
PAGE 1097
New route to transgenic animals


1099
Asteroids packing double whammy

ASTRONOMY

China Doubles Budget to Create Astronomy Megainstitute

BEIJING—China has embarked on a fundamental overhaul of the way it runs its astronomy programs. It will double spending on astronomy research, consolidate the management of the country's telescopes under one roof, and slash payrolls by more than half as part of a broader effort to strengthen the country's capacity in basic research.

The new initiative will be led by the National Astronomical Observatory Center (NAOC), one of a dozen megainstitutes being created by the Chinese Academy of Sciences (CAS) under its Knowledge Innovation Program (*Science*, 8 January, p. 150). "This will be the biggest reform in 50 years for China's astronomical research and should be marked as a grand holiday," says the center's deputy director, Wang Jingxiu, a professor at the Beijing Astronomical Observatory.

NAOC, established on 23 April, links four major observatories in Beijing, Nanjing, Shanghai, and Yunnan as well as three satellite operations around the country and two planned telescopes, one already under construction. It will receive $6 million a year over 3 years in operating funds, twice the combined budgets of the existing facilities. At the same time, the new center will have a staff of 406, less than one-third the current level of 1429 employees, as some scientists and many administrators and support staff will lose their jobs. "The innovation program has provided an opportunity and financial means for us to deal with the problems of redundant institutions, irrational distribution of resources, and low efficiency," says Ai Guoxing, head of the Beijing Astronomical Observatory and director of the new center. The separate observatories and stations will continue to exist for a time, caring for their staffs' nonresearch needs and helping to relocate those whose jobs were eliminated by the reorganization.

Ai, a 60-year-old solar physicist, has long been a major force in Chinese astronomy. "He's not very democratic, but he has the vision and the determination to get things done," says Wang Haimin of the New Jersey Institute of Technology in Newark, a former student and current collaborator of Ai's. "I would expect him to focus on a few important projects."

One key aspect of the new organization is a competitive process that will fund the best scientists, regardless of age and current position, based on peer review by outside panels. A network of 35 research groups headed by principal scientists will be set up to conduct research in nine priority areas,* with the scientists being given a big voice in hiring from outside their institution and in managing their research funds. Twenty-eight such groups have already been set up, each with five to 10 times the research budget of existing teams as well as higher individual salaries.

The idea of putting sufficient resources in the hands of the most capable scientists is already paying off, says 33-year-old Luo Guoquan, deputy director of the Yunnan Observatory and principal scientist of a research group. Luo says a Chinese colleague, trained at Cambridge University, scrapped plans to return to England after hearing about the new center. Now the 34-year-old has been made a principal professor, too. "We young people are pleased to see the improvements," says Luo, "and we feel we have brighter prospects now."

The new center will also assume responsibility for assigning time on the major facilities, which include a 2.16-meter optical telescope in Xinglong station in Hebei province northeast of Beijing, a multichannel solar magnetic telescope on the outskirts of Beijing, two 25-meter radio telescopes in Shanghai and Xinjiang, and a 13.7-meter millimeter-wave telescope in Qinghai. Proposals from Chinese scientists outside the center and foreign scientists will compete for two-thirds of the allocation, says Ai, who adds that observatories and stations have traditionally resisted opening their facilities to outsiders, including CAS scientists. "It has been a waste of resources and low efficiency," he says.

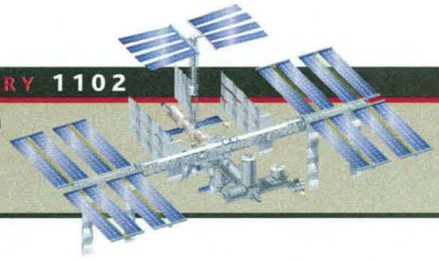
For example, Wang notes that the Qinghai millimeter telescope was used by only three or four groups a year because of its remote location in western China and a tiny research budget. To make it more attractive to researchers, NAOC has created 18 positions and is soliciting applications from young astronomers with doctoral degrees.

Another important task for the center will be to plan and carry out new government-funded megascience projects. A 4-meter

Star power. Ai Guoxing will direct a new center that will manage China's major observatories, including the new LAMOST telescope (artist's conception) under construction.

CREDIT: NAOC

* The nine fields are large-scale structures, galaxy formation and evolution, high-energy and catastrophic processes, star formation and evolution, solar magnetic activities and solar environments, space geodynamics, dynamics of solar system and celestial bodies, space-based observations and exploration, and methods and techniques in astronomy.



field telescope called LAMOST (Large Area Multi-Object Spectroscopy Telescope) is currently under construction at Xinglong station (*Science*, 8 November 1996, p. 915), while a space solar telescope and a 500-meter-wide radio telescope called FAST are still under development (*Science*, 7 August 1998, p. 771). CAS is also moving ahead with plans for a new optical telescope, in the 3- to 4-meter range, for the Yunnan Observatory. It would replace a 1-meter telescope near Kunming whose capability has been degraded by light pollution. NAOC's arrival on the scene should help cut through red tape on domestic projects, says Wang, as well as offering one-stop shopping to potential collaborators from abroad.

That streamlined management is also expected to foster partnerships with Chinese universities that operate strong programs in basic astronomical research. Three subcenters will be created in Beijing University, Nanjing University, and the China Science and Technology University in Hefei, with money mainly coming from the center.

If all goes smoothly, NAOC will evolve into the National Astronomical Observatory by the end of 2000 and the separate facilities will lose their individual identities. The triple attraction of new telescopes, more money, and an improved working environment is expected to bolster Chinese astronomy in the coming decade, says Wang. "It is impossible to make conditions as comfortable as our foreign counterparts," he says, "but we will try our best." **–LI HUI**

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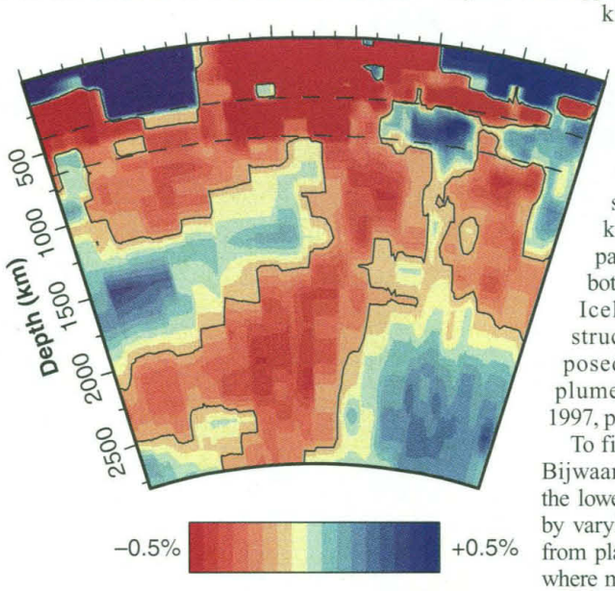
MANTLE DYNAMICS

Iceland's Fires Tap the Heart of the Planet

On Earth, what goes up must come down. But inside the planet, just how things work hasn't been so obvious. Researchers probing Earth's interior have traced great sheets of rock—former sea floor—plunging deep into Earth's mantle, hard against the molten iron core (*Science*, 31 January 1997, p. 613). But do such slabs—or any other rock from these great depths—ever come up again? Many researchers have thought that mantle plumes—narrow columns of rising hot rock that feed volcanoes at hot spots like Hawaii and Iceland—tap the deep mantle, but they had no hard evidence, and others argued that plumes have shallower roots. Now, with a sharper view of the lower mantle, a pair of seismologists is extending Iceland's plume to the very base of the mantle, 2900 kilometers down.

By using new tricks to process earthquake waves into a seismic image, seismologists Harmen Bijwaard and Wim Spakman of Utrecht University in the Netherlands have produced an image of a plume rising from near the bottom of the mantle all the way up to Iceland's surface, as they report in a recent issue of *Earth and Planetary Science Letters*. "It's really cool—you can see the plume going down," says seismologist Richard Allen of Princeton University. "I would now say there's good evidence—although not yet proof—that the Iceland plume originates from the core-mantle boundary."



A long way up. In this vertical cross section of the mantle beneath Iceland, a column of seismically slow and therefore hot rock (red) rises from near the core to the surface.

Seismologists have tried to map the plume by combining the travel times of waves passing under Iceland from distant earthquakes to form a kind of CT (computerized tomography) scan. Hot rock slows seismic waves, so researchers could check such images for a hot, seismically slow column of rock. But with conventional methods, the limited seismic data give such fuzzy views of the mantle that a complete plume can't be recognized, although researchers have found parts of it.

Using seismic waves recorded on Iceland itself, for example, seismologist Cicely Wolfe of the Woods Hole Oceanographic Institution (WHOI) in Massachusetts and her colleagues imaged a 350-kilometer-wide plume extending to 400 kilometers beneath the island; Allen recently narrowed the width of that plume to 200 kilometers. Two years ago, Yang Shen of WHOI and his colleagues showed that at greater depths, something hot and narrow beneath Iceland is apparently raising the traditional 660-kilometer boundary between upper and lower mantle by 20 kilometers (*Science*, 6 February 1998, p. 806). And last fall Donald Helmberger and his colleagues at the California Institute of Technology in Pasadena seismically detected a 250-kilometer-wide dome of partially molten rock at the bottom of the mantle beneath Iceland—just the kind of structure that has been proposed as a likely source for plumes (*Science*, 31 January 1997, p. 614).

To fill in the rest of the picture, Bijwaard and Spakman brought the lower mantle into better focus by varying the image's resolution from place to place, sharpening it where many wave paths happen to pierce a particular spot, rather than using a uniform but lower resolution, as is typically done. The pair also calculated the 7.6 million seismic wave paths individually rather than averaging many wave paths together, as is often done to save computing time.

The end result is what they call "the first rather detailed image of a whole mantle plume." The pictured plume is no textbook example—it's still as much as 500 kilometers wide versus the expected couple of hundred kilometers, twisted a bit, and even seems to branch at one point. And because few seismic waves passed through the top and very bottom of the mantle, the image is not very reliable there. But "for most of the lower mantle," says Bijwaard, "vertical resolution is very good, implying the continuous structure seen there probably really is continuous." Allen agrees, and Rob van der Hilst of the Massachusetts Institute of Technology—whose own global images from the same raw data hadn't shown a distinct plume—also accepts that the new work "is indeed evidence for a continuous plume" in the lower mantle.

If Iceland does build itself with rock from

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