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From philosophy to physics

Fritz London's first published paper in a professional journal was in philosophy. In 1921, the year he graduated from the University of Munich, whilst supervised by one of the most well-known phenomenologists, Alexander Pfänder, he wrote a thesis that dealt with deductive systems. It was among the very first attempts to investigate ideas about philosophy of science expressed by the founder of the phenomenological movement in philosophy, Edmund Husserl. It was a remarkable piece of work for someone who was 21 years old. In this work, London developed an antipositivist and antireductionist view. This is all the more surprising, given London's knowledge of and interest in science, and the appeal of positivism to many scientists. London also intervened in the controversy between Richard Tolman and Tatiana Ehrenfest-Afanassjewa about the possibility of finding physical laws by dimensional considerations alone. Many of the ideas elaborated by London in his later researches, including his insightful suggestions and discussions of macroscopic quantum phenomena, can, indeed, be traced back to these early philosophical wanderings.

Right after his graduation from the University he started teaching in the Gymnasium and, when he was ready to matriculate as a Gymnasium teacher, he resigned and went to Max Born, who was at the University of Göttingen, to work in philosophy. Born did his utmost to discourage him, but to no avail. Born's only hope to persuade the young London to do an actual calculation, like all others beginning a career in physics, was to convince him to go to Munich and to study with Arnold Sommerfeld. There he did his first calculations in spectroscopy and, in 1925, he published his first paper in physics with Helmut Hönl on the intensity of band spectra. Soon afterwards he became Peter Ewald's assistant in Stuttgart and there he did his work on quantum mechanics.

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His researches in transformation theory showed, among other things, London's quite impressive mathematical abilities. London also tried to express Hermann Weyl's theory – unifying gravitation and electromagnetism – within the quantum mechanical framework and he was among the first to introduce complex phases in quantum mechanics.

The years that left nothing unaffected

Though greatness and war are incommensurate notions, historians insist on calling one of the most catastrophic events in human history the 'Great War'. When in the fall of 1918 the war ended, there were nearly two million dead and four million wounded. The end of the war did formally bring peace. But it was also the start of a long protracted disagreement between those who thought they had won the war and Germany, whom no one doubted had lost the war. It was not peace with honour but peace with defeat, and soon the whole of German society was torn apart by those stormy passions which nurture only on defeat.

The mutiny of the sailors at Kiel, the proclamation of a Soviet Republic in Bavaria by Kurt Eisner, and the huge demonstrations by workers in Berlin were events which took place in less than ten days. Prince Max of Baden announced the abdication of the Emperor and appointed as Chancellor the leader of the Social Democrats, Friedrich Ebert. Another of the leaders of the Social Democrats, Philipp Scheidemann, ostensibly fearing that unless he proceeded quickly, the Spartacists would proclaim a Soviet Republic, proclaimed the Republic in the city of Weimar. November 9, 1918, became the formal beginning of a period in Germany whose significance both for Germany and Europe can hardly be overstated. The Weimar Republic was born in defeat and it was tragically defeated in less than fifteen years. The elections of January 1919 brought what appeared to be a viable coalition. On January 15, 1919, the two leaders of the Spartacists, Karl Liebknecht and Rosa Luxemburg were murdered in cold blood by right-wing thugs. The hopes that with an elected government the anarchy of the preceding months would come to an end were soon gone. At the end of February, Eisner was murdered. As a result, there was a general strike in Bavaria and the proclamation of the Socialist Council's Republic. There ensued bloody clashes, when two months later the government troops, intent on crushing the insurgence, used all their might on guilty and innocent alike. The Allies with their recent successes in the battlefields fresh in their memories, failing to realize

their Pyrrhic victory, dictated their humiliating terms to Germany. By the end of the summer of 1919, Germany had signed the Treaty of Versailles and had a new constitution. Germany was to become a democratic republic. 'The next four years stood under the signs of domestic violence and foreign intransigence, the two interacting, and to Germany's misfortune, reinforcing one another.'¹

For a long time, Germany resembled a helpless and desperate person in quicksand. Every move to escape the paralyzing humiliation of defeat in the Great War got the country in a greater mess. As Germany faced its past and tried to transcend it, the Left faced its own past and tried to assert it. Both would soon fail. That the Right would be against the Left was, of course, expected. But ironically as the war was the unmaking of the Right, peace brought the downfall of the Left. There was much bitterness, hate, violence and political maneuvering by the Left, about the Left and, most importantly, against the leftists. Utopias that appeared to be so immaculate and, hence, so resistant against all kinds of 'evil forces' were reduced to unrecognizable amateurish exercises on paper, after the realities and contingencies of governmental and administrative responsibilities set in. None of the old ideas and ideologies was left unaffected. None of the institutions could claim itself impregnable against the onslaught of 'modernity'. The years of the Weimar Republic left their mark on everyone and everything. And, then, the whole thing (and the exact determination of the 'thing' for many members of a generation, among them Fritz London, was rather immaterial) started crumbling like an old newspaper, into many small pieces, each carrying part of the story.

Fritz Wolfgang London was born in Breslau (now Wrocław, Poland) on March 7, 1900. His mother, Louise née Hamburger, was the daughter of Heinrich Hamburger, one of the co-owners of the I. Z. Hamburger cotton mill in Liegnitz with business offices in Breslau. His father, Franz London, whose father was Meyer London, was born in 1863 in Liegnitz. He studied at the Universities of Marburg, Leipzig, Giessen, Zürich, Breslau and Berlin and in 1886 he received his doctorate in mathematics from the University of Breslau. In 1889, he became a *Privatdozent* in Breslau and also worked for an insurance company. His research field was constructive geometry. In 1896, he was appointed as titular Professor at the University of Breslau and when he died on February 27, 1917, he was Professor of Mathematics at the University of Bonn. Both parents were Jews. Franz had to wait many years to have a 'proper' academic appointment and this difficulty must have been one of the factors in his decision to have both his sons baptised. Fritz was baptised when he was 7 years old.

Fritz London's last four years at the Gymnasium in Bonn were the

years of the Great War. In fact, he graduated from the Gymnasium earlier to be able to do volunteer work for the army, but was not accepted because of the problems he had with his spine. His spine was a little bent and needed massaging, and for that reason he, often, could not freely play with other children. Nevertheless, this ailment did not prevent him from learning mountain climbing, which was his second hobby after piano playing. After his father's death, from angina when he was 54 years old, the 17-year-old Fritz, the oldest male in the family, felt a deep sense of responsibility. Naturally Franz's death was a strong blow to Louise London, and Fritz felt that he should do all he could so that she would recover. Later, Fritz often talked about what his father's loss meant to his mother, but never discussed what the loss did to him.



Figure 1. Fritz London's parents, Louise (née Hamburger) and Franz London, at their home in Bonn in 1915. (Courtesy of Lucie London.)



Figure 2. Fritz London, seven years old, at the gate of his house in Bonn. His father is at the window on the left, the grandfather Alfred Hamburger is at the window on the right. The woman is unidentified. (Courtesy of Lucie London.)

The appeal of ideas

Between his last year in the Gymnasium in 1917–1918 and the final manuscript of his graduating thesis in philosophy from the University of Munich in 1921, London had written a number of essays which were quite suggestive of his early interests and influences. The only other document from his school days is a personal notebook from 1915 to 1916. Among its contents are several drawings: of a young man in what appear to be school surroundings titled *Morning Sickness*; figures in various positions; stars of David; Gothic buildings; geometrical figures and some geometrical proofs; bored and snoozing students in a class with a teacher; a drawing of a fiendish figure with

rather strong features, with, scribbled in Greek, διαβολος the word for devil; maps and travel itineraries. There are a few drawings with graveyards with crosses and with the buried person's soul emanating from the grave towards the sky. One such grave has his name, his date of birth and the date of death with the last two digits erased. On the same page there is also a vase with (his) ashes and the title *In the Crematorium*. All this is followed by his will, dated March 20, 1915, where he stipulates that should God in his infinite wisdom decide that he should die, his bedroom should be used as a lodging for poor women and his money should be distributed to the poor. There is also the beginning of a play written in 1916 by Fritz and titled *The Comedy About Nakedness*. The characters have Greek names, the girls are blond with blue eyes and 'often naked' as he stipulates, as is Philo the heroine's love; their parents are 'never naked'. The only text of the play is detailed stage directions about the opening scene in a busy street as the sun sets and the two lovers enter.

The first full essay written by London when he was still in school was an essay about Goethe the scientist. There is also an earlier essay on the history and principles of telegraphy. Two other essays were either written in his last year at school, or, more probably, in his first years while he attended university. One of them is about the absoluteness of knowledge and the other is a critique of the methods of cognition. Furthermore, there is an essay titled *Relative/absolute/dynamical*, written most probably in 1919, and, finally, an untitled essay which almost certainly was the essay he showed to Alexander Pfänder (at the University of Munich in 1921) who, then, told him to go ahead and expand it for a thesis, being one of the necessary prerequisites for receiving one's degree from the university. Interestingly, London added various comments to these school essays during his later years, as is evident from his notes in the adjacent pages and margins.

London's excursions in philosophy should not be regarded merely as expressions of someone with a cultivated and inquiring mind who tried his luck by letting himself be lured by the appeal of the philosophical tradition of Germany. Themes and issues first raised in these school essays found a more mature expression in his philosophy thesis. They also appeared in his later publications in physical chemistry and molecular physics, and took a dramatic expression in his low temperature researches and the conception of the macroscopic quantum phenomena. It is not, of course, the case that everything London did can be traced back to his philosophical papers, nor that he did not have any novel and radical suggestions afterwards. Quite the opposite is the case: his lasting contributions were proposed without an explicit reference to any of his philosophical thoughts, yet there are unmistak-

able signs of links that can be discerned between his early writings in philosophy and his later polemics defending his unique approach to the interpretation of superconductivity and superfluidity as macroscopic quantum phenomena.

Concerning his approach to philosophy, London did not follow the practice of many physicists who were either among the founders of quantum mechanics or among its first practitioners. Most of these physicists wrote some kind of a philosophical piece after having made those contributions by which they established their reputation in the community. Some of these pieces are texts for a rather sophisticated audience, some are explanations of the implications of quantum mechanics and relativity, some are historico-philosophical accounts of the development of what is called ‘modern physics’, and others are attempts to present, in a systematic manner, a series of metaphysical issues within the context of the new developments. London followed a different path. His work in philosophy, never mentioned by others when there is reference to the philosophical writings of this generation, was of the professional kind, and was impressively ambitious: he wanted to discuss the issue of a deductive theory and the conditions for the existence of such a theory. In a thoughtful essay examining Husserl’s philosophy of science, Thomas Mormann (1991) considers London’s thesis, together with Husserl’s ideas concerning philosophy of science, as having anticipated the semantic approach to the philosophy of science.

Goethe as a scientist

Goethe als Naturforscher was completed on July 1, 1917, and there we find the first traces of ideas that were to be fully expanded in his philosophical thesis. It was well received by his teacher. The language of the essay is heroic and, in places, almost poetic.

London’s youthful admiration for Goethe was almost uncontrollable. He complained that the German people did not think highly of Goethe as a scientist because of his incorrect conjectures in optics. ‘The foreigners’ he noted ‘surpass us in objectivity’, since Goethe’s works had been extensively translated and respectfully read in France and England. He felt that it was wrong to assess the importance of Goethe’s work solely by his views on optics. He thought that Goethe’s researches in osteology and botany were serious contributions to science. And these contributions resulted from Goethe’s mystic conception of nature and, more specifically, from his notion of *Urphänomen* – that of the primal, archetypal phenomenon.

Even though London’s assessment of Goethe’s color theory was that

of a physicist (the theory was wrong, whereas Newton's was right), London wanted to change the focus of criticism and to argue that Goethe should be considered as being the person who developed an aesthetic theory of the harmony of colors. Goethe had claimed that he was actually doing physics, and the reason for such a claim was because he generalized his psychological experiences. For Goethe the experience of seeing was the basis of knowledge, and he thought that whatever was being unravelled through seeing was also the unravelling of the real world. London considered Goethe to be in conflict with Kant. Nevertheless, one had to be lenient. A genius should be excused for attempting to turn such a method into a general rule. After all, Goethe, as London pointed out, was in a position to grasp intuitively the dependencies among various entities through his unconditional and absolute 'surrender to the whole'.

At the end, London wondered whether it might have been Goethe's idea to identify the *Urphanomen* with God, since the creation regarded as the *Urphanomen* cannot be explained by any science and the philosophers choose the way of speculative research. In the investigations for the *Urphanomen*, one witnessed the dark struggle of one who sought God as being the 'nucleus of the physical research of Goethe'. Attracted by Goethe's force of intellect, London, nevertheless, was unwilling to adopt Goethe's methodology, not because its results rendered it questionable, but because it was problematic on epistemological grounds. And at that level his sympathies and preferences were with Kant.

How absolute is our knowledge?

The second essay from his early years is titled *Speculations about the absoluteness of our knowledge*. London wrote this essay in November 1918, having already graduated from the Gymnasium, and there are no indications that he wrote it for any kind of course requirements. It is a serious and disciplined expression of his attempts to clarify for himself a series of issues that he was thinking about. The practice of writing a long piece to clarify the conceptual issues of a particular problem characterized London to the end of his life. Another important characteristic of this essay is London's explicit commitment to Kantianism.

Science seeks the absolute. Whichever way one looks at the absolute it does not change. Everything depends on the absolute, but it does not depend on anything else and there is no explanation for that. The relative is to be understood as a function. It is the 'flickering form of Proteus, which takes on a different appearance whenever one changes

one's vantage point'. Thinking depends on the notion of function. The search for the absolute can be realized by answering the following question: in these function-like subordinations, is there a member which is not subordinate to any other? Interestingly, London referred to the work of scientists for the answers to such philosophical questions, and he started a systematic presentation of the methodologies of various disciplines to see the extent to which the researchers in these disciplines had reached any conclusions concerning the absolute. There was no possibility of finding the absolute in theology, since the miracle of the world could not be understood rationally. Neither in geology nor in mineralogy could one find absolutes. Astronomy did not have an absolute, since it became possible to provide an equally satisfactory explanation of the phenomena, independent of whether the earth was in the center of the universe or not. It may acquire an absolute if it was verified that the universe is closed, but what about if there are many universes? It may be the case that the elements in chemistry could be considered as absolutes, but this is not so, since they are differentiated from each other with respect to their specific weight, and, more importantly, they have structure. It is also not possible to consider either mass or energy as being absolutes, since one can be transformed into the other and it is not known which one is primary. Mechanics is the only discipline where such a discussion is rendered unnecessary because of the special theory of relativity. Geometry, also, could not provide absolutes: not only can one start from the axioms to derive a number of relations, but also one can start from the properties and these can lead to the axioms. Therefore, geometry is not a strictly deductive system, but it resembles a spiral.

At this point there is an addition to the text and the handwriting indicates that this intervention was made sometime after the mid-1920s. In the additional text, London discusses the impossibility of determining an absolute through systems of coordinates, since there cannot be a privileged system. He must have (re)read his essay after becoming conversant with the general theory of relativity, most probably during 1926 when he worked on Weyl's ideas to unify the gravitational and the electromagnetic fields. His conclusion was that there are no absolutes and that the tendency of the sciences to find absolutes was wrong and was an expression of their anthropocentrism – since the human spirit demands limitations.

London, then, proceeded to a discussion on the nature of reality. He considered it to be like the interior of a reflecting sphere where all points are equivalent: every point reflects itself upon itself *ad infinitum*. If it were possible to enter this sphere, then this may lead us to the belief that there is something absolute in the sphere by looking at our 'indeterminately disfigured' image. But this absolute changes in a

function-like manner when we change our position in the sphere or our method of observation. For this reason we delimit ourselves to the view that if we leave the inside of the sphere then the absolute disappears. And though we think the absolute disappears, we do not believe that reality disappears.

Everything is a dream, it is the great whole in its admirable aimless attempts, in its causal regularities. All this is the work of our spirit. All our knowledge is a function of ourselves. The only absolute is the thinking spirit.

Cogito ergo sum.

Acquiring knowledge

The *Critique of the methods of cognition* is of special interest, since it contains, in embryonic form, some of the ideas that Fritz London developed analytically in his thesis. London took a very strong anti-reductionist stand, expressing his abhorrence for any approach that had as its strategy the formulation of the equations of motion for the minutest constituents as a necessary step for deriving the behavior of the whole. Apart from this pronounced antireductionism, there are three thoughts in this essay which he would develop further in his philosophy thesis. Firstly, the relation between an object and a condition is not one of subordination, but one of coordination. Secondly, concepts are not hierarchically arranged, but acquire their meaning only with respect to other 'similar' concepts within the same framework. Thus, the meaning of concepts is primarily contextual. Thirdly, deduction is a process that produces truths and, hence, the construction of a deductive theory should transcend the possibilities provided by formal logic.

London also pointed out an intrinsic incoherence in du Bois-Reymond's scheme. On the one hand, du Bois-Reymond's scepticism was expressed by *ignoramus et ignorabimus*, on the other, he stressed the necessity of an approach to nature that conceived the world as being describable by means of a single mathematical formula determining all that happens. London found refuge in 'Verwoorn's conditionalism': to explain is to describe all the conditions of an event or of a state of affairs. Instead of trying to understand nature as an object, one attempts to examine the kinds of functions that are present in nature 'ignoring the question about objective reality'. And in his sympathy to conditionalism we witness the first signs of what eventually became his commitment to phenomenology.