LIMITS TO THE APPLICABILITY OF GALILEAN METHODOLOGY

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Although there are foreshadowings of a certain materialistic explanation of natural phenomena in some of the ancient Greek philosophers, Copernicus was the first to express clear materialistic explanations, such as that the planets were bodies which exerted a force of gravity like the earth. [1, 2] One must, of course, distinguish between an ontological and a methodological materialism. The latter requires that only notions relating to matter should be used to formulate explanations for the material universe. No spiritual (non-material) entities should be invoked in the attempt to explain, for instance, a collision between billiard balls. Ontological materialism, on the other hand, claims that only material exists. All phenomena in the realm of what one might wish to call the spirit have their origins in or are reducible to matter. Copernicus and those who followed his thinking were only methodological materialists, [3] although Copernicus' own attachment to traditional ways of thinking did not permit him to employ this methodology in a full and rigorous way.

Galileo was really the first to break ties with Aristotelianism and to seek in a consistent way to explain phenomena both on the earth and in the skies by employing other material, physical phenomena and by using mathematics. Even when his explanations are wrong they are materialistic in this sense. In his *Dialogue on the Two Great World Systems* he explains, for instance, the force of gravity of the planets by asserting that their globes consist of magnets. He rejects any influence of the moon on the tides, because he will not accept any non-physical, invisible force field. Thus, while Galileo's methodological materialism was thorough, it was also many times quite primitive and led to erroneous results. Nevertheless, from him has derived the methodological materialism which characterizes scientific research today.

One might ask how applicable such methods are when the physical phenomena under investigation have resonances at other levels of existence, for instance, when living and sensate matter or

human psychology are involved. In the physical-mathematical sciences the method has, of course, had great success.

It appears to me, however, that even within the exact sciences Galilean methodological materialism is not sufficient. Ancient philosophers asked the question "what for". Because teleology could have no part in his method, Galileo asked the question "why". Today the dominant question in the physical sciences is "how" or, when probability theory is considered, "how much".[4] If we are dealing with individual objects or restricted conglomerates of such objects, for instance, with planets, the planetary system, star clusters, this historical trend in the questions asked is quite acceptable. When, however, the object of inquiry is the universe as a whole, one must transcend the methodological materialism implied in that trend of questions. During the first half of the twentieth century, before Einstein's General Relativity, cosmology was more the domain of the philosopher. It was only with the development of the physical concepts necessary to discuss the singularity in some cosmological models that the balance shifted from philosophy to theoretical physics. Along with this shift there has been a reinforcement of the question "why" in place of the question "how". "Why", we ask, are the fundamental physical constants and the fundamental laws of physics such as they are and not other. The anthropic principle in cosmology has even recentered our attention on the question "what for".[5] Thus the strict methodological materialism of Galileo is no longer adequate.

REFERENCES

[1] Heller, M. and Rudnicki, K. 1982, Analecta Cracoviensia, **4**, 33-49.
[2] Rudnicki, K. 1982, *Die Sekunde de Kosmologen* (Vittorio Closterman, Frankfurt).
[3] Rudnicki, K. 1978, *Das Goethanum*, **31**, 243-246.
[4] Schiller, P.E. 1957, *Naturwissenschaft und Geisteswissenschaft Philosophich-Anthroposophischer Verlag* (Dornach).
[5] Carr, B.J. 1982, *Acta Cosmologica*, **11**, 143-151.

Comment by Heller

I would not call the scientific method of constructing mathematical models and comparing them with experimental results a materialistic method. In fact, as I have shown elsewhere (Analecta Cracoviensia 1982), the concept of matter itself was effectively eliminated by Newton from modern physics. The term "matter" cannot be defined operationally, and consequently it does not belong to the vocabulary of science. Its physical counterpart, the term "mass", refers only to a parameter in the equations of motion and has nothing in common with the philosophical idea of matter.

It is true that mechanistic philosophers interpreted Newtonian mechanics in a materialistic way, but it is no less true that this interpretation was due to ignorance of the fact that the notion of matter had been eliminated from among the conceptual tools of science. Modern physics is not a science of matter but a science of lattices of abstract relationships constructed on the basis of a set of measurements.

This criticism is not directly against the main thesis of Rudnicki's contribution. He has clearly distinguished between ontological and methodological materialism. I assert only that the ontological materialism can hardly be reconciled with the language and methods of modern science.

Reply by Rudnicki

While I agree with the main idea of Heller's remark, I wish to assert that, not only the term "matter" but, even more so, all terms of a non-material nature have been eliminated from the discourse of modern physics, whose notions lie under, not above, the plane of notions related to matter.

III.

CULTURAL REPERCUSSIONS OF THE GALILEO AFFAIR