Forgotten Inventor Emerges from Epic Patent Battle with Claim to Laser

A 20-year struggle to be recognized as a primary inventor of the laser seems near to success for a long-forgotten claimant, Gordon Gould. After an epic series of legal battles which is without obvious precedent in patent case law, Gould on 11 October was awarded what he considers a basic patent which vindicates his long-contested claims.

The award may prompt reevaluation of scientific credit for the laser, of which Charles Townes and his brother-in-law Arthur Schawlow are popularly considered the sole inventors. Gould's claims, if supported in full, would not in any way detract from the credit due to Townes and Schawlow but would establish that he conceived the idea independently. Gould claims to have been first both to invent the laser and to have realized the full range of its potential, from range finding to use in achieving nuclear fusion.

Credit for the invention has been denied Gould both because Townes and Schawlow published first and because they were assigned a basic patent on the laser in May 1960, a verdict which Gould appealed and lost. The notarized notebooks in which he recorded his ideas in 1957 and 1958 have never been published, although they are the basis of patent claims which will, if granted in full, embrace an entire industry.

The new award has thrown the laser industry into angry confusion. The Townes-Schawlow patent expired just recently after having run its 17-year course. Industry executives are outraged at the prospect of having, as they see it, to pay twice over for the same thing, although several are personally glad to see Gould vindicated. "Gould deserves credit—he has hung in there and he is a very good scientist and nice person," says Donald Sims, president of Hadron Inc. "But as a businessman I consider I've already paid my dues. It's very awkward for the Patent Office to change its mind. If the laser amplifier was the basic thing, the patent should have been awarded to Gould in the first place."

Gould's present patent covers only optically pumped laser amplifiers, which account for about a third by sales value of the laser market. But five pending applications, including one that covers gas lasers, will, if granted, bring 95 percent of the laser business within the orbit of his patents, according to Refac Technology Development Corp., Eugene Lang, president of Gould's licensing agent. Sales of the laser industry are estimated at $1 billion a year, with $5 billion projected for 1984.

The resurrection of Gould's claims has come as a complete surprise to scientists such as Schawlow, who remembers only that his and Townes' claim was confirmed over Gould's 10 years ago and has not followed the progress of the litigation since. "I find myself very puzzled, but that is how patent law works," Schawlow says of the Patent Office's award to Gould. Schawlow, who never received royalties from his patent (his rights were signed over to Bell Telephone), comments that if Gould can make the award for optical pumping stick, then "it looks like he has something pretty valuable."

Gould's protracted fight for vindication may well be headed for the kind of ending usually confined to storybooks. Still $60,000 in debt for past attorneys' fees, he now stands a sporting chance of joining the club of multimillionaires.

"Some of the agony is that he filed when he was 38 and now he is 57," says his present attorney Joseph Littenberg. Gould does not see it that way. He is remarkably unbitter about what for many would have been a saga of unparalleled frustration.

"I don't hold any grudges against anyone," he remarked in an interview on 11 October, a few hours after his patent award had come into effect. Gould is now vice-president of Optelecom, a small company that makes optical fibers for guided missiles. His office, next to a passport photographer's shop, is located at the back of a shopping center in Gaithersburg, Maryland. "Back in the beginning," Gould reflects, "I felt some injustices were done in a couple of those interferences [Patent Office procedures for adjudicating between rival claims], and I felt very frustrated, but these things have long since mellowed and at this point I look on it as just an interesting adventure."

Gordon Gould

The "interesting adventure" has been uncertain, often lonely, and punctuated by numerous setbacks and heartbreaks. Gould has taken on in court such adversaries as Hughes Aircraft, Westinghouse, and Bell Telephone, fighting Bell not once but three times. During the 15-year course of litigation, his claims have reached the Court of Customs and Patent Appeals three times, which seems to be a record for a single case.

"There are many small inventors who work that patent system very well, but when there is a lot of money involved, such as in the Gould case, there are going to be people who will try to fight that patent in court," observes Nelson Moskowitz, the patent examiner who allowed Gould's present claim.

In addition to the constant litigation, Gould also fell foul of the military security bureaucracy which, because of his association with Marxism in the early 1940's, denied Gould clearance to work on a laser development project he designed, confiscated his notebooks, and generally impeded his work on lasers at a time when practical development of his ideas was crucial to establishing his claims.

It is probably too early to assess Gould's part in the invention of the laser or even the significance of the present patent award. Not only is the case one of the more complex in patent history, but those most knowledgeable in the field, the Patent Office's examiners, decline to make any substantive comment for fear of jeopardizing patent-holders' rights in court. Attorneys for Bell Telephone, holder of the expired Schawlow-Townes and other laser patents, also decline substantive comment. Schawlow is unable to comment in detail since he has never seen Gould's notebooks, and Townes is traveling abroad.

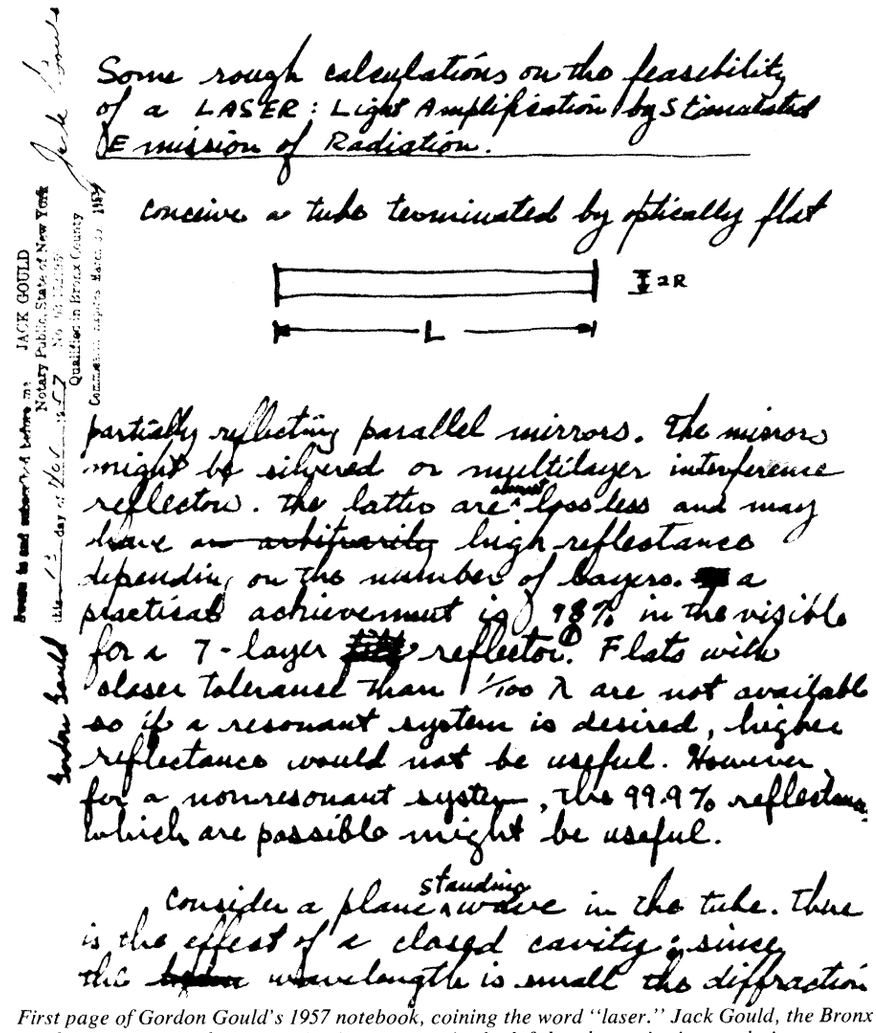
Patent examiner Moskowitz says that his ruling "does not contradict" the appeals court ruling of 1966 in favor of Townes and Schawlow. Gould and his licensing agent agree: in their view,

Gould's claims and the Schawlow-Townes patent cover different, but equally basic, aspects of the laser.

Laser amplication of light occurs when the electrons in a material, raised to a higher energy level so as to create a "population inversion," cascade back to a lower level and emit coherent radiation as they do so. The two methods by which population inversion is most generally achieved are optical pumping—for which the 11 October patent was granted Gould—and collisional excitation (as when a gas is excited by electrons)—for which Gould has a patent pending. The Schawlow-Townes patent, according to Gould, emphasized the pair of parallel mirrors which select from and enhance the lasing light radiation, but it did not "teach" how to make a laser amplifier.

According to Refac, Gould's licensing agent, the overall course of the 15-year litigation started when Gould lost on a technicality to Townes and Schawlow. He failed to prove "diligence," a patent law requirement that an inventor, from the day of conceiving his idea, spends every possible moment trying to reduce it to practice. Gould could only prove diligence from December 1958, the date of his second notebook, so losing the right to claim the 13 November 1957 date of the first notebook as the moment of invention. Since the Schawlow-Townes patent was filed in July 1958, the court found in their favor, and it was widely assumed that Gould's claims had been disposed of.

What in fact happened was that Gould's patent claims covered so many modes and applications of laser devices that they overlapped with many later claims filed by other laser inventors. Before Gould's claims could be cleared, the interferences with other patents had first to be settled. It has taken almost 15 years for the arcane machinery of the Patent Office and patent courts to run its ponderous course. Gould's claims withstood some challenges and yielded to others. The answer that the machine has now spewed forth, almost exactly 20 years after the day of original invention, is that Gould is indeed entitled to a patent on the basic phenomenon of laser amplification. With this patent granted, Refac's president Lang is confident that awards of the pending applications will soon follow. These include the use of lasers for heating, for melting and evaporating materials, and for distance measuring, as well as the application covering the principle of collisional excitation.


Some rough calculations on the feasibility of a LASER: Light Amplification by Stimulated Emission of Radiation.

Consider a tube terminated by optically flat

partially reflecting parallel mirrors. The mirrors might be silvered or multilayer interference reflectors. The latter are almost lossless and may have an arbitrarily high reflectance depending on the number of layers. A practical achievement is 97% in the visible for a 7-layer reflector. Flats with closer tolerance than 1/100 λ are not available so if a resonant system is desired, higher reflectance would not be useful. However for a nonresonant system, the 99.9% reflectances which are possible might be useful.

Consider a plane standing wave in the tube. There is the effect of a closed cavity since the wavelength is small the diffraction

JACK GOULD
Notary Public, State of New York
Qualified in Bronx County

First page of Gordon Gould's 1957 notebook, coining the word "laser." Jack Gould, the Bronx candy store owner whose notarization appears in the left hand margin, is no relation.

Gould's story begins in the winter of 1957. He was then a graduate student at Columbia University's radiation laboratory, of which Townes was the director. Townes had already invented the maser, a device for stimulating the emission of a coherent microwave beam, and the idea of doing the same at the wavelengths of light was much in the air.

Gould had been working on optical pumping systems for years, both at Yale and for his Ph.D. thesis, which concerned the optical excitation of thallium. During the weekend of 7–8 November 1957, the basic concepts of laser action "came in a flash," Gould says. He spent the following several days putting his ideas to paper. On the Friday he took his notebook to a local notary who ran a Bronx candy store. Besides the original conception, his notebook entry of 13 November 1957 contains the first use of the word "laser."

A few weeks later Gould received a phone call from Townes asking about the thallium lamp which he was working on for his Ph.D. thesis. Townes's queries alerted him that Townes might be thinking along similar lines. Gould took his ideas to an attorney who advised him, erroneously, that he would have to reduce his ideas to practice to get a patent. Gould's thesis adviser, Polykarp Kusch, seemed unlikely to approve work on any so practical device as a laser, so Gould postponed work on his Ph.D. (to which he never returned) and left Columbia to pursue his laser ideas with a corporation known as TRG.

At TRG Gould developed other laser ideas which he recorded in a second notebook of December 1958. In particular he foresaw the intensive heating effects that could be derived from lasers, on the basis of which he wrote a proposal for the military use of lasers. The Defense Department's Advanced Research Projects Agency was so impressed with the idea that in 1959 it awarded Gould and TRG a $1-million contract, three times the sum that he had asked for.

Gould now began to run into serious difficulty in establishing credit for his ideas. From an early age he had wanted to be an inventor, and perhaps because he saw himself as an inventor rather than as a physicist, he neglected the scientific

road to credit, which is to publish first. With their celebrated paper in *Physical Review* of 15 December 1958, Townes and Schawlow became the first to publish a description of the laser. They were also first to file a patent application, in July 1958, which placed the burden of proving priority on Gould, whose claim was filed 9 months later.

Gould suffered a further setback when the Defense Department, carried away with excitement over the laser's military potential, first classified the Gould-TRG contract, and then denied its originator clearance to work on it. Even Gould's own notebooks were declared to be classified material to which, lacking a clearance, he was denied access. Schawlow recalls that the Defense Department also tried to classify the work at the Bell Telephone Laboratories but backed off when Bell threatened to drop laser research altogether rather than do classified work.

Blackmail by FBI

Gould was denied clearance because of an incident that occurred as far back as 1943 when he was working on the Manhattan project. "My first wife and I were both socialist minded, in great contrast to the way I feel now," Gould remarks. "We studied in a Marxist study group for a while. We were discharged when that was discovered. It was discovered because there was an agent of the U.S. government in the group, who was in fact our teacher. It was he who encouraged us to join it. He was a paid agent provocateur. The FBI blackmailed him into becoming an informer, and then into getting people into this group."

Gould's political ideas were changed abruptly by the Czechoslovak coup of 1948, and the divergence of views encouraged him and his wife to separate. But the McCarthy period of American political history was about to begin, and the FBI's blackmail game was to haunt him twice more. In 1954, when he was teaching part-time at City College, New York, he was fired for refusing to supply a Board of Higher Education subcommittee with the names of friends who might at one time have held similar political beliefs. The same incident of 1943 underlay the Defense Department's denial of clearance some 16 years later. "It put him at a terrible disadvantage and maybe had a lot to do with the way the patent was awarded," remarks Frederick Burns, president of Apollo Lasers; being unable to work on his contract, Gould was deprived of the opportunity to reduce his ideas to practice. The first working laser was produced in 1960 by Theodore Maiman of Hughes Aircraft. But Maiman's broad claim for a laser patent was rejected—because the Patent Office eventually decided that Gould had priority in the idea for a ruby laser.

Just as Schawlow and Townes were backed by Bell Telephone, Gould's claims were supported by his employer, TRG, which spent about $250,000 in pursuing them. The company was taken over by Control Data Corporation and dissolved in 1970. Since Gould had come to TRG with many of his laser ideas already formed, he managed to avoid signing away his patent rights as many industrial researchers are required to do. With the dissolution of TRG he was able to reacquire his patent rights and continue litigation on his own account. But by 1974 his resources had been wiped out and his case was no nearer resolution. Gould then entered into an agreement with Refac, a New York–based technology licensing company, whereby Refac would continue the litigation and the royalties would be split on a 50:50 basis. At the Patent Office's request, Refac's attorneys have divided Gould's original patent claims into six separate inventions, of which the first has now been awarded a patent.

The tortuous course of Gould's patent claims mirrors some of the main events in the development of laser technology. His claims have gone through five Patent Office "interferences" with other inventors and the numerous appeals that have resulted. The first interference, with the Schawlow-Townes patent, was lost on appeal, through failure to prove diligence. A second interference, initiated in 1963, pitted Gould again against Bell for a device known as Brewster angle windows, which facilitate transmission of laser beams. Gould won, on appeal, in 1967. A third battle with Bell took place over Ali Javan's claim for a helium-neon laser; Gould lost on appeal in the U.S. courts, although he won a similar interference action in Canada.

A fourth interference action took place between Gould and Robert Hellwarth of Hughes Aircraft over invention of Q-switched or "giant pulse" lasers. A court decision in 1973, 10 years after the interference was initiated, found in Hellwarth's favor on the grounds that Gould's 1959 patent application did not give sufficient detail to make an operable Q-switch. According to Refac, the court in the same decision held that the Schawlow-Townes patent also failed to "teach" how to make a workable laser oscillator. (Schawlow says he has no knowledge of this decision.)

Gould's big break came in the outcome of a fifth interference action, with Irwin Wieder of Westinghouse. Wieder's claim covered all optically pumped laser amplifiers. A court decision of 1972 ruled against Wieder and affirmed Gould's priority on all his claims. It was this decision which opened the way for Gould's present set of claims.

According to Refac, Gould's present and pending patent applications will cover almost the entire industry, if granted. The hundreds of laser patents granted to other parties throughout the world are for the most part "probably subordinate to inventions contained within Gould's 1959 patent application," according to Refac. Gould's position as "father of the laser," the company claims, "in no way denigrates the enormous value, consequence and contribution of many other brilliant physicists such as Townes, Schawlow, Maiman, Hellwarth. By the same token, the work of all these eminent scientists cannot detract from Gordon Gould's rightful position which, after eighteen years, is coming to fruition."

Refac is now engaged in negotiation with makers of optically pumped lasers to collect a royalty fee. The company also holds that even users of lasers are subject to paying royalties, a retrospective claim that several manufacturers regard as outrageous. The claim may be just a bargaining chip, as may the position of laser manufactuers such as Apollo Lasers' president Fred Burns, who says he will "take any reasonable step to avoid paying royalties twice over." A patent, says Gould, who should know, "is just a government license to sue somebody—it doesn't provide any way to collect the money. You have to do that by negotiation or litigation."

For Schawlow, the turn of events is something of a puzzle. "It sounds like what happened when Watt invented the steam engine—someone else patented the crank." Gould says he has no hard feelings toward Schawlow or Townes, and believes they have none toward him—"They just don't understand what has been going on."

Musing in his Gaithersburg office, opposite an outside photograph of one of Optelecom's targets, a Soviet T-54 tank, Gould conveys that he values the patent award for its vindication of his position as much as for any royalties it may generate. "If as a result of this a lot of money comes in, it is not going to change my life much. The things I get satisfaction out of, I will be able to do better, that's all. Instead of writing proposals most of the time, I can actually be doing something constructive."—NICHOLAS WADE