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October 24th, 1923

Dr. Simon Flexner,
Rockefeller Institute of Medical Research,
66th Street and Avenue A,
New York City, New York.

Dear Dr. Flexner:

In considering the proposal to enlarge the scope of the fellowships in Physics and Chemistry so as to include Mathematics, I should think it desirable to have clearly in mind the close inter-dependence of all the sciences. It is well-known, of course, how Medicine constantly uses the results of Physics and Chemistry, and how, in return, the problems arising from Medicine stimulate research in Physics and Chemistry. The relation between Mathematics on the one hand and Physics and Chemistry on the other, is of precisely this sort. It has frequently happened that an attempt to solve a physical problem has resulted in the creation of a new branch of mathematics. A classical example of this is in the theory of the conduction of heat. When this problem had been stated in mathematical terms, it was found that the mathematics then in existence was inadequate to solve it, and new mathematical machinery had to be devised. The resulting studies by Fourier and others not only gave to Physics the theorems and formulas it required, but also led to new mathematical developments which have affected most of the branches of mathematical analysis.

Another example of the hand-in-hand development of Mathematics and Physics is the history of the theory of electric waves which resulted both in the electromagnetic equation of Maxwell and in the experiments of Hertz and the other inventors of wireless telegraphy.

In the modern case of the Einstein Theory, the relation between Mathematics and Physics has been more one-sided. Einstein's work is a contribution to Physics in which Mathematics is used as a tool. It happened that the necessary mathematics was already in existence, having been worked out by Riemann, Christoffel and others some fifty years before. This left Einstein free to apply his genius to the physical and philosophical problem, using the mathematics whenever it was needed. He Had he been under the necessity of creating the mathematical tools which he used in his gravitation theory, it is more than probable that this theory would have been long delayed and possibly never completed. Indeed it may be added that without the pioneer work of the creaters of non-Euclidean geometry, the fram of mind in which Einstein approached his problem would not have been possible.

The rôle of mathematics in the Quantum Theory is quite similar to its rôle in the Einstein Theory. In particular, Bohr's Quantum Theory of Atomic Structure is based on a very profound study of the calculus of variation theorems in classical dynamics. To realize this it is only necessary to attempt to read Bohr's Memoir of 1918 in the Proceedings of the Danish Academy. The problem of atomic structure is, of course, still far from a complete solution and no one knows whether the mathematics of today is adequate to such a solution or not. If not, the development of Physics at this point can come about only through an advance in Mathematics.

I have said nothing about the direct relations between Mathematics and Chemistry because these are more distant from my personal experience. However, I have no doubt that any chemist will think at once of the work of Willard Gibbs, if not of more recent examples.

The question might be asked: "Why should not a separate Board be created to look after fellowships in Mathematics"? In the interest of Mathematics, I think it is very desirable that fellowships in this science should be administered by a Board which contains both physicists and chemists, because this will tend to keep closer contact and will have the effect of stimulating interest on the part of mathematics in problems of physics and chemistry. This sort of a broadening of the interests of the mathematicians in this country is very desirable at the present time.

I hope this letter will cover the points which you desired me to write about, but if not, I shall be glad to write you further. And of course I shall be glad to do anything else which you may think would be of use in helping to obtain an appropriation for these fellowships.

Yours sincerely,

O.V. -F. (Signed) Oswald Veblen.