Science and Human Freedom

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Michael Esfeld
Section de Philosophie
University of Lausanne
Lausanne, Switzerland

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Introduction

The age of enlightenment has two faces. On the one hand, there is the liberation of humankind as expressed, for instance, in Immanuel Kant's (1784) definition of enlightenment as "man's emergence from his self-imposed immaturity".[1] On the other hand, there is scientism, that is, the idea that scientific knowledge is unlimited, encompassing also humankind and all aspects of our existence, as illustrated, for instance, in Julien Offray de La Mettrie's *L'homme machine* (1747). Both have the rejection of knowledge claims of traditional authorities (such as the church) in common. But whereas the former is about giving each person the freedom to take their own decisions, the latter paves the way for assuming that scientific knowledge is in the position to predetermine the appropriate decisions, both individually and collectively.

These two faces of enlightenment can be traced back to antiquity. According to Aristotle's *Politics*, the organization of society is a matter of decisions that the citizens have to take in common deliberation. It is not predetermined by any knowledge. For Plato, by contrast, it is a question of knowledge how to conduct one's individual life as well as society. Consequently, as he sets out in the *Republic*, the philosophers should rule. In modern times, scientific knowledge then takes the place of the

[1] Quoted from Kant (1983, p. 41); "der Ausgang des Menschen aus seiner selbst verschuldeten Unmündigkeit" in the German original.

knowledge of which Plato assumes that it can be acquired by philosophical contemplation.

Accordingly, this book is in the first place about what the scientific image of the world is and what are its limits. Its central objective is to bring out how science makes us free and thereby contributes to the open society (in the sense of Popper's famous book *The open society and its enemies* (1945), which was the first philosophy book that I read). The present book therefore first works out why natural science, through the laws that it discovers, strengthens our freedom instead of infringing upon it; building on this, I will then show why it is wrong-headed to assume that science can give us the norms to design society and our individual lives. This mistake originates in enlightenment personalities such as La Mettrie, it is later implemented in Marxism and it is fuelled today by a misapprehension of the discoveries in physics, evolutionary biology, genetics, neuro- and cognitive science, etc. Giving science such an unjustified power, then, provokes the reaction to refuse recognizing that science discovers truth about the world. Unfortunately, this reaction is also widespread among postmodernist intellectuals. It invites abandoning the demarcation line between fact and fake. It thereby jettisons not only scientism, but also the idea of science contributing to the liberation of humankind.

Consequently, this book shows what is wrong with the widespread claims to the effect that scientific laws (such as, notably, universal and deterministic laws in physics), scientific discoveries (such as, for instance, discoveries in genetics or cognitive science) and scientific explanations (such as, for instance, explanations of human behaviour in evolutionary biology or neuroscience) infringe upon human free will. In brief, in the first place, the ontology of science—that is, what has to be admitted as existing in the world in order to make the truth of scientific theories intelligible—is not rich enough to entitle conclusions to that effect. Moreover, scientific laws, discoveries and explanations are about contingent facts by contrast to something that is necessary (that is, that could not have been otherwise). Most importantly, scientific theories are conceived, endorsed and justified in normative attitudes of giving and asking for reasons that presuppose the freedom of persons in formulating, testing and judging theories. For that reason, persons cannot be subsumed under the scientific image of the world. Hence, science gives us information about the world that can serve as guide for our actions, but not norms, neither for the individual life, nor for society—on pain of committing what is known as the naturalistic fallacy (that is, the attempt to deduce norms from facts). Science makes us free in that it shows that we have the freedom to set up the norms for what to think and how to act—as individuals as well as in societies—, but thereby also the burden of the responsibility for our thoughts and actions.

What is science? At least the following three traits distinguish science from other human enterprises, including other intellectual ones:

- *Objectivity*: What science tells us about the world does not depend on any particular viewpoint. Science is independent of gender, race, religion, or geographical or temporal location. Scientific theories propose a point of view from nowhere and nowhen—although, of course, they have a particular origin; but their validity is independent of that origin. Everybody can become part of the scientific community. There is no Chinese mathematics, physics or biology in contrast to an American one. The same applies to philosophy insofar as it is an argumentative enterprise that strives for knowledge about the world and our position in it.
- *Systematicity*: A scientific theory seeks to represent as many phenomena as possible in terms of as simple a law as possible. Prominent examples are the law of natural selection in evolutionary biology and the law of gravitation in physics. The latter is an ideal example of a law of nature, because it applies to everything in the universe.
- *Confirmation by evidence*: Any claim in science has to be such that it can be confirmed by evidence that is accessible independently of the claim in question. That is, the claim has to allow the derivation of predictions that can be checked without presupposing the claim at issue. For instance, Einstein's theory of gravitation predicts that starlight passing by the sun will be bent by the gravitational field of the sun. This can be observed at a solar eclipse (first done in 1919). The observation of this phenomenon is independent of the theoretical claims of general relativity theory about the geometry of space and time and the behaviour of the gravitational field. As this example

shows, confirmation does not always imply intervention by means of experiments. The crucial issue is observation of new phenomena predicted by and made intelligible by the theory.

Laying stress on these features as characterizing science usually is associated with the stance that is known as *scientific realism*, signifying, in brief, that science reveals the constitution of the natural world. If a human enterprise can achieve that goal at all, only science can do so. This book is committed to scientific realism. The crucial point in our context is that laying stress on these features does not prevent us from acknowledging the limits of scientific explanations and, notably, realize how science makes us free instead of infringing upon our freedom.

In a broader perspective, this book is an essay on the interplay between what Wilfrid Sellars (1962) calls the *scientific* and the *manifest image of the world*. The manifest image is not common sense. It is the philosophically reflected view of the world that puts persons at the centre, taking them to be irreducible to something more fundamental and thus endorsing them as ontologically primitive. Consequently, one does not answer the question of the relationship between these two images by showing how one can explain the familiar macroscopic world on the basis of fundamental physics.

This book distinguishes between three ways how to conceive the relationship between these two images:

1. *The scientific image is complete*: Persons can be reduced to the ontology of science via functional definitions, on a par with everything else that does not figure explicitly in the ontology of science. In the last resort, this is the ontology of fundamental physics. That is to say: the persons that exist in the world are identical with certain specific configurations of matter and their behaviour under certain conditions in the environment. A complete physical description of the world entails also all the true propositions about persons, including the rules they follow and should follow in their thoughts and actions.
2. *The manifest image is complete*: Everything that there is in the world is in some way or other analogous to persons. Scientific theories that abstract from the features that are analogous to persons are only of

instrumental use for efficient predictions. They do not reveal the essence of the world.
3. *Each image captures only a part of what exists*: The scientific image tells the truth about the world when leaving the features that characterize persons aside. These features exist and are ontologically primitive on a par with matter in motion.

Following Kant's enlightenment philosophy and Sellars's call for a synoptic view of both these images, the book argues for a particular version of (3): the scientific image—as well as any scientific theory—presupposes the freedom of persons in forming concepts, building up and justifying theories. However, being a person is not a fact, a property or a substance in addition to the material ones. It is an attitude that one adopts to oneself and others. In adopting this attitude, one brings oneself into existence as a being that creates meaning and thereby rules for thought and action and that, consequently, has to justify what it thinks and what it does.

On this basis, the book argues for a twofold conception of freedom: in the first place, there is freedom in the sense that the laws of science, even if they are universal and deterministic laws, neither predetermine our motions, nor the motions of any other objects. First comes the motion of matter, then come the theories and the laws that reveal contingent patterns or regularities in these motions. If the scientific image were the complete image, this would be all the freedom that there is. However, if one acknowledges that the scientific image is conceived, endorsed and justified by persons in normative attitudes of giving and asking for reasons, one realizes that there is a freedom that is characteristic of persons only and that is a freedom from matter in motion. It is the freedom to set up norms for thought and action (indeed, the freedom to have to set up such norms). Again, there is nothing in science that prevents us from having our actions shaped by this freedom.

The book is organized in three parts or chapters. The next chapter works out what the ontological commitments of science are and what they are not. It focuses on the fundamental and universal theories of physics from Newtonian mechanics to today's quantum physics. The chapter answers the following question: Which ontological commitments are minimally sufficient to understand our scientific knowledge? The purpose of this chapter is not to teach physics, although it will go into some physical details. The objective is to work out the philosophical points that are necessary in order to grasp why science does not come into conflict with our freedom.

Chapter 2 then goes into the achievements as well as the limits of scientific laws and explanations. It leads to making the case for science bringing out our freedom instead of infringing upon it. By the end of Chap. 2, we will have obtained an argument to the effect that there is no basic conflict between the scientific and the manifest image as regards time and free will (both are interconnected: without openness for change and time as its measure there is no free will). Such conflicts are, to use the term of Rudolf Carnap (1928), pseudo-problems (*Scheinprobleme*) that result from a misapprehension of the ontological commitments of scientific theories.

Against this background, Chap. 3 considers the focal point of the conflict between the scientific and the manifest image of the world, namely normativity, which concerns not only human action, but already thought. The chapter then elaborates on how both images lead to human freedom, sets out the mentioned twofold conception of freedom and goes into the consequences of that freedom, pointing out that there is no knowledge—scientific or otherwise—that infringes upon freedom. The summary at the end provides an overview of the main propositions of the book.

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Matter in Motion: The Scientific Image of the World

1.1 Atomism from Democritus to Feynman

Science in the Western culture goes back to Ancient Greece, namely the Presocratic natural philosophers. Among them are Leucippus and Democritus (about 400 B.C.), who were the first atomists. Democritus is reported as maintaining that

> … substances infinite in number and indestructible, and moreover without action or affection, travel scattered about in the void. When they encounter each other, collide, or become entangled, collections of them appear as water or fire, plant or man. (Fragment Diels-Kranz 68 A57; quoted from Graham 2010, p. 537)

In a similar vein, Isaac Newton writes at the end of the *Opticks*:

> … it seems probable to me, that God in the Beginning form'd Matter in solid, massy, hard, impenetrable, moveable Particles … the Changes of corporeal Things are to be placed only in the various Separations and new Associations and motions of these permanent Particles. (Quoted from Newton 1952, question 31, p. 400)

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To turn to contemporary physics, Richard Feynman says at the beginning of the famous *Feynman lectures*:

> If, in some cataclysm, all of scientific knowledge were to be destroyed, and only one sentence passed on to the next generations of creatures, what statement would contain the most information in the fewest words? I believe it is the *atomic hypothesis* (or the atomic *fact*, or whatever you wish to call it) that *all things are made of atoms—little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another*. In that one sentence, you will see, there is an enormous amount of information about the world, if just a little imagination and thinking are applied. (Feynman et al. 1963, ch. 1–2)

This is atomism. The success story of modern science is at its roots the success story of atomism. It is evident from these quotations why atomism is attractive: on the one hand, it is a proposal for a theory about what there is in the universe that is both most parsimonious and most general. On the other hand, it offers a clear and simple explanation of the realm of the objects that are accessible to us in perception. Any such object is composed of a large number of discrete, pointlike particles. All the differences between these objects—at a time as well as in time—are accounted for in terms of the spatial configuration of these particles and its change. This view is implemented in classical mechanics. It conquered the whole of physics via classical statistical mechanics (e.g. heat as molecular motion), chemistry via the periodic table of elements, biology via molecular biology (e.g. molecular composition of the DNA), and finally neuroscience—neurons are composed of particles, and neuroscience is applied physics. In a nutshell, what paved the way for the success of science is the idea to decompose everything into elementary particles and to explain it on the basis of the interactions of these particles.

To understand how the atoms interact, one needs laws that describe their motion. That is why atomism remains a speculative stance in Antiquity and becomes science only in modern times: only modern physics formulates laws of motion for the atoms. Nonetheless, the attractiveness of atomism does not depend on what precisely is proposed as these laws. Its attractiveness is independent of a particular physical theory. It consists in the idea of composition by particles together with the idea that differences in this composition account for all the differences that there are. There is a direct and intuitive link from this idea to the observable, macroscopic objects.

That link is direct and intuitive because all that is observed in science as well as in common sense are the positions of discrete objects relative to each other and the change of these positions—in other words, the variation in the distances among discrete objects that make up a configuration of objects and the change of such configurations. Accordingly, all measurement outcomes are recorded as relative positions within configurations of discrete objects and variations of such positions, such as, for instance, pointer positions or digital numbers on a screen. In this vein John Bell (2004, p. 166) famously says "… in physics the only observations we must consider are position observations, if only the positions of instrument pointers". The qualification "in physics" is appropriate, because common sense observations typically involve colours, sounds or scents of spatially arranged objects. The positions of objects are discerned by means of these sensory qualities. However, sensory qualities do not figure in physical theories, at least not explicitly (we will consider that issue in Sect. 3.1).

That notwithstanding, all the evidence that we have in science is evidence of positions of discrete objects relative to other discrete objects. For instance, even in the case of the gravitational waves detected by LIGO (Laser Interferometer Gravitational-Wave Observatory) in 2016, all the evidence is evidence of change in the relative positions of discrete objects that finally are particles. This change then is mathematically described in terms of a wave rippling through the gravitational field. This fact highlights again the direct link between the experimental evidence and the idea of atomism: it is relative positions of discrete objects all the way down from the macroscopic objects to their ultimate constituents, or all the way up from the ultimate constituents to the macroscopic objects. Thus, if a theory gets the spatio-temporal arrangement of the particles right (that is, the arrangement of fermionic matter according to contemporary physics),[1] it has got everything right that can ever be

[1] Cf. Bell (2004, p. 175).

checked in scientific experiments.[2] Two theories that agree on the spatio-temporal arrangement of the particles cannot be distinguished by any empirical means, whatever else they may otherwise say and disagree on. By the same token, two possible worlds with the same spatio-temporal arrangement of the particles are indiscernible by any scientific means.

Hence, what is relevant for the account of the perceptible macroscopic objects and their differences are only the relative positions of the particles—in other words, how far apart they are from each other, that is, their distances—and the change of these distances. Any intrinsic nature of the atoms is irrelevant for that task. Realizing this point stands in contrast to the mainstream tradition in ancient and medieval thought where the focus was on an inner form (*eidos*) of the objects—that is, some characteristic, intrinsic features that belong to each object considered independently of all the other objects. Aristotle's *Categories* and *Metaphysics* are the *locus classicus* of this tradition. To put it differently, on atomism, the atoms are the substance of the world. They are permanent: they do not come into existence and they do not go out of existence. But they are substances only in the sense of permanent existence. They are not substances in the sense of having an inner form. The atoms are featureless. All there is to them are their positions relative to each other—that is, their distances—and the change of these positions.

René Descartes is the central figure who brought about the shift from Aristotelian forms in the medieval, scholastic conception of nature to an essence of the material objects that consists only in their extension—that is, the spatial relations or distances among these objects—and motion (that is, the change of these spatial relations). In short, for Descartes, nature is only *res extensa*. Descartes also formulated laws of motion. But these did by and large not turn out to be correct, mainly because Descartes conceived the interaction of the material objects in a mechanical way as direct contact. Laws of interaction that prevailed go back to Newton, with the law of gravitation being the prime example. Newtonian gravitation is interaction without direct contact, as in the attraction of the Earth by the Sun. Let us therefore have a closer look at the interplay between objects and laws.

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[2] See also Maudlin (2019, pp. 49–50).

1.2 Primitive Ontology

The atoms that atomism poses cannot be further decomposed into smaller things, because they are not extended themselves: they are point particles. All the extension comes from the spatial relations in which they stand, making up for configurations of point particles. These are the bedrock of the universe so to speak, since one cannot go further down than spatially arranged point particles in scientific enquiry. In other words, their configurations are the ultimate referents of our scientific theories, what they talk about in the last resort. Let us introduce the philosophical term *primitive ontology*. Ontology is about what there is (*to on* in ancient Greek). The primitive ontology is about what is admitted as simply existing in the sense that it cannot be derived from anything else or introduced in terms of its function for anything else. What takes this place depends on our theories: it is the hypothesis of science that the universe is ultimately constituted by spatially arranged point particles. If this hypothesis is right, then the particle configuration of the universe is the bedrock, at least as far as scientific enquiry is concerned.

Are there alternatives to atomism? The Presocratic natural philosophers do not only include the atomists Leucippus and Democritus. Before them came Thales, Anaximander, Anaximenes and Anaxagoras who searched for the stuff out of which everything is made. Thales apparently took water to be that stuff, whereas the others thought of it as something more abstract. In any case, the stuff view of nature is opposed to atomism: instead of a plurality of discrete, indivisible objects, there is just one continuous stuff that stretches out throughout the universe. One problem with this view is that one may find the idea of a bare stuff substratum of matter mysterious. Furthermore, that stuff substratum admits of different degrees of density as a primitive matter of fact: there is more stuff in some regions of space than in others. In brief, there is nothing in this view that individuates or distinguishes material objects by properties or relations, such as their spatial relations in a configuration of discrete objects as on atomism.

More importantly, it is unclear how this view could account for the macroscopic world with which we are familiar. There is nothing in this view that matches the theory of composition in atomism: the spatially arranged point particles compose what is known today as atoms in the sense of the chemical elements, these compose molecules, and the molecules finally compose the macroscopic objects with which we are familiar. In a nutshell, water is not a continuous, primitive stuff, as the ancient conception of the four elements earth, water, air and fire has it. Water consists in molecules that are composed of hydrogen and oxygen atoms, which, in turn, are composed of protons, neutrons and electrons, etc. until one gets down to the point particles.

The primitive ontology hence is not a matter of speculation. Although whatever is supposed to be the bedrock of the universe is likely to be quite far away from the features of the world with which we are familiar, there has to be a clear and intelligible link with these features, such as the link from particles to macroscopic objects via composition. Nonetheless, the crucial point is not the idea of composition as such, however intelligible or intuitive it may be, but to cash out the promise of explaining all the differences in the macroscopic objects in terms of differences in the particle composition and change in that composition. Laws of motion for the particles are indispensable to achieve this aim. That is why this aim is achieved only by modern science. Consequently, both atomism and the view of a continuous stuff remain speculative before the advent of modern science. Modern science then vindicates atomism by providing laws of particle motion on the basis of which the promise of explaining the differences in the macroscopic objects in terms of differences in the particle configuration can be fulfilled.

Stressing the importance of laws brings out that the intuitive link from spatially arranged point particles to macroscopic objects via composition is not the argument for the primitive ontology of atomism. The fact that all that is observed in science and common sense are spatial arrangements of discrete objects and the change of these arrangements is not the argument for that ontology either. This fact and that intuition suggest trying out a primitive ontology of point particles that are characterized by their relative positions and the change of these positions only. But the argument for that ontology then is its explanatory force, that is, how it accounts for all the evidence that we have on that parsimonious basis. In