

## Odyssey of a Nobel Laureate

The year was 1955. The young Norwegian immigrant sat in the employment office at the Canadian General Electric plant in Ontario, Canada. Since arriving in Canada three months earlier with just \$190 in his pocket, he had struggled to support his wife and new baby with a low-paying job in an architect's office. This interview was his big chance.

The young man was a mechanical engineer, a 1952 graduate of the Norwegian Institute of Technology, and he'd brought along a transcript of his courses and grades. Across the desk, the interviewer ran his eye down the list: 3.0's and 4.0's in physics and math. "Nice marks," he commented.

By the end of the day, Canadian GE had a new employee: Ivar Giaever. The interviewer didn't know it, but he had signed up a future Nobel laureate. On December 10, 1973, Ivar - who by that time had moved on to become a physicist at the General Electric Research and Development Center - would be presented with the Nobel Prize for physics.

And there was something else the interviewer didn't know. In Norwegian colleges, the grading system is just the reverse of that in Canada and the U.S. Over there, the highest mark is a 1.0 and the lowest is a 4.0!

In Stockholm, Ivar shared the 1973 Nobel Prize for physics with two other scientists. Working independently, they had made key advances in the study of electron tunneling, applied to both semiconductors and superconductors. The latter are materials that lose all resistance to the flow of electricity when cooled to temperatures near absolute zero (minus 459° Fahrenheit).

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Question: When you were growing up in Bergen, Norway, did you see that Nobel Prize glinting out there somewhere in your future?

No, I really didn't. I had no connections with science whatsoever. I'd never met a scientist, although - like everybody else - I'd heard of Einstein. I was interested in taking apart clocks and other things and trying to put them together again, and I was an admirer of creative people like great musicians and writers. I tried to play an accordion, but I wasn't very good. I wrote some poems, but I wasn't very good at that either. I was interested in creative people, but I didn't know at that time how I could be one.

Question: Is that finally what made you want to be a mechanical engineer?

When I finished high school, it was a toss-up between engineering and pharmacy. I was always interested in mechanical things, but I wasn't absolutely sure I wanted to do engineering. My uncle was an engineer. He also was a very dull person. I was also interested in becoming a druggist since my father was one. Fortunately for me, I chose engineering.

Question: You've never made a secret of the fact that you weren't the world's greatest student, have you?

That's right. In my Nobel Prize talk, I pointed out that when the award was announced, my hometown newspaper ran a story about me headlined: "Master of billiards and bridge, almost flunked physics, gets Nobel Prize." I admitted that the reporting was reasonably accurate and confessed that I almost flunked math as well. I did manage to graduate with an average degree.

At the time of Ivar's work, theorists had been struggling for decades to explain the strange phenomena that occur in superconductors. His research on electron tunneling in these materials provided the critical data that conclusively confirmed the accuracy of one of those theories. That contribution brought him science's top award.

A decade has slipped by since that once-in-a-lifetime evening when Ivar became the second GE scientist to become a Nobel laureate. (The first was Dr. Irving Langmuir, who won the 1932 Nobel Prize for chemistry.) On the outside, very little appears to have altered in Ivar's life. He still lives in the same split-level house a mile down the road from the R&D Center. He still works in the same laboratory bay. And he still has a lively sense of humor.

But under the surface, plenty has changed. The man who switched from mechanical engineering to physics, winning the Nobel Prize along the way, has switched fields again. He's now involved with one of the fastest-moving areas of modern science: biophysics (the study of living things with the tools of a physicist).

One recent result of this work was the invention of a new technique for mass-culturing mammalian cells. Vast quantities of these cells are required for medical research and for the production of vaccines and other scarce substances. Ivar and a colleague learned how to grow the cells on droplets of oil suspended in a nutrient solution. The result: increased yields over conventional methods in which cells are cultured on flat surfaces.

Question: What made you leave Norway?

After I finished college and spent a year in the army, I tried to find a place to work and a place to live. It was relatively easy to find a job, and I worked as a patent examiner. But it was absolutely impossible to find a place to live. I finally gave up and took my wife and son to Canada - with every intention of moving back to Norway some day. In Canada, I tried to get a job at a lot of companies, but everybody except Canadian GE turned me down flat.

Question: Was that because their interviewers knew how to interpret Norwegian report cards?

No. The problem was that those companies wanted to hire only Canadian citizens, and I wasn't one. I want to emphasize that I didn't tell the Canadian GE interviewer that my college grades were good. He deduced that himself, and I didn't correct him. Anyway, I always felt that my performance in physics and math was pretty good - even if my marks didn't agree.

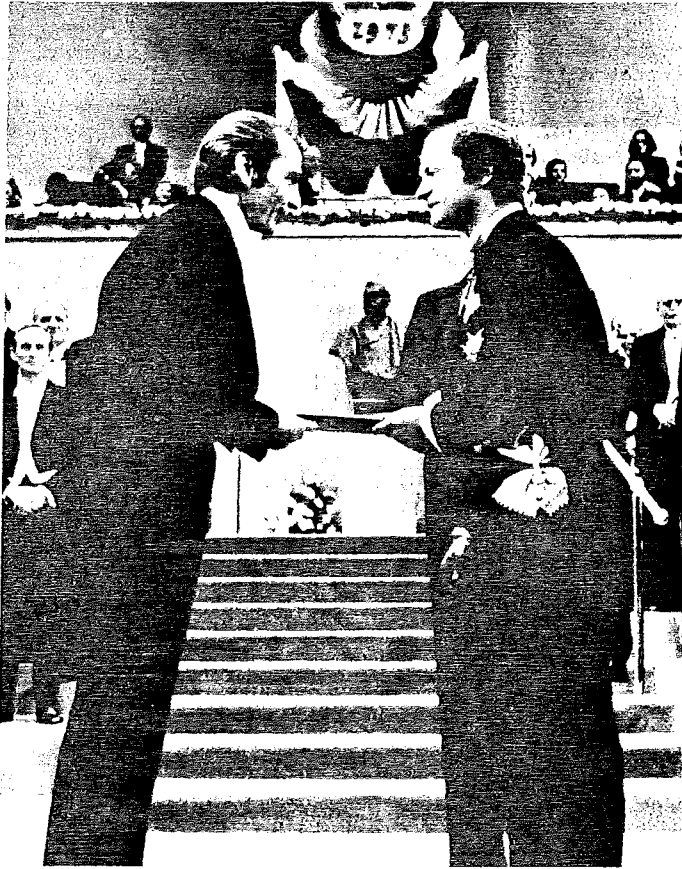
Question: What was the catalyst that changed a guy who got low marks in science and math into a Nobel laureate?

I really owe that to the General Electric Company. At Canadian GE, they took me on the Test Course, giving me rotating assignments testing switchgear, DC machines, and so on. I liked that a lot. And secondly, I had a chance to join GE's Advanced Engineering Program, the company's in-house training course for engineers.

At that point in my life, I was married and a father, and I  
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Stockholm, December 10, 1973: Ivar Giaever (left) and King Carl XVI Gustaf.

felt much more responsible than I did when I went to college. I knew that this was my last chance to make something of myself. I really worked very hard, and I learned an awful lot. You've also got to realize that, in Norway at that time, the common thing for an engineer was a job in manufacturing in a small company, where common sense rather than, say, theoretical knowledge was a premium specialty. But in a company like GE, it was clear that an engineering degree gave you a vast opportunity. I really got fired up by that.

The training course brought me to Schenectady, and I eventually wound up at the Research Laboratory (now part of the R&D Center). The scientists here were very exciting and stimulating, and I decided to switch from engineering to physics. On a part-time basis, I started to go after a doctorate in physics from Rensselaer Polytechnic Institute.

While I was splitting my time between the lab and RPI, I got the idea that led to the Nobel Prize. Since the experiment was successful, I did not have time for RPI, so I dropped out of a course in solid-state physics. The professor who taught the course still likes to tell people about giving me an "Incomplete." I later went back and passed it. I received my Ph.D. in physics from RPI in 1964.

**Question:** What were things like on that day when you were notified that you had won a Nobel Prize?

The call came to my house around 7:00 a.m. Five minutes later, one of the wire services called and, after that, the phone never stopped ringing. The lab sent a limo around to my house, and I sent it back. What with all the calls, I hadn't had breakfast yet - and I was a little embarrassed about all the attention. Then, the poor driver came back and insisted that I had to get in because all my friends and colleagues

were waiting for me in the lobby. When I got there, they actually rolled out a red carpet. Unfortunately, after that first day, they stopped sending around the limo.

**Question:** What have been the advantages and disadvantages of the Nobel Prize?

You have very distinct advantages, because you get a lot of opportunities that normally wouldn't come your way. For example, people invite you to go to exotic places. I was invited to spend a month in the People's Republic of China, touring some of their labs. A Nobel Prize also lets you meet very many famous people and provides you with a different perspective.

It also has some distinct disadvantages. Unfortunately, most people take Nobel Prize winners seriously, and that includes some of the Nobel Prize winners themselves. Because I'm a winner, people tend to think I should have some unique insights into everything, from the Middle East crisis to every conceivable scientific field. Of course, I don't know any more about them than anyone else, so I've got to watch what I say - which I'm not very good at. I also receive a lot of invitations to give talks. All told, however, the advantages far outweigh the disadvantages.

**Question:** You hold a bachelor's degree in mechanical engineering, a Ph.D. in physics, and, a few years ago, you switched your field to biophysics. Why this latest move?

These days, physics requires a lot of teamwork and dependence on sophisticated, expensive equipment. Biology suits me better in many ways. It's still a field where a lot of things happen every day and where a single, simpleminded person can make a difference. It suits my temperament much more.

**Question:** Looking back on the numerous twists and turns in your career so far, do you see any message?

Life is a series of turning points, where your path can go in one direction or another, and mine has been no exception. For example, what if there hadn't been a housing shortage in Norway and I had stayed there? What if that interviewer in Canadian GE's employment office had understood what my grades really meant? And so on. That goes for the Nobel Prize, too. It's really nice to get it, but you realize that a lot of other people are equally qualified. I was lucky.

**Question:** Considering your history, I'll bet that parents sometimes ask you for advice about how to motivate their kids. What do you tell them?

I do get questions like that, but I'm no expert on children, either. But look, children live with you, and they see how you behave, and they imitate your own behavior, whether you like it or not. Parents might keep that in mind when they tell children to do their homework and then park themselves in front of a football game or something else on TV.

What you should really do, I think, is to expose children to a lot of things. One way is through books. I grew up in farm country. My father loved to read, and he bought big wooden cases full of books at auctions in Denmark. (Norwegians can read Danish.) I learned how to read long before I started school. Of course, when you buy boxes of books at auctions, most of the stuff you get is garbage. But I read them all - including Tarzan in Danish.

**Question:** Now that you've outgrown Tarzan, what do you do for fun these days?

Tennis, skiing, wind-surfing, and running. I took up marathon running a couple of years ago. I entered the New York Marathon in 1982, and I actually finished it (although my time is classified). A marathon is a little over 26 miles long. I

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think that running must be good for you, because it's painful and you just can't let yourself vegetate away, which a lot of people do when they hit their 50's. I've cut back this year, and I get in only about 20 miles a week. I also crosscountry ski a lot. I have a bunch of friends I went to school with in Norway - who also got 4.0's in their subjects, I might add - and they all live here in the U.S. The five of us get together one week in the winter to go downhill skiing - last year at Lake Tahoe and this year probably in California.

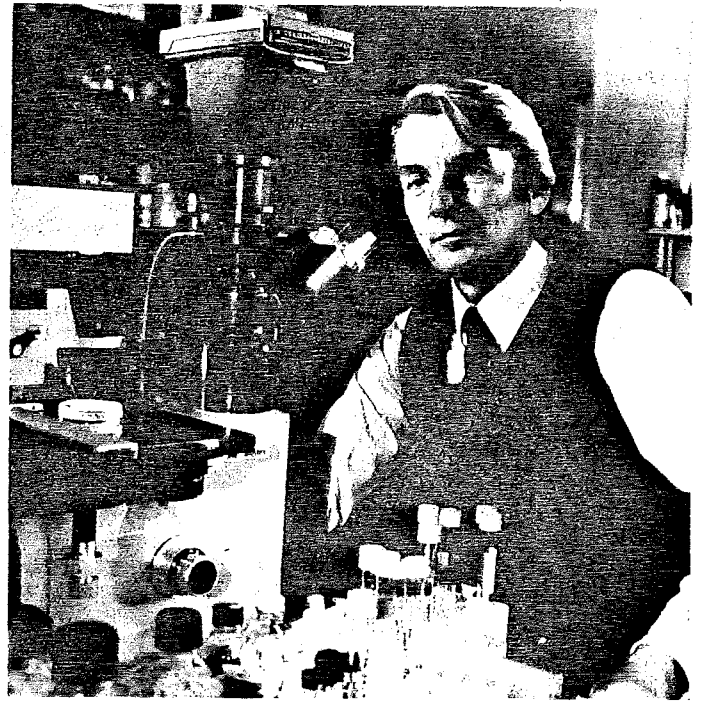
Question: Let's talk about creativity. What's the secret of inventing something?

People think that ideas come in a flash, but that's not true. Suppose you have an invention in mind, but don't quite know how to do it. You hit your head up against the wall many times. You think about the problem a lot, consciously and subconsciously, and nothing really happens. You are always sort of working at it - even when you're standing in line at a bank. Then, suddenly, you realize that you've been thinking about things slightly wrong - and the solution falls into place. Once you know what it is, you often can't imagine why you couldn't have thought about it before.

Question: Is that why Edison said genius is one percent inspiration and 99 percent perspiration?

I can hardly believe that Edison was serious when he coined that phrase. When I was taking GE's advanced engineering program, I worked harder than at any time before or after in my life. The secret was that I liked it. It is my belief that you can't pay or force people to work that hard - to be so obsessed with something that you spend most of your time worrying or thinking about it. The only reason people do that is for excitement or a genuine love for the subject.

How many people would be willing to play the slot machines in Las Vegas for, say, \$10 an hour if they could not partake in a profit? Of course, because of expectations, people are willing to play - and lose - even though the task itself is more mindless than any assembly line.



Ivar in the lab: from mechanical engineering to physics to biophysics.

I really feel that "excitement" is what makes the world turn, whether you find it in a tennis match or in lonelier pursuits such as fishing and crossword puzzles. And for those of us who are lucky, it comes in our daily pursuit.

- Pete Van Avery