On the Correspondence of Leibniz and Huygens with Papin

Gottlob Frege

[The speaker drew the audience's attention to the correspondence of {Gottfried Wilhelm} Leibniz and {Christiaan} Huygens with {Denis} Papin, which E. Gerland recently edited on behalf of the Royal Academy {of the Sciences} in Berlin.[1] It is prefaced with an account of Papin's life which shatters the myths that have come to be associated with his name and which does justice to his inventive genius without exaggeration.] | [93]

This book stimulates our interest chiefly because it transports us most vividly back to an age in which the first seeds of so much began to stir that now, in full bloom, enriches our lives and increases our might. We become acquainted in many respects with the then current state of knowledge and see the difficulties with which the pioneers of scientific and technological progress had to contend, and we gain thereby a benchmark for their significance. In particular, we become acquainted with a new side of Leibniz. The correspondence with Papin confirms also for the realm of inventions that he took a most enthusiastic, often active interest in all the promising endeavors of his age. [94]

We see how slight the general knowledge of the correct principles of mechanics still was in those days from the fact that Papin, in calculating the efficien-

Translated by Marcus Brainard and Pierre Adler. This review was first published under the title "Ueber den Briefwechsel Leibnizens und Huygens mit Papin" in *Sitzungsberichte der Jenaischen Gesellschaft für Medizin und Naturwissenschaft für das Jahr 1881* (Jena: G. Fischer, 1881), 29–32 (= meeting of July 15, 1881). It was republished in Gottlob Frege, *Begriffsschrift und andere Aufsätze*, ed. Ignacio Angelelli (Darmstadt: Wissenschaftliche Buchgesellschaft, 2d ed., 1964), 93–96. The pagination of the latter is indicated in the margins of the translation. According to the editor, the initial paragraph, in brackets, stems from someone other than Frege, who is the speaker referred to. Translators' additions are placed within braces in the first paragraph and in brackets elsewhere in Frege's article.

1. In this review, Frege discusses Ernst Gerland (ed.), *Leibnizens und Huygens' Briefwechsel mit Papin, nebst der Biographie Papin's und einigen zugehörigen Briefen und Actenstücken* (Berlin: Königliche Akademie der Wissenschaften, 1881), viii + 399 pp.

The New Yearbook for Phenomenology and Phenomenological Philosophy VIII (2008): 321–23
ISSN 1533-7472 • ISBN 978-0-9701679-8-9

cy of a machine, makes an error, which Huygens has to correct by reference to the principle that a system's center of gravity cannot rise on its own.

The correspondence with Huygens ranges especially over the cause of tensile strength [*Festigkeit*], of the double refraction of light, and of gravitation, the law of which had already been established by Newton.

The age's ideas about chemistry are signaled by the fact that Leibniz thought that the ethyl alcohol flame could be used for air replacement in diving bells, which Papin refutes by means of experiments.

Leibniz's opinion about the earlier heat [*Glut*] of the Earth is also noteworthy.

Regarding the then current medical theories, Papin speaks quite skeptically. He is opposed to the use of strong drugs and expects much of the curative power of the organism supported by diet. Leibniz agrees with him on this point. It seems that in medicine, too, these men were ahead of their time. Just how far Leibniz, who as a philosopher placed such great importance on the role of reason in the formation of our knowledge, was from disparaging experience is evident from his having recognized that the attainment of further experience was the most urgent requirement for medicine and his having recommended to the Berlin government that each year it collect the experiences made in the provinces. |

Now concerning inventions, Papin expected more from the diving bell, in his [95] somewhat sanguine manner, than has so far been achieved. In it he wanted to be able to make the longest journeys with greater speed and less danger than with ordinary ships. During times of war, he wanted to use it to slip into enemy harbors and destroy their ships.

The execution, of course, fell far short of these expectations. Through a hose that was held open by a spiral-wound wire and whose end was attached to a piece of wood floating on the surface, he drew fresh air down. A pump was used to lower and raise the vessel, oars in leather sleeves to propel it. As the first trial failed, Leibniz strongly maintained his high opinion of the inventor and his belief in the practicability of the undertaking contrary to skeptics. A second trial had a satisfactory outcome, so it seems, but was not pursued any further.

Of Papin's inventions, the steam engine aroused the greatest interest. He and Leibniz already foresaw nearly all the applications that are made of it now. Let me mention wood and marble cutting, water lifting, corn milling, steam ships, and steam carriages. Papin regarded the invention of the steam engine as more important than that of the transformation of metals. The starting point was likely Huygens's gunpowder engine, in which the powder gases lifted a piston and, after their escape, left an imperfect vacuum in which the piston was pushed down again by the external air pressure. Papin sought to remedy the defects of this engine by producing the vacuum through the condensation of water vapor. Later he also used the pressure from steam and ultimately steam alone by venting the spent steam into the atmosphere.

Anyone insufficiently familiar with the history of this invention will tend to explain the circumstance that the realization of Papin's expectations took so long by the fact that the theoretical views on the pressure and the condensation of water vapor first had to be clarified, and that the individual creative thoughts that gave rise to the invention of the steam engine could only be developed over the course of many decades. Instead, we see | that those theoretical views had already reached suf- [96]
ficient clarity back then and that almost all those thoughts were already available—in one letter, Leibniz even speaks of the automatic control of the engine, the use of the heat from the spent steam and the combustion gases. By contrast, we see with both regret and astonishment the inventors of that time battling with the imperfection of the tools. One gains a picture of that battle when one imagines oneself faced with the task of building a steam engine with the aid of workmen who are used to working only for the habitual necessities of life. What today is easily made with our machine tools, sorely tried the inventors' patience and proved often enough to be impracticable. Thus, for example, it was impossible to make precisely turned steam cylinders with airtight-fitting pistons of the requisite size. This was the reason why water had to take on the role of sealant and the floating piston served only to confine the immediate contact of the steam with the water to a small peripheral area. I believe that already in Papin's day the steam engine would have seen a high degree of realization if today's means had been available. But, of course, the stimulus afforded by the thought of the steam engine was needed in order to create these tools. This reminds us not to overestimate the merit of men who first made an invention usable on a larger scale but also to do justice to their predecessors.

Other of Papin's inventions will be mentioned only briefly.

Regarding the oven for melting glass, as well as for metallurgical and similar purposes, we note the principle of air pressure regulation, which is still followed today in such facilities. In this connection, a centrifugal blower was employed by Papin, which was also used for air replacement in mines.

Leibniz thinks of a portable barometer without mercury on the order of a pump, which was probably like an aneroid barometer [namely, a barometer without liquid].

Regarding his computing machine, Leibniz considers himself fortunate to have seen its realization in the main. The difficulties were due, probably much as in the case of the construction of the steam engine, to the imprecision of the work at that time.