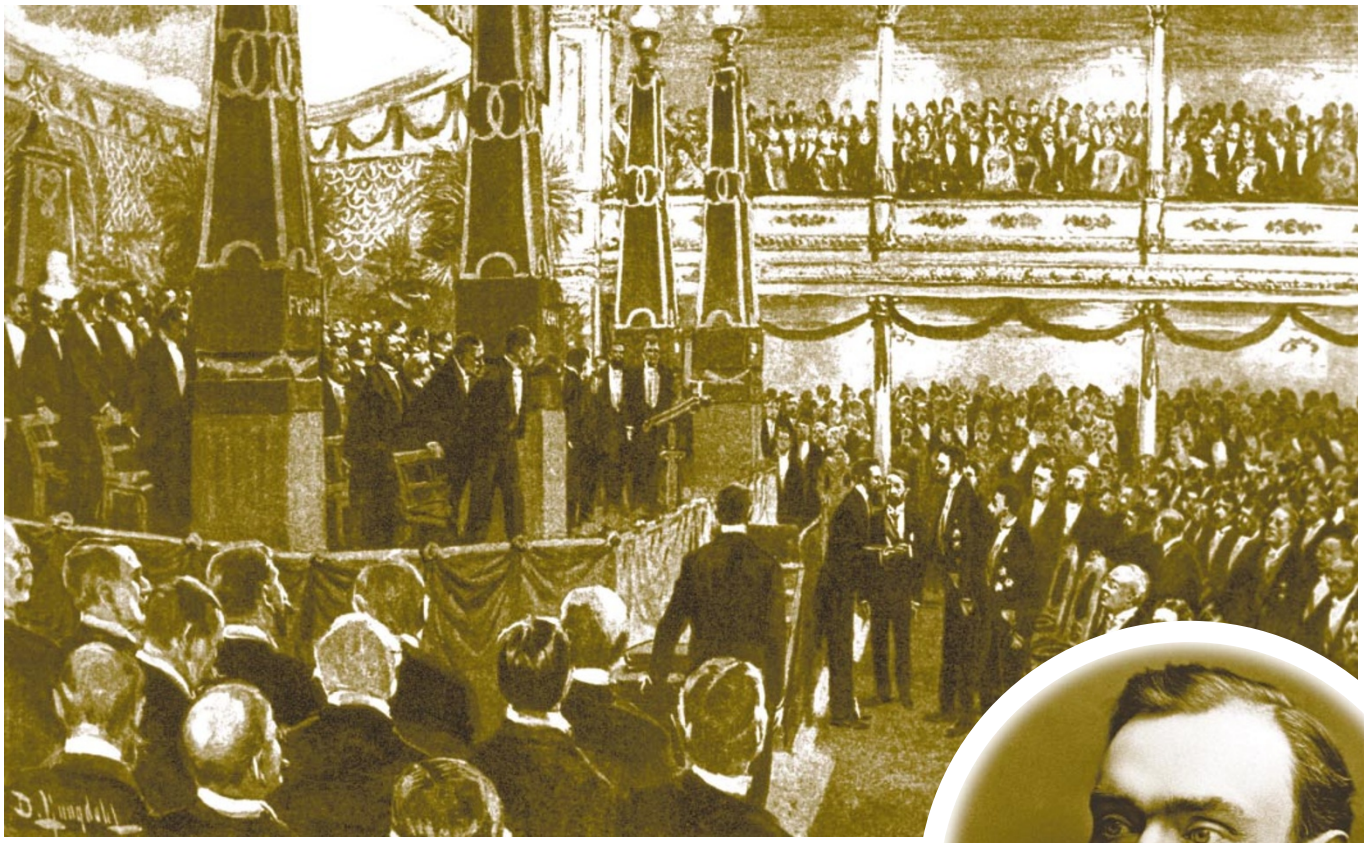
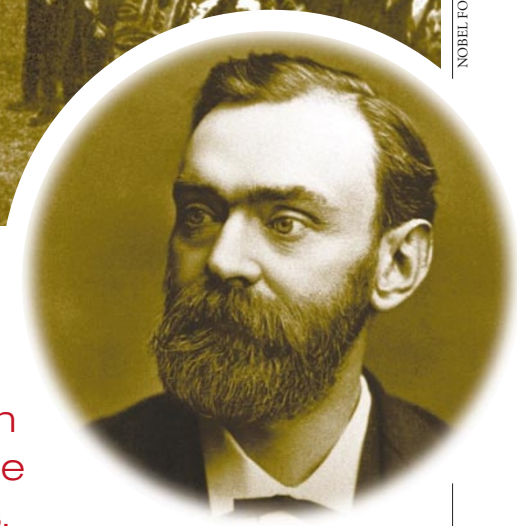


NOBEL FOUNDATION



NOBEL FOUNDATION

Eyes on the prize

The Nobels mark their centenary this week. Their prestige is unquestioned, but does the way in which winners are selected reflect the way science is done in the twenty-first century? Trisha Gura investigates.

For a few days each October, scientists who were previously famous only within their narrow fields of endeavour are fêted as heroic pioneers who have extended the boundaries of human knowledge. Areas of research that might normally struggle to gain media attention find themselves given top billing.

Such is the prestige of the three science Nobel prizes. The announcement of this year's winners (see pages 553–554) marks the awards' centenary — a good time to reflect on how they came to acquire their present status, and to ask whether the procedure for choosing the winners is in tune with twenty-first-century science.

The Nobels perform an impressive public-relations job for research — or at least for those disciplines that the prizes honour. They create an inspiring image of lone pioneers receiving the ultimate accolade for their individual brilliance. But now that science has evolved into a more collaborative process in which projects can command billion-dollar price tags and involve thousands of scientists, is this image really appropriate? And how do the few key individuals to be rewarded get selected? The details remain mysterious, as the Nobel committees' deliberations are kept secret for 50 years after each prize is awarded. But as historians of science trawl through earlier archives, they have found that the selection process has, on occasion, been eccentric.

Winning lines

When he wrote his will, Alfred Nobel probably had no idea what it would lead to. Fabulously wealthy from his invention of dynamite, Nobel bequeathed the majority of his estate to create five prizes to honour achievements that have "conferred the greatest benefit on mankind" in chemistry, physics, physiology or medicine, literature and the promotion of peace.

Nobel charged four Scandinavian institutions with selecting the winners: the Royal Swedish Academy of Sciences, responsible for physics and chemistry; the Swedish Academy, for literature; the Karolinska Institute, Sweden's leading medical school, for physiology or medicine; and a committee appointed by the Norwegian parliament, for peace. (The economics prize is a modern invention, established by the Bank of Sweden and first awarded in 1969.)

The prizes' value was unprecedented. When they were first awarded in 1901, five years after Nobel's death, the value of each represented about 30 times the salary of a university professor. Today, a lone winner of a Nobel will take home 10 million Swedish Kronor, or about $940,000.

The sums involved certainly helped to build the Nobel legend, but money cannot completely explain the prizes' unique status. A handful of other science awards — some of which were set up to reward disciplines not covered by the Nobels — now offer handsome payments (see 'Not quite a Nobel…', page 564). Yet none have quite the same cachet — how many winners of the Crafoord prize can you name?

AP

Past and presentations: the first Nobel award ceremony in 1901 (left) and last year's version (above) — prestigious legacies of Alfred Nobel (left, inset).

Science historians argue that the Nobels owe part of their prestige to the geopolitical climate into which they were launched — and the calibre of some of the early winners. Nobel willed that the prizes should be truly international, which gelled with the intense, but peaceful, national competition that characterized the end of the nineteenth century — the modern Olympics had just been launched, and world fairs were in vogue. Within the first five years, Nobel laureates included such luminaries as Wilhelm Conrad Röntgen, the discoverer of X-rays, physiologist Ivan Pavlov, and Pierre and Marie Curie, rewarded with Henri Becquerel for their work on radioactivity.

Today, the stakes are even higher. In addition to the monetary value of the prize, laureates can expect their labs to receive an immediate boost in funding from public and private sources, and unprecedented opportunities for travel. For those who enjoy the celebrity, there is also the prospect of book contracts and television appearances.

"In the first few years after you get the prize, granting is probably biased in your favour," says Hamilton Smith of Celera Genomics in Rockville, Maryland, who shared the physiology or medicine prize in 1978 for the discovery of DNA-cutting restriction enzymes.

Arvid Carlsson of Gothenburg University in Sweden, who shared last year's medicine or physiology prize for his work on the neurotransmitter dopamine, says that obstacles which had been frustrating his efforts to launch a spin-off company to exploit a drug for Parkinson's disease, including financing and accommodation on the university campus, suddenly melted away. "A number of problems were completely eliminated," he says.

Fame game

Nobel laureates can also become public figures, whose views are sought by those in power. Take Peter Doherty, who shared the prize in physiology or medicine in 1996 for his work on cell-mediated immunity. Doherty, who works at St Jude Children's Research Hospital in Memphis, Tennessee,

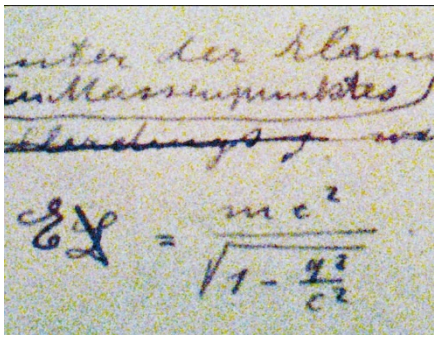
SPL; CORBIS; NOVOSTI/SPL

Shining stars: luminaries such as Pierre and Marie Curie (left), Wilhelm Röntgen (centre) and Ivan Pavlov (bearded, right) helped to cement the Nobel legend.

was the first Australian to win a Nobel since 1975. "I have been very much on the public stage in Australia," says Doherty, who has found himself projected as a spokesman for science, and given access to the country's leading politicians. He jokes about acquiring a celebrity akin to that of "a sort of minor figure in a coffee commercial".

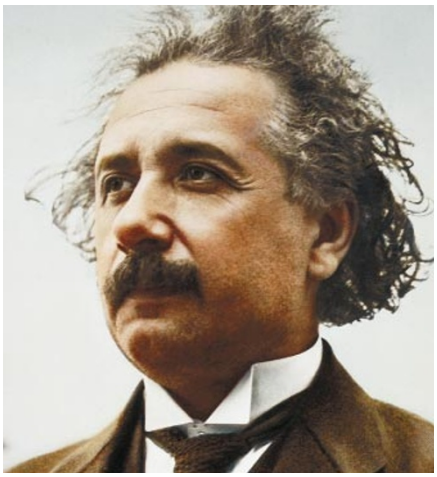
No wonder, then, that scientists worldwide are fascinated by the process for selecting winners. This had to be painstakingly worked out after Nobel's death, as he left no clear instructions. The inventor had not consulted with any of the institutions he named, nor did he illuminate his two executors — his personal assistant Ragnar Sohlman and engineer Rudolf Lilljequist, who had no prior association with Nobel.

Rows erupted when the executors, academic institutions, the Swedish government and Nobel's family — who received a tiny fraction of his inheritance — sat down to thrash out a legal statute. For the science prizes, the sparring factions eventually settled on a formula that remains largely unaltered a century later. Nobel's wish that the prize be awarded for work conducted in the preceding year was immediately thrown out — it simply did not give enough time to assess the impact of a discovery. And a rule that the prize could be split between two discoveries if both were thought to merit an award was inserted.



All in the mind: Einstein's general theory of relativity was dismissed as mere speculation by the Nobel selection committee.

To be eligible for consideration, a candidate must be proposed by a nominator from one of six categories: members of the awarding institutions; members of a Nobel committee selected for each prize; previous winners; professors of physics, chemistry and medicine at Swedish and other Nordic universities and technical colleges that existed in 1900; chairs in these fields at six other universities or faculties of medicine selected by the awarding institutions; plus scientists invited to participate on an ad hoc basis.



AP; CORBIS

The Nobel committees, made up of between three and five people, lie at the centre of the decision-making process. There are no limits on members' nationalities, but historically most have been Swedish.

Japan seeks a record haul

In December 2000, as part of its Science and Technology Basic Plan, the Japanese government set its scientists an ambitious goal: 30 Nobel prizes in the next 50 years. This would mean a fivefold increase in the success rate experienced over the past half-century.

Few Japanese researchers take this statement seriously. As one researcher at the University of Tokyo's Graduate School of Medicine says: "Could the government of any other country get away with making such ridiculous promises?" How a national drive for greater Nobel success should be conducted remains unclear, and there is the potential for efforts to backfire. An information office established in April at the Karolinska Institute in Stockholm by the Japan Society for the Promotion of Science has already been dismissed by some scientists as a veiled — and vain — attempt to lobby the medicine Nobel committee.

But the plan has at least sparked a debate on why Japanese scientists are so poorly represented in the ranks of Nobel laureates. Some Japanese scientists argue that the problem is a fundamental lack of creativity, stemming from an educational and social system that promotes rote learning and conformity. But James Bartholomew, a historian of Japanese science at Ohio State University in Columbus, rejects this self-deprecating stereotype. "The image of the Japanese as unoriginal is unfounded," he says.

Nevertheless, many researchers believe that Japan's academic '*koza*' system, which places immense power in the hands of university professors and limits the freedom of younger investigators to set their own research agendas, has a stifling effect. "Everyone in our lab had to do projects dictated by our professor," says one molecular biologist, now in the United States. "But we each had our own 'shadow projects', which we could only work on when he was not around."

Hideki Shirakawa of the University of Tsukuba, who shared last year's chemistry Nobel for his work on electrically conducting organic polymers, argues that improving the situation may require changes to the laws that govern Japan's public university system. "Younger scientists have a very restricted range at universities," he says. "They have no chance to change supervisors unless they go abroad."

AP

Kenichi Fukui (back row, centre) with the other scientific laureates of 1981.

AP

Hideki Shirakawa receiving his chemistry Nobel last year.

Language may also be a barrier — researchers who are not at ease with English inevitably struggle to gain international recognition. Bartholomew points to Kenichi Fukui of Kyoto University, who shared the 1981 chemistry Nobel for his theoretical insights into the mechanics of chemical reactions. Fukui, who died in 1998, was criticized for his "insufficiently elegant" English formulation of his ideas even after he won, says Bartholomew. How many more deserving candidates failed to be nominated because of their poor English skills remains unclear. Lurking in the background, though seldom voiced directly, are fears that Japanese researchers are discriminated against by the European and North American scientific establishment.

But some members of that establishment argue that Japanese scientists must shoulder some of the blame. Speaking on a visit to Japan in July, Anita Aperia of the Karolinska Institute, a member of the medicine Nobel committee, questioned the approach of some of the nominations coming from Japan. "People have to realize that the nominations are for discoveries, not for lifetime achievements," she said.

Whatever the reasons for Japan's poor showing in the Nobels, few expect an official target to make an enormous difference. "We can't be short-sighted," says Reiko Kuroda, a biophysicist at the University of Tokyo and a member of the Council for Science and Technology Policy, the government's premier science advisory committee. "Nobels are an outcome of good research culture, not a target to be directly aimed at."

David Cyranoski, Tokyo

AP

Into the limelight: both Arvid Carlsson (left) and Peter Doherty say their Nobels altered their lives.

Members are selected by the awarding institutions, and their terms are limited to nine years. Many of the conventions that determine the committees' workings are unwritten. "It takes a long time to learn the rules," says Cecilia Jarlskog of CERN, the European Laboratory for Particle Physics near Geneva, who headed the physics committee until 1999.

Usually, the committees' word is final. But they are monitored by the awarding institutions, which on occasion have pulled rank. In 1906, for instance, the Royal Swedish Academy of Sciences rejected the chemistry committee's majority decision to award the prize to Dmitri Mendeleev for his periodic table of the elements. This intervention was a result of the powerful influence exerted by Swedish chemist Svante Arrhenius, who won the chemistry prize in 1903 for his theory of electrolytic dissociation — of which Mendeleev had been a prominent critic. Mendeleev died the next year and never won a Nobel.

Picking winners

Today, as in the early 1900s, invitations for nominations are sent out in September with a deadline of the following February. Committee members spend their summers reading through the stacks of evaluations and publications.

For three-quarters of a century, this was all the public knew about the selection process. But in 1975, the Nobel Foundation decided to open the archives on each prize after 50 years. Science historians have since pored over details of the nominations, and of the views expressed by members of the Nobel committees, for the early prizes. If the archives are any indication, the statutes generated confusion and contention from the start. Nominators were not sure how to interpret wording such as "greatest benefit to mankind" or even how to define physics or chemistry.

For example, in 1923, the solar astrophysicists George Ellery Hale and Henri Deslandres had emerged from the Nobel physics committee's earlier deliberations as leading candidates. But according to historian Robert Marc Friedman of the University of Oslo, author of *The Politics of Excellence: Behind the Nobel Prize in Science* (Henry Holt, New York, 2001), newer members of the committee decided that astrophysics was a subdiscipline of astronomy, rather than physics, and so was not eligible.

> I have very much been on the public stage … like a sort of minor figure in a coffee commercial. **Peter Doherty**

Friedman says that many of the early committees were rife with strategizing and personal biases. "The distance between the high ideals declared and the actual practices are even more apparent than I had originally anticipated," he says.

One classic struggle surfaced in the delay in awarding prizes to the physicists Max Planck and Albert Einstein. According to Friedman and other historians, this was mainly because the Swedish scientific community in the early 1900s embraced experimental physics and dismissed theory as mere speculation. As late as 1921, Bernhard Hasselberg of the Royal Swedish Academy of Sciences, a member of the Nobel physics committee, intervened from his sickbed to protest against Einstein being rewarded for his work on general relativity. "It is highly improbable that Nobel considered speculations such as these to be the object of his prizes," Hasselberg wrote.

Difficult choices: Cecilia Jarlskog believes that selection processes may have to change.

CERN

Faced with impasse, the Royal Swedish Academy of Sciences deferred the award of the 1921 physics prize. A solution was found the following year by committee member Carl Wilhelm Oseen of Uppsala University, who suggested that Einstein be awarded the reserved 1921 prize for his discovery of the law of the photoelectric effect. But Oseen was careful to delineate the empirically proven law from the quantum theory that lay behind it — the idea that light can behave as particles as well as waves.

Rumour mill

It is not clear to anyone outside the committees or awarding institutions whether such internal battles still take place, as the deliberations remain shrouded in secrecy. In this information vacuum, rumours abound about candidates and their associates or host institutions lobbying for Nobel recognition. "I hear there are a lot of scientists and people around them who are in touch with the Karolinska outside the regular nomination procedures," says Carlsson. The decision by the Japan Society for the Promotion of Science to establish an information office at the Karolinska Institute, for instance, has been viewed in this light (see 'Japan seeks a record haul', opposite).

Many observers argue that overt lobbying is unlikely to be effective — and is probably counterproductive. The committees "are not exactly naive", says Doherty. Jarlskog stresses that flooding the Nobel committees with nominations for a particular individual will not work, as winners are not chosen by tallying the nominations.

Some scientists argue that the entire process should be opened up to public scrutiny. "I think this is completely out of phase with the current face of science," says one critic, who asked not to be identified. "If the prize is going to have the capacity to rewrite history, which it does, the system ought to bear some accountability." But others argue that a more transparent process would only unleash torrents of discontent. "I would not like to see candidates know who nominated them," adds Carlsson.

Jarlskog argues that truly deserving candidates tend to be nominated year after year, which means that their claims are eventually recognized. "We assume that it is better to be late than to be wrong," she notes. But thanks to rules that prevent posthumous awards, even if the candidate was alive when

nominated, the wait proves too long for some candidates. "There is a lot of luck in this," Carlsson says. "In my case, I had to see to it that I lived sufficiently long."

Three-way splits

But the most vociferous debate surrounds the 'three-person' rule. This is a 1968 amendment to the statutes, covering all Nobel prizes, which states: "in no case may a prize be divided between more than three persons".

The rule sparked intense controversy three years ago, when many scientists were outraged at the exclusion of Salvador Moncada, director of the Wolfson Institute for Biomedical Research at University College London, from the medicine prize (see *Nature* **395,** 625–626; 1998). That prize, for research on signalling by nitric oxide in the cardiovascular system, was shared by Ferid Murad of the University of Texas Medical School in Houston, Robert Furchgott of the State University of New York and Louis Ignarro of the University of California, Los Angeles.

Although no one doubted the winners' contributions, previous laureates led by César Milstein of the Laboratory of Molecular Biology in Cambridge, winner in 1984 for his discovery of monoclonal antibodies, argued that Moncada had been an equally pivotal figure. Moncada today declines to discuss his bitter disappointment. But Murad argues that there were "one or two others in line" before Moncada, and says he is disappointed by the negative publicity generated by the protests. "It was a mess and totally inappropriate," he says.

This particular controversy might never be entirely settled, but it highlights the three-person rule's limitations. In many fields, it is increasingly difficult to identify three or fewer individuals responsible for a particular discovery. In disciplines such as high-energy physics and genomics, it is practically impossible. "With collaborations getting bigger and bigger, it is not obvious who the driving force was," says Roger Cashmore, director of research for collider programmes at CERN.

Celebrity shared

Cashmore suggests that, in such cases, the prize might be awarded to an institution, as has been done for the peace prize on several occasions, most recently to the medical aid charity Médecins Sans Frontières in 1999. "It does not make as huge an impact, but it does award the institution enormous recognition and kudos," he argues. But so far, the awarding institutions for the science prizes have declined to allow institutional awards.

Although such awards might ease the particular headaches created by disciplines such as high-energy physics, they would leave the general issue of the three-person rule's potential for arbitrariness unresolved. "We ought to create something that gets to the real heart of what science is supposed to be about," advocates Friedman.

But for every voice in favour of relaxing the three-person rule, there is another arguing for tradition. Says Murad: "If you change it from three, should it be given to four, ten, twenty? Where do you stop?"

Others argue that relaxing the rule would destroy the mystique that enables Nobel laureates to become influential spokespeople for science. "It's the star system," says Doherty. "By giving the prize to hundreds of people, you will rapidly lose that effect."

"One should be very careful," agrees Jarlskog. But she believes that the awarding institutions may revisit the statutes to consider whether adjustments are needed to reflect the changing face of science. "They have to, and I think they eventually will," she says.

Meanwhile, some Nobel laureates suggest that one way to avoid the arguments would be to do away with the prizes altogether. "Einstein would be Einstein without the prize," says Jack Steinberger of CERN, who shared the 1988 physics Nobel for working out how to create intense, high-energy neutrino beams, and for discovering the muon neutrino.

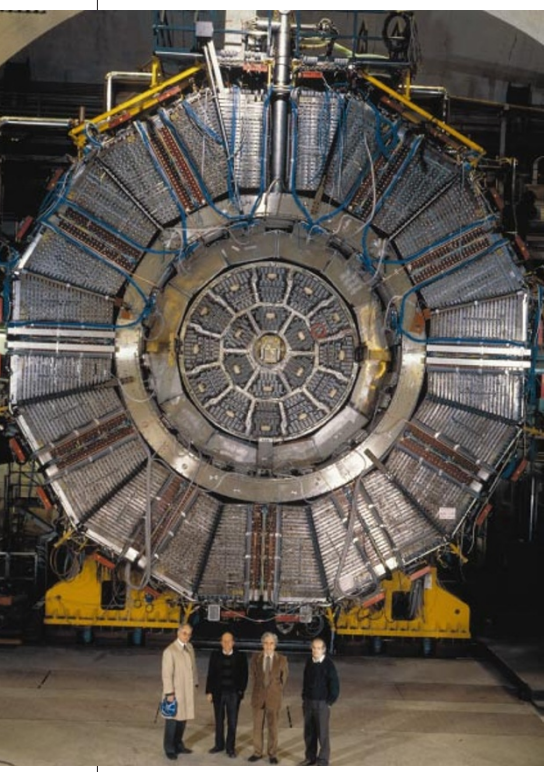
Maybe so, but that begs the question: would Jack Steinberger still be Jack Steinberger, Peter Doherty be Peter Doherty, or Hamilton Smith be Hamilton Smith? They are all brilliant scientists, but their reputations were greatly enhanced by their Nobel awards. Einstein, on the other hand, was a one-off — a uniquely charismatic genius whose iconic status did not depend on the approval of the Nobel physics committee.

For those scientists who can only aspire to more everyday levels of excellence, the Nobels represent an unparalleled opportunity to propel the research that they love onto the public stage, and perhaps to use their new-found celebrity status for the good of science. For these and other reasons, it is a safe bet that each October for decades to come, many of the world's leading scientists will continue to dream of receiving that life-changing phonecall from Stockholm. ■

Trisha Gura is a science writer in Cleveland, Ohio.

www.nobel.se

CERN



High-energy physics involves collaborations, which makes it hard to pick individual winners.

Not quite a Nobel...

The Nobel prize may be the ultimate scientific honour, but over the years various other awards have been established that carry immense prestige — and, in some cases, rich monetary rewards.

Recognizing that Alfred Nobel's will left many scientific disciplines out in the cold, the Royal Swedish Academy of Sciences in 1980 established the Crafoord prize (www.kva.se/eng/pg/prizes/crafoord/index.asp). Awarded each January, this US$500,000 prize recognizes outstanding researchers in fields including mathematics, astronomy, Earth sciences and ecology.

The four Swiss–Italian Balzan prizes (www.balzan.it), worth US$620,000 each, are similarly broad in their scope, and since 1961 have been awarded each year for outstanding achievements in a broad range of intellectual endeavours including physical, mathematical and natural sciences, and medicine. The US$100,000 Israeli Wolf prizes (www.aquanet.co.il/wolf/wolfpriz.html) similarly cover a range of areas including mathematics, agriculture, chemistry, physics and medicine.

The discipline most obviously passed over by Nobel, mathematics, has high-profile awards of its own. For the field's young guns, aged 40 years or less, up to four Canadian Fields medals (elib.zib.de/IMU/medals/index.html) are awarded every four years. They are worth only US$9,500, but their value in terms of career enhancement is huge. And the Norwegian government this year announced that it is establishing a US$570,000 Abel prize (see *Nature* **413,** 100; 2001), without age restriction, intended as a direct counterpart to the Nobels. The first prize will be awarded in 2003.

But not all of the other top prizes are there to fill in the gaps left by Nobel's will. The 54-year-old Albert Lasker medical research awards (www.laskerfoundation.org/awards/awards.html) — often dubbed the 'American Nobels' — are presented each year in September. There are three awards, for basic medical research, clinical medical research and public service, each worth $50,000, and they are a good indicator of further success. More than half of the Lasker winners since 1962 have gone on to receive a Nobel. **T.G.**