REPRINTED FROM:

THE COLLECTED PAPERS OF

# Albert Einstein

VOLUME 6

THE BERLIN YEARS:
WRITINGS, 1914–1917

A. J. Kox, Martin J. Klein, and Robert Schulmann
EDITORS

József Illy and Jean Eisenstaedt
CONTRIBUTING EDITORS

Rita Fountain and Annette Pringle
EDITORIAL ASSISTANTS

ENGLISH TRANSLATION OF SELECTED TEXTS

Alfred Engel, TRANSLATOR
Engelbert Schucking, CONSULTANT

DOC. 3

## "Inaugural Lecture"

(pp. 16–18 in translation volume)

Princeton University Press
1997

## Doc. 3

[p. 739] [The inaugural lectures of those members who newly entered the Academy since the Leibniz-Session of 1913 followed this lecture.]

### Inaugural Lectures and Responses

Inaugural Lecture of Mr. Einstein

Most honored colleagues!

Please accept first my heartfelt gratitude for the greatest favor you could have bestowed upon a person such as I. By calling me into your Academy you have put me into a position that allows me to devote myself wholly to scientific studies and [1] frees me from the distractions and tribulations of a practical profession. I ask you to believe in my feelings of gratitude and the assiduousness of my striving, even if the fruits of my efforts may appear to you as meager ones.

Allow me to append a few general remarks about the position which my field of work, theoretical physics, takes vis-à-vis experimental physics. A mathematician friend recently said to me, half jokingly, "The mathematician knows some things, no [p. 740] doubt, but of course not those things one usually wants to get from him." The theoretical physicist is in a very similar position when the experimental physicist asks him for advice. So, what are the reasons for this strange lack of adaptability?

[2] The methodology of the theoretician mandates implicitly that he use as his basis general assumptions, so-called principles, from which he can then deduce conclusions. His activity, therefore, has two parts: first, he has to ferret out these principles, and second, he has to develop the conclusions that can be deduced from these principles. His school provides him with excellent tools with which to fulfill the second-named task. Consequently, when the first one of his tasks is already solved for some area, or rather some complex of phenomena, then sufficient diligence and insight assure that success will not be denied to him. But the former task, namely to establish these principles which can serve as the basis of his deductions, is one of a completely different kind. Here there is no learnable, systematically applicable method which would led him to the objective. The researcher must rather eavesdrop on nature to become privy to these general principles, by recognizing in larger sets of experiential facts certain general traits that can then be strictly and precisely formulated.

Once this formulation is achieved, a chain of conclusions sets in, often with unforeseen connections, far transcending the domain of facts from which the principle has been wrested. However, as long as the principles that must serve as the basis for the deduction remain undiscovered, the individual experimental fact is of no help to the theoretician. In fact, he cannot even do much with individual empirically



established general laws. Instead, he must rather remain in a state of helplessness vis-à-vis the individual results of empirical research until principles reveal themselves to him so that he can make them the basis of deductive developments.

Presently, theory is in just that position with respect to the laws of heat radiation and molecular movement at low temperatures. Just fifteen years ago, nobody doubted that GALILEI-NEWTONIAN mechanics and the MAXWELLIAN theory of the electromagnetic field as a basis of molecular movements would lead to a correct description of the electrical, optical, and thermal properties of matter. Just then PLANCK showed that the establishment of a law of heat radiation consistent with experience, required a method of calculation whose incompatibility with the principles of classical [p. 741] mechanics was becoming ever more apparent. With this method of calculation PLANCK introduced to physics the so-called quantum-hypothesis, which has since found outstanding confirmation. With this quantum hypothesis he toppled classical mechanics for those situations where we have sufficiently small masses with sufficiently small velocities and sufficiently large accelerations—so that today we can accept the laws of motion established by GALILEI and NEWTON only as limit-laws. But, despite the most strenuous efforts of theoreticians, we have not succeeded in replacing the principles of mechanics with those that are adequate for PLANCK's law of heat radiation or the quantum hypothesis. As incontrovertibly as it has been proven that heat derives from molecular movement, we still must concede today that the basic laws of this movement confront us in a similar manner as the planetary movements confronted the pre-NEWTONIAN astronomers.

I just pointed out a set of facts for whose theoretical treatment we lack the principles. But it can happen as well that clearly formulated principles lead to conclusions that are completely or almost completely outside the domain of facts that are presently accessible to our experience. In this case, protracted experimental research may be needed in order to find out whether or not the theoretical principles correspond to reality. Such a case offers itself with the theory of relativity.

An analysis of the temporal and spatial base concepts has shown that the theorem of a constant light velocity in vacuum, which follows from the optics of moving matter, does not at all force us toward a theory of a light-ether at rest. Instead, it has been possible to establish a general theory that takes cognizance of the fact that the translatory motion of the earth is never noticeable in the experiments conducted on earth. Thereby we use the relativity principle, which states: laws of nature do not change their form when one changes from the original (admissible) coordinate system to a new one that is in uniform translatory motion relative to the former. This theory found noteworthy confirmation in experience and has led to a simplification of the theoretical description of whole complexes of facts that were already connected.

From a theoretical point of view however, this theory does not grant full satisfaction because the relativity principle that has been stated above favors *uniform*
[p. 742] motion. If it is true after all that *uniform* motion cannot have an absolute meaning from the physical point of view, we then have the obvious question whether or not this statement can be extended to nonuniform motions. It turned out that one arrives at a very distinct extension of relativity theory when one uses a relativity principle as a basis that is extended in this sense. In this manner one is led to a general theory
[3] of gravitation that includes its dynamics. At this moment, however, we do not have
[4] the experimental material necessary to test the justification of the introduction of this basic principle.

We have determined that inductive physics has questions for deductive physics and vice versa; and eliciting the answers will require the application of our utmost efforts. May we, by means of united efforts, soon succeed in advancing toward conclusive progress.



Doc. 4

# Remarks on P. Harzer's Paper: "On the Dragging of Light in Glass and on Aberration"

Doc. 4 is not translated for this volume.