His Mind at Work: A First Glimpse, through Einstein's Archive

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Diana Buchwald has asked me specifically to speak about my "personal involvement with the material at Einstein's Archive." I shall obey. In the brief time given I can of course only summarize the highlights of nearly a decade of visits and work on Einstein’s papers when they were still at the Institute for Advanced Study in Princeton, and I shall leave out entirely the decades of my own research. My reward for the initial arrangement and study of Einstein’s Archive was that I could dare to think I glimpsed his mind at work. I shall of course talk about that. But let me first give the setting which made my long "personal involvement" with the Einstein papers possible.

It all began on the 13th of August 1959. I had gone to the Institute, to meet Helen Dukas, Einstein's secretary from 1928 until his death in 1955, during Einstein’s American years more or less also in charge of the household and now a Trustee of his Estate according to his last will [2 photos]. I came introduced by my colleague at Harvard, the scientist-philosopher Philipp Frank, himself an
inexhaustible resource on the intellectual and scientific history of his
time, the successor to Einstein in 1912 at the University of Prague,
and his friend and biographer. I had started an historical study of
Einstein's work, and Frank thought Helen Dukas could be of help to
me.

I shall never forget the scene that greeted me when I was led to
see her. After Einstein’s death, she had been relegated to the large,
room-sized vault in the basement of Fuld Hall, and was now there, the
whole scene illuminated only by her rather insufficient desk lamp. She
was sitting at her desk, bent over some papers, a large stack of file
drawers loomed in the darkness beyond. I could not help but think of
Juliet in the crypt, after the death of Romeo.

I asked whether I might look at some documents in preparation
for a paper on Einstein’s work which I was to give soon at an
International Congress. Perhaps on Frank’s recommendation, she
became very helpful, leading me to the file cabinets, each crammed
full of folders, assembled in an order which only she could have
puzzled out. At any rate, the visit went well for my purpose, and
indeed perhaps also for hers, because a few days later, she wrote me,
"It is a real satisfaction to me to be able to help you, and I am looking
forward to it eagerly."
Since Helen (as she offered I could call her) is a key both to my story and indeed to the existence of the whole Collected Papers of Einstein, a few more words of description are essential. She was born in 1896 in Freiburg in Breisgau. She had to interrupt her education at age 15, after her mother had died, and took charge of running the household and bringing up the younger children. Later she became governess in the home of Raphael Straus in Munich, one of whose new nephews was Ernst Straus. Let me give you a taste of this remarkable woman's wit and tough realism. As it happened, in the 1940s, Ernst came to the Institute, to be one of Einstein's assistants. When Ernst introduced himself to Helen, she said, Of course I know you well. I was present at your circumcision. Or again: in one of her letters to me (and we had a correspondence of well over 100 letters altogether), she said the Russian historian-philosopher Kuznetsov "has sent me the English translation of his new Einstein biography. With my letter of thanks, I enclosed two pages of corrections; and I have found since some more." And in a copy of her to the President of the Israel Academy of Sciences, she wrote him, "I looked a little into the catalogue (of an exhibit you sent me). But "The Zionist Congress of 1949 took place in Zurich, not München. I was there!"

After Einstein’s death, Helen attended to his stepdaughter, Margot, in their home on Mercer Street, even while even keeping up with the
continuing correspondence and inquiries, also trying to find new
documents, retyping old, fading ones, or the handwritten ones,
particularly those in Gothic script. Her sharp memory and her utter
devotion and reliability became quickly obvious.

But I am getting ahead of the story. For me, standing in that
vault for the first time in 1959, looking over this unsuspected,
enormous, chaotic treasure of letters, manuscripts and notebooks, I
felt like Ali Baba in "The Tales of the Arabian Nights," when he called
out "Open Sesame." Even during that first of some fifty or sixty visits
over many years later, I saw two essential needs. One need
centered that of our profession, and the other concerned Helen
herself. I felt that the profession of historians of science must
somehow capture her experience, her memory of the events and
correspondence in which she had been involved (for she had
essentially read all of the correspondence and typed all of Einstein's
letters from the '20s on). In the absence of serious help, she had
been trying to type out a catalog of the papers, correspondence, and
manuscripts. John Wheeler soon put the matter clearly in his letter to
the Rockefeller Foundation, to recommend that I get some support for
a serious project, namely to put the huge heap of correspondence in
good order for use by scholars. Only a few, such as Martin Klein, had
dared to use it so far. Wheeler wrote, "...the great mass of the
material is unorganized. Miss Helen Dukas works at this only in a limited way and without assistance or guidance by anyone trained in the history of science. An enormous task requires doing it, and it goes ahead only at a niggling pace.”

The financial support I looked for was also needed for microfilming at least the scientific part of the collection. The grant application was successful—more on that in a minute, except to quote here from one of Helen’s letter to me of those days: “The work you have in mind for me fascinates me, but also fills me with apprehension.” And in an earlier letter, “I have been hoping for something like this to turn up.”

I also had to plant in Helen’s mind the idea of eventually allowing publication, so as to provide scientists, historians of science, and philosophers of science with the necessary material for future good work.

Helen also had to be made to see the historical value of the riches all around her, and to bring into the vault what she called the “personal stuff,” which she kept at home, and which really was needed to supplement the "scientific correspondence."

This effort succeeded by September 1968, when she had a number of file cabinets brought from home into the vault, to be included and catalogued. She also made available documents that she
had kept in a safe within that vault; it contained correspondence with Freud, Roosevelt, Romaine Rolland, Elsa's letters. So eventually there were orderly, catalogued folders on Gandhi, Stalin, Paul Valèry, Bertrand Russell, Chaim Weizmann, the Queen of the Belgians, Tagore, Schweitzer, Thomas Mann, Bernard Shaw, as well as the light-hearted verses of Einstein, all these joining the files that were already on hand, the likes of Schrödinger, Pauli, Curie, Lorentz, Bohr, Born, Ehrenfest, Infeld, Hilbert, Bose, de Broglie, Bohm, Debye, Eddington, and so forth, to Meitner, Minkowski, and so forth to Wenzl, Wien and Zeeman. [show slide of card] By 1963 there were 130 such file folders done and catalogued, some very bulky, with Ehrenfest's having no less than 165 items. And from about 1976 on, the strong editorial staff of the Princeton University Press project greatly expanded what we had started. By the time John Stachel finished in January 1980, he had 42,000 items in his big index, which he said had been initially based on what he called our "little index".

Not less important than the profession's needs were of course Helen's own needs. She certainly seems to have been rather lonely after Einstein's death, and quite neglected by the Director of the Institute, Robert Oppenheimer, as far as I could guess she was without an office or salary. The Foundation money I raised was primarily to provide her with a salary for her work, and it also gave her the
companionship of graduate students, carefully selected by John Wheeler and myself. These students were hired to come for a few hours or days per week; they did excellent work in cataloguing, but also brightened Helen's life.

To help with the work at hand, I made periodic visits to the Institute myself, at least monthly, sometimes weekly, starting in the early 1960s. At Oppenheimer’s invitation, I came to the Institute during two one-semester leaves from Harvard, as Member in 1964 and as Visitor in 1971. Let me confess that as we worked together I came to love Helen, nearly two decades my senior, as I had loved my favorite aunt.

Of course, all the work we did helped also in my own research, far beyond my initial hopes. Thanks even to the first visits, I was able, in two papers given in 1959, to include (always with Helen’s permission) key material that had been unpublished and, as it were, was waiting for me in the vault. Throughout my later writings on Einstein, one will constantly find reference to permissions granted by the Trustees, Helen and Otto Nathan, allowing me to publish materials from the Archive as part of my own work. I have little doubt that without that rather accidental, introduction to the Archive of Einstein and his circle, my professional life would have been very different.
My mental preparation for research on Einstein’s work, my pilgrimage, so to speak, had actually begun much earlier. One day, when I was about fifteen years old, my father and I went on our habitual searches through bookstores when he had time, and there my eyes fell on a battered copy of Einstein's first book on relativity, the one he called "gemeinverständlich." Here was something I had been waiting for. [slide] Undeterred by the inscription of the previous owner ("That Jew Einstein stole it all from Lorentz..."—after all, this was in Vienna), I tried my best to get a glimpse of that enchanted part of science which had not yet entered our school curriculum. In fact, it was one of the two books I took along when I left Vienna about a year later. [slide]

But the intellectual fruits of work on the Archive came quickly.

The main reason for my initial trip to Fuld Hall’s vault was that while there were many biographies of various quality, and even Einstein’s own extraordinary Autobiographical Notes in the Schilpp volume of 1949. But virtually nothing had been done by historians of science, a lot of whom seemed still occupied with the never-ending task of glimpsing the minds of scientists of earlier times, such as Galileo and Newton. Someone had to take “the first step forward,” to start, seriously on Einstein.
In fact, at the time, some works passing for historical analysis were downright misleading. One example is the famous case of Sir Edmund Whittaker, a distinguished physicist known especially for his contributions to classical mechanics. His book, *A History of the Theories of Ether and Electricity*, was first published in 1910, and his second edition, in the 1950s. It was in many respects a *tour de force*. But in that second edition, completed in 1953, Whittaker revealed his strange view of the origins of Einstein's special theory of relativity. The 1905 paper, Whittaker wrote, set forth the relativity theory of Poincaré and Lorentz with some amplifications, and which attracted much attention.

A second, more well known sort of perspective on the origins of Einstein's theory was, in those years, the generally shared idea that for Einstein the Michelson-Morley experiment was the "crucial" basis on which he had built his theory, rather than being small and indirect, one of the many negative ether experiments of which young Einstein undoubtedly had read, and which, for many other physicists undoubtedly made Einstein's work palatable in retrospect. Einstein repeatedly denied this allegation. But the false story fulfilled nicely the needs of pedagogues to make Einstein's counter-intuitive work plausible to students.
By now we know better, not least because of Einstein's responses found in the Archive, where he rejects again and again, in different ways, the attempts by his correspondents to tie him down on the cross of Michelson's apparatus. [SHOW SLIDES of Shankland's proposed text] All this has now been pretty well cleared up, for example, in John Stachel's book *Einstein, B to Z*.

From the great use many scholars have made of the Archive in clarifying old and new speculations about Einstein's way of thinking, let me briefly point to just a very few revealing ones. Einstein’s three epochal papers of 1905—sent to the *Annalen der Physik* at intervals of less than eight weeks—seem to be on entirely different fields, the quantum theory of light, Brownian motion, and relativity. It had been suspected by a few that they might have arisen from thinking about one general problem. An unpublished letter of January 17, 1952, from Einstein to von Laue, confirmed that suspicion. Einstein had already known that Maxwell’s theory leads to the wrong prediction of the motion of a delicately suspended mirror "in a Planckian radiation cavity." His preoccupation with fluctuation phenomena was at the bottom of all three papers, the considerations of Brownian motion, of the quantum structure of radiation, of Einstein's more general reconsideration of what he called "the electromagnetic foundations of physics" itself.
Thanks to letters such as the one to von Laue, one can also retrospectively verify other indications Einstein himself had given of how his mind worked. My favorite example has been his remarkable letter, previously unpublished, to his old friend Solovine. There Einstein is responding in typical visual terms to Solovine's pained question to have him explain himself once more, after all these years. [SLIDE: See pgs 30-31 in *The Advancement of Science and Its Burdens.*]

Perhaps others here will speak more of the batch of some 50 letters that came into the Archive later in the 1980s. They have become famous as the "Love Letters" between these two young blassmates at the Poly in Zürich, Mileva Maric and Einstein. The letters are indeed full of romance and passion, on both sides, but they are even more—a new keyhole for watching young Einstein develop his ideas, over several years, leading to the relativity theory. Thus in an early letter (March 1899), the 20-year-old Albert writes he realizes "how closely intertwined our psychological and physiological lives are." But he then adds, "My musings about radiation are now beginning to reach more solid ground." As many such letters show, his love life and his physics research are seemingly unified. Thus he writes to Mileva in August 1899: "You are such a robust girl, and have so much vitality
and health in your little body." But even without starting a new paragraph, his very next, historically important sentences, are that: "I...am now studying again Hertz's propagation of electric force [1892], with great care....I am coming more and more to the conviction that the electrodynamics of moving bodies [note the phrase!], as currently presented, does not correspond to reality [Wirklichkeit], but lets itself be presented more simply. The introduction of the word 'Ether' in the electric theories has led to the conception of a medium of whose motion one can talk without, I believe, connecting with that assertion a physical sense. I believe that electric forces can be directly defined only for empty space."¹ And so forth, with more physics, until he returns toward the end of that letter to the rest of his psychological and physiological self. "If you only would be again a little with me! We understand ourselves so well in our black souls, and, on the other side, about drinking coffee, eating sausages, etc......[six periods, underlined]" All this, six years before his paper of 1905, which used as its title the very words in this letter, and dismissed the ether in a curt phrase. Those letters also give us a good idea what books and articles he was reading toward his breakthrough of 1905.

¹ All translations are from the original German documents, by this author.
My last example of the eye-opening power of the Archive came from a lengthy, then still published essay I found there, in Einstein's handwriting, of around 1920. Its title, in translation, is "Fundamental Ideas and Methods of Relativity Theory, Presented in their Development." It is one of my very favorite documents, not least because it contains the amazing passage in which Einstein reveals what, in his words, was "the happiest thought of my life"—der gluecklichiste Gedanke meines Lebens. Alas, I don’t have time to tell you what that thought was—maybe in the discussion period.

[He refers to a typically visualized thought experiment that came to him in 1907—nothing less than the Equivalence Principle of General Relativity: It occurred to Einstein that while a man was falling from the roof of his house anything he tried to drop would move along with him, thus indicating the equivalence of acceleration and gravity [cf. p. 371 in Y. Elkana, ed., The Interaction between Science and Philosophy, 1974], or, in his words, "the acceleration of free fall with respect to the material is therefore a mighty argument that the postulate of relativity is to be extended to coordinate systems that move non-uniformly relative to one another...."]

But I want to draw attention to another passage in that manuscript. That manuscript actually begins in a largely impersonal, pedagogic tone, similar to his first book on relativity, published in
1917. But in a surprising way, from p. 20 on, in the section titled "General Relativity Theory," Einstein suddenly switches to a personal account. He reports that in the construction of the special theory, the "thought concerning the Faraday [experiment] on electromagnetic induction played for me a leading role." He then describes the experiment, in words similar to the first paragraph of his 1905 paper, concentrating on the well known fact that in relative motion the induced current is the same whether it is the coil or the magnet, which is in relative motion, but that the "theoretical interpretation of the phenomenon in these two cases is quite different." While other physicists had been quite satisfied with that fact all those decades, here Einstein reveals where he is so different, at the depths of his soul: "The thought that one is dealing here with two fundamentally different cases was for me unbearable [war mir unerträglich]. The difference between these two cases could not be a real difference.... The phenomenon of the electromagnetic induction forced me to postulate the [special] relativity principle."

Let us step back for a moment to contemplate that word "unbearable." It is reinforced by the famous passage in Einstein's Autobiographical Notes, written in 1946 (published in 1949), "By and by I despaired [verzweifelte ich] of discovering the true laws by means of constructive efforts based on known facts. The longer and the more
despairingly I tried, the more I came to the conviction that only the discovery of a universal form or principle could lead us to assured results.” [“The example I saw before me was thermodynamics.”]

Other physicists also confessed they were brought to despair in their research, for example, Bohr and Heisenberg. Still others were evidently even brought to suicide by such despair. For researchers of high quality, at the very frontier, the psychological stakes are very high. Einstein was able to resolve the despair by turning, as he did in the first paragraph of his 1905 paper, to the postulation of two formal principles—as had Euclid, Newton and Spinoza—and adopted this tool of thought as a preferred one in the use of his inquiring mind.

And he also had a second method to bridge over unbearable differences: by generalizing the theory, so that the apparently differently grounded phenomena are revealed to be coming from the same base. We have already hinted at this in his use of the physics of fluxuation phenomena as a commonality shared in the origins of the three great papers of 1905. But Einstein had confessed to this generalizing approach to physics earlier, in a letter of 14 April 1901 to his old school friend, Marcel Grossmann, while Einstein was working on his very first published paper on capillarity. There he tried to bring together the opposing behaviors of bodies, moving upward when a liquid is in a capillary tube, but downward if the liquid is released
freely. In that letter, he really announced both his intellectual and his emotional *Leitmotiv* in one sentence: "It is a wonderful feeling [*ein herrliches Gefühl*] to recognize the unity of a complex of appearances which, to direct sense experiences, appear to be quite separate things." [PROJECT the sentence]

The postulation of universal formal principles, and the discovery among phenomena of a unity, of *Einheitlichkeit*, through the *generalization* of the basic theory—those were his two favorite weapons,² as Einstein's letters and manuscripts showed. Writing to Willem de Sitter on 4 November 1916, he confessed: "I am driven by my need to generalize [*mein Verallgemeinerungsbedürfnis*]." That need, that compulsion was also deeply entrenched in German culture; it resonated with, and supported, Einstein's approach.³ [Let me just remark in passing that while still a student at the Poly in Zürich to get his certificate as a high school teacher in science, he took on the side optional courses on Immanuel Kant and Goethe, whose central works he had already studied since his teenage school years.]

² A third was his use of freely adopted (non-Kantian) categories, or thematic presuppositions. The prominent ones include the primacy of formal explanation; unity or unification; logical parsimony and necessity; symmetry; simplicity; causality; completeness; continuum; and of course constancy and invariance. (See the discussion of these in "Einstein's Model for Constructing a Scientific Theory," chapter 2 of *The Advancement of Science, and Its Burdens* [Harvard University Press, 1998]).

That *Verallgemeinerungsbeduerfnis* is clearly a driving force behind Einstein's career trajectory. Thus he generalized from Faraday, Fizeau and aberration to special relativity; there he generalized and unifies space and time, electric and magnetic forces, energy and mass, and thereby resolves the whole long dispute between the mechanistic and electromagnetic world pictures. Then he went on to generalize the special theory to produce what he first significantly called [in the article of 29 May 1914] *die verallgemeinerte Relativitätstheorie*—Paul Ehrenfest wrote him [4 Dec. 1919, Seelig] in puzzlement: "How far will this *Verallgemeinerung* go on?" And finally, Einstein throws himself into the attempt of a grand unification of all forces, the Unified Field Theory. This was a magnificent and perhaps unique, life-long, intense, coherent dedication, despite his failure at the very end, which nevertheless set the stage for the ambition of today's scientists, who have taken over that search for the Holy Grail of physics.

So much for a quick account of trying to glimpse the mind of Einstein as scientist. But, finally, one more thought urges itself on anyone who has studied this man's work and life in detail. As in his science, Einstein also *lived* under the drive to unify, in his politics, in his social ideals, even in his everyday behavior. He abhorred all nationalism, but calling himself in Berlin, even during World War I, a European. Later he supported the "One World" movement, and helped
to initiate the international Pugwash movement of scientists during the Cold War. He was as ready to befriend visiting high school students as the Queen of the Belgians, having an instinctive penchant for democracy and a dislike of hierarchy and class differences. [This must have cost him greatly in the early days, as when he addressed his chief professor, on whose recommendation his entrance to an academic career would depend, by no title, calling him simply “Herr Weber.”] And in Einstein's essays on ethics, he cites Moses, Jesus, and Buddha as equal prophets.

No boundaries, no barriers; none in life, as there are none in nature. Einstein's life and his work are so consistent and mutually resonant that we can recognize both carried on together in the service of one project, the fusion into one grand coherency. Max Weber and others have called that sort of science “charismatic”, because through it one seems to “come into contact with what is essential in the universe” [Bernard Gustin]. I believe this is exactly what people everywhere, even when quite ignorant of Einstein's physics, felt when they flocked to catch a glance of him, when they put his picture on their walls and T-shirts, and when they, and we here, feel uplifted, as we see him in a certain glow of comradeship, as we see him in this splendid Museum Exhibit brought back to us.