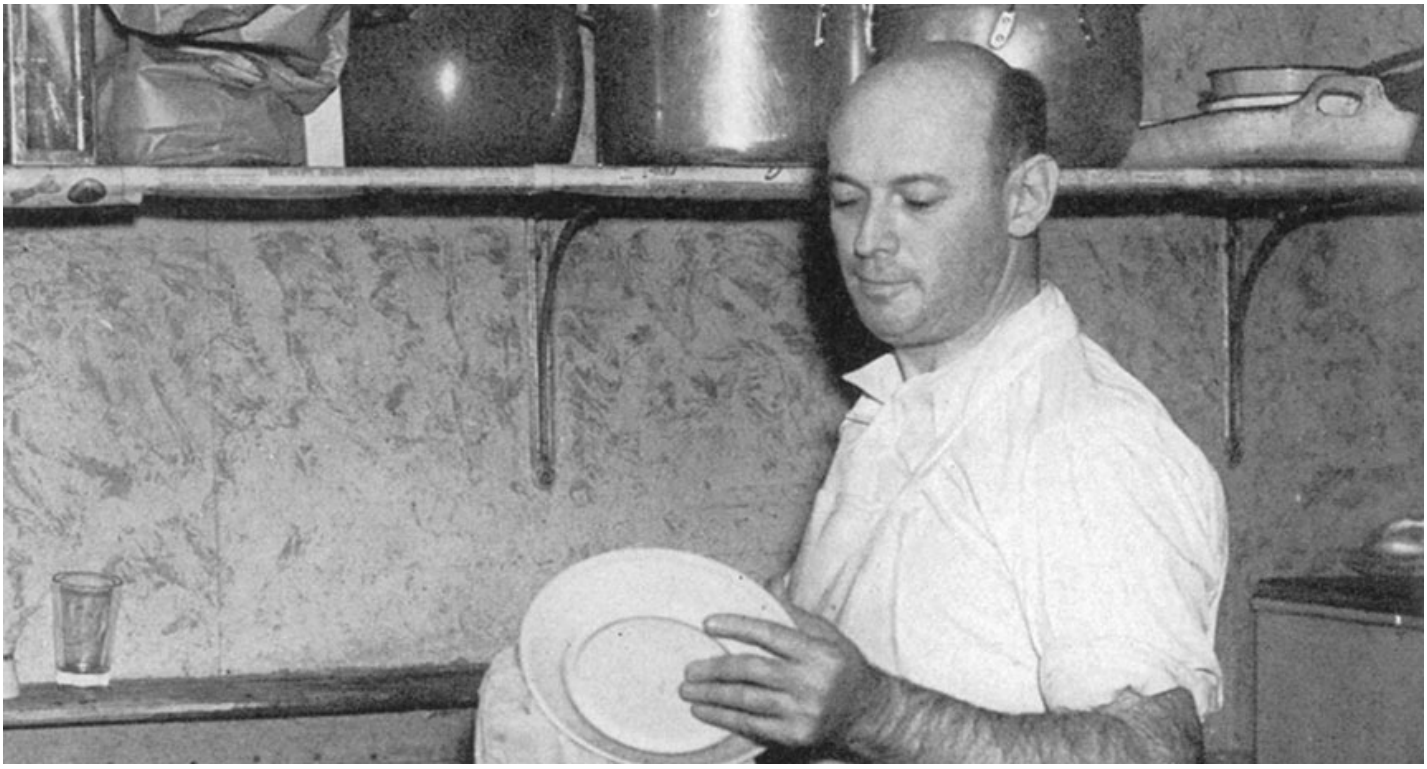
History of Science, General Relativity at 100

The amateur who helped Einstein see the light

Eccentric engineer played crucial role in theory of gravitational lensing

By Tom Siegfried 6:00am, October 1, 2015



With some help from *Science News Letter* (the precursor to *Science News*), a restaurant dishwasher named Rudi Mandl persuaded Einstein to explore the phenomenon of gravitational lensing.

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Generally speaking, general relativity is not the sort of physics that offers much fodder for amateurs. Its mathematical intricacies were too much even for Einstein at first. He struggled for years to find the equations that showed how general relativity could describe gravity, finally succeeding in 1915.

But a couple of decades later, an eccentric amateur noticed a consequence of Einstein's theory and induced him to push his math a bit further. Einstein's math, the amateur asserted, implied that gravity could distort light like a lens. Nowadays such "gravitational lensing" is a valuable tool exploited by astronomers to probe the cosmos. But in the 1930s, virtually nobody knew anything about it, except for a restaurant dishwasher named Rudi W. Mandl.

Physicists and historians have often noted that it was Mandl who persuaded Einstein to take gravitational lensing seriously. Some, notably Jürgen Renn, have even documented the crucial role that *Science News Letter* (the pre-1967 incarnation of *Science News*) played in the gravitational lens drama. But rarely have any of these accounts provided much more than a cursory description of who Mandl was, and nobody seems to have cared about whatever happened to him.

Renn, in a paper written in 2000 with Tilman Sauer, refers to Mandl as an "amateur scientist." General relativity expert Clifford Will, in a review of gravity's light-bending history, calls him an "electrical engineer." On the Einstein papers website, an entry on gravitational lensing calls Mandl an "amateur engineer." In fact, Mandl was trained as an electrical engineer, but in 1936 he was making a living as a busboy and washing dishes for restaurants in Washington, D.C. It seems that he also augmented his income via a hobby — drawing intricate geometric designs on eggshells.

But he still pursued an interest in science. And one day in the spring of 1936, he dressed up in a baggy blue suit and paid a visit to the *Science News Letter* offices (then in the building of the National Academy of Sciences) to discuss his ideas on gravitational lensing in space.

He brought along sheets of paper covered with his mathematical scribblings and a friend to help translate his broken English. Somebody at the magazine (not sure who, but it might have been staff writer Robert Potter) listened politely and managed to elicit a fair amount of biographical detail from Mandl. He was born in Moravia (later to be part of Czechoslovakia) on January 30, 1894. He went to school in Austria, enrolling in the Technologisches Gewerbe Museum of Vienna in 1911. When World War I came along, Mandl found himself in the Austrian army. He was then captured and sent to Siberia, but somehow escaped, and then managed to return to Vienna, where he completed his degree in electrical engineering in 1919.

For some reason, he then moved to South America briefly before returning to Europe to open a business in Germany, trying to sell an electric iron of his own invention. But German economic upheavals in 1923 obliterated his business, and eventually he made his way to the United States.

Besides revealing his life story during his visit to *Science News Letter*, Mandl also communicated the essence of his new idea, based on Einstein's theory of gravity, otherwise known as the general theory of relativity. Einstein had become famous when astronomers tested a key prediction of the theory concerning the bending of light as it passed by a massive object, such as the sun. Mandl, who had familiarized himself with general relativity, also knew a lot about optics, and he saw in the gravitational light bending a similarity to lenses. Lenses can magnify or distort an object's appearance by bending the light emanating from it. Mandl believed that such effects could be seen in space when one star eclipsed another.

"You see," he said, "the light from a distant star will be bent as it passes the nearer star and the effect will be a great brightening that anyone can see with a small telescope."

Mandl inquired whether *Science News Letter* would publish his ideas. But then as now, people off the street do not ordinarily possess sufficient scientific credibility to warrant news coverage of their ideas. Nevertheless, Mandl's science seemed plausible. So *Science News Letter*'s astute journalists offered to pay his way to Princeton to visit Einstein himself. That meeting took place on April 17, 1936.

Einstein, the record suggests, conversed with Mandl cordially. His German better than his English, Mandl was perhaps able to articulate his ideas more clearly than he had through a translator. Einstein's archives include later correspondence between him and Mandl, as well as a sketch of the lensing process that Mandl had drawn. Mandl also shared his suspicion that the intensification of distant starlight because of gravitational focusing might have played a role in mass extinctions (as of the dinosaurs), apparently by causing deleterious mutations. Einstein advised against trying to publish that part of the idea.

Still, Einstein seems to have taken Mandl more seriously than anyone else might have. In fact, Mandl had approached other prominent scientists with his idea, only to be rebuffed. But Einstein had a different perspective. Back in 1912, even before his general theory had been completed, Einstein had himself contemplated gravitational lensing, scratching out some formulas in a notebook that Renn examined in the 1990s. Einstein believed that such an effect would be too minuscule to observe and so let the idea drop, publishing nothing about it.

During their initial conversation, Einstein responded positively to Mandl, but upon reflection decided there was no point in publishing anything about an unobservable effect. But Mandl persisted, writing Einstein several times, eventually eliciting an admission that some small paper might be worth doing. And Einstein did in fact perform the calculations of the light intensification by gravitational lensing that Mandl had suggested. Mandl pointed out that nobody would publish his own ideas (he'd tried); only Einstein would be able to get a paper accepted. But months went by. Mandl moved from Washington to New York City. No paper by Einstein appeared. Renn and Sauer suspect that Einstein had decided to forget about it.

Mandl, of course, had not. Rather than writing again to Einstein, though, he wrote instead to *Science News Letter*, asking whether Einstein had published his calculations. That letter arrived on September 16, and the same day Potter sent a letter off to Einstein.

"Could you tell us what is the status of the Mandl proposal from your point of view, with the promise that anything you would write would be completely confidential?" Potter wrote.

"Whether such a confidential answer by Einstein to this question was ever written is unclear," Renn and Sauer remark in their account. But in fact, Einstein did respond, as *Science News Letter* reported in its

December 19, 1936 issue: “The courteous reply in German stated that the Mandl idea was interesting and would be ready for publication shortly.”

But that publication might never have appeared, Renn and Sauer suspect, had it not been for the intervention of Science Service, the organization that published *Science News Letter*. “Einstein seems to have laid the matter to rest,” they write. “Because of the involvement of the Science Service, however, the affair had taken an administrative turn and was no longer just a question between two individuals.”

And so Einstein’s brief paper, “Lens-like action of a star by the deviation of light in the gravitational field,” was published in the Dec. 4 *Science*.

“Some time ago,” Einstein wrote in his paper, “R.W. Mandl paid me a visit and asked me to publish the results of a little calculation, which I had made at his request. This note complies with his wish.”

But that was not the end of the gravitational lensing story.

Einstein had minimized the practical significance of his calculation. “There is no great chance of observing this phenomenon,” Einstein wrote in *Science*. But his publication inspired others to pursue the matter further. One popular account, by the acclaimed astronomer Henry Norris Russell, was published in the February 1937 issue of *Scientific American*. (Einstein had shared his *Science* paper with Russell ahead of its publication.) Russell agreed with Einstein that such a lensing effect would be hard to spot on Earth. But on a hypothetical planet orbiting the companion star to Sirius, gravitational lensing would be easy to notice whenever Sirius was eclipsed by its companion, Russell pointed out.

About the same time, the Caltech astrophysicist Fritz Zwicky wrote a letter appearing in the *Physical Review*, pointing out that even though the odds were against detecting lensing by a single star, chances of observing an effect would be much greater if the lensing object was an entire galaxy. Zwicky’s interest in the issue had been provoked by conversation with the engineer Vladimir Zworykin of RCA, known today as one of the inventors of television. And just why, you ask, had Zworykin raised the issue with Zwicky? Because Zworykin was one of the other scientists who had been urged to investigate gravitational lensing by Mandl (*SNL: 2/6/37, p. 87*).

Mandl’s role in gravitational lensing was widely reported later in 1937 by a newspaper columnist named Frederic J. Haskin. His column, syndicated to over 100 newspapers, provided answers to factual questions submitted by readers. In May, papers across the country published a Haskin column that responded to a curious question: “Who discovered the space-lens theory?” The answer by Haskin: “Rudolf W. Mandl was recently announced by Dr. Albert Einstein as the discoverer of the space-lens theory.”

From that time on, Mandl apparently pursued a career as an inventor — he sought patents for a puzzle game, a picture frame and an improved drill design. In New York, he got a job in an apartment building tending the furnace, which covered his rent. He registered for the draft in 1942, giving his birthplace (Wsetin, Moravia) and his full name: Rudi Welt Mandl. At that time he worked in a machine shop in Queens, and listed a friend, Miss Anna Appel, as someone who would always know his address. He became a naturalized U.S. citizen in 1946.

Little else is known about Mandl’s life. As far as I know, none of the accounts of his role in lensing ever reported his eventual fate. He lived briefly in Florida: There’s a divorce record – Rudi W. Mandl from Gennie Gezia Mandl — in Polk County, Fla., in 1945, and in 1944 he had informed the draft board that he resided in Lakeland, the Polk County seat.

In any case, Mandl eventually headed west, to California. I found a voter registration record listing Rudi W. Mandl at 123 Kilkea Drive in Los Angeles in 1948. And there’s a record of his death in Los Angeles on December 31, 1948.

But is there a way to be sure that the Rudi W. Mandl of Los Angeles was the Rudi who discovered the space-lens theory? In fact, there is a pretty compelling clue.

In the Long Beach *Independent* of May 2, 1948 — on the sports page — a columnist described an offer made by an inventor to baseball teams around the country. This inventor claimed to have a machine capable of controlling the temperature in such a way as to prevent rain from falling on a stadium, guaranteeing that games would never be rained out. The inventor: Rudi W. Mandl of Los Angeles.

Yes, that Rudi. In the letter he sent to various teams, sportswriter Dave Lewis noted, Mandl included a paragraph establishing his credentials. “I refer you to the Science News Letter of December 19, 1936,” Mandl

wrote. “You will see that I collaborated with Prof. Einstein….”

Today, of course, baseball games still get rained out. On the other hand, astronomers today make use of gravitational lensing all the time to study the universe. So perhaps you could say that Rudi Mandl batted .500. Pretty good for an amateur.

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