science was not handed down to us: it has evolved with us. If it is an evolutionary adaptation, then what is it adapted for? Not for the discovery of truths about the universe. Rather, it has evolved to endow us with efficient means to increase the chances of survival and reproduction. Viewed under this angle, the alleged theoretical significance of science is moot. Its only significance can be practical. This, as I see, offers the strongest support yet for the thesis of the economy of thought.

But as we saw, this support may be illusory in the first place because of the threat of circularity. The evolutionary theory itself, as any other discipline (save perhaps for psychology), must be justified by reference to the economy of thought. The threat is real only so far as we portray ourselves standing outside the scientific enterprise and surveying its elements from a standpoint immune to scientific conceptions. The truth evidently is, we are not. We are fully immersed: our reasoning, our notions, our very language, are all continuous with science. Methodological maxims

we use in examining scientific theories are themselves products of scientific theories, rather than bits of a priori knowledge. Thus, embracing a full-fledged naturalism, possibly of the Quinean variety, would lift the threat of circularity.

Yet, even with that threat lifted, it is now time to ask the most uncomfortable question of all: what can the thesis of the economy of thought help us achieve? In many instances it is used as a claim in the history of science, necessary to explain the emergence of certain scientific concepts. On other occasions, however, it is used as an anti-metaphysical hammer to crush metaphysical notions. Thus, for example:

[Natural science] has to resolve the more complicated facts into as few and as simple ones as possible. This we call explaining. These simplest facts, to which we reduce the more complicated ones, are always unintelligible in themselves, that is to say, they are not further resolvable. . . . The ultimate unintelligibilities on which science is founded must be facts, or, if they are hypotheses, must be capable of becoming facts. If the hypotheses are so chosen that their subject can never appeal to the senses and therefore also can never be tested, as is the case with the mechanical molecular theory, the investigator has done more than science, whose aim is facts, requires of him—and this work of supererogation is an evil. (*History and Root of the Principle of the Conservation of Energy*, 55–57)¹¹

The normative employment of the thesis of the economy of thought is suspect. Let me circle back for a moment to the example of literature in §2. Literature may have originated in storytelling, and storytelling may have fulfilled a vital task of bringing different individuals, developing their social ties. Conceivably, the essential social purpose of storytelling is what made its institution an enduring mark of every minimally developed culture. Literature, even while emancipated from storytelling, inherited the same function. Its institution continues to fulfil the function of bonding: it creates the common intellectual and emotional frame of reference for otherwise distant individuals within a society.

Some such analysis may be true, but what should it tell us about individual works of literature? Nothing very much. Using it in evaluating those works would be in bad taste. One cannot police literary practice and condemn those works that ostensibly fulfil no social purpose. Grading novels based on the number of readers it ‘brought together’ would reveal an absurd lack of literary education.

By the same token, the economy of thought may have been the function of nascent science, and may continue to be the function of mature science. Unlike the function of literature, and for reasons already mentioned in §4, the function of science might not be a proper subject of an empirical discovery. But even assuming science as an institution to have such a function, one cannot use it for evaluating individual scientific claims. Just like novels, theories should be evaluated by their internal norms. An external norm can be used perhaps in extreme cases when the institution seems to malfunction—when, for instance, science as a whole, for the most part, has become a mere intellectual game. Under those, and only those, conditions a philosophical revision may be

¹¹Cited from Mach (1911). The same claim is in *Science of Mechanics* IV.iv.9.

necessary to redirect science to its original purpose.

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