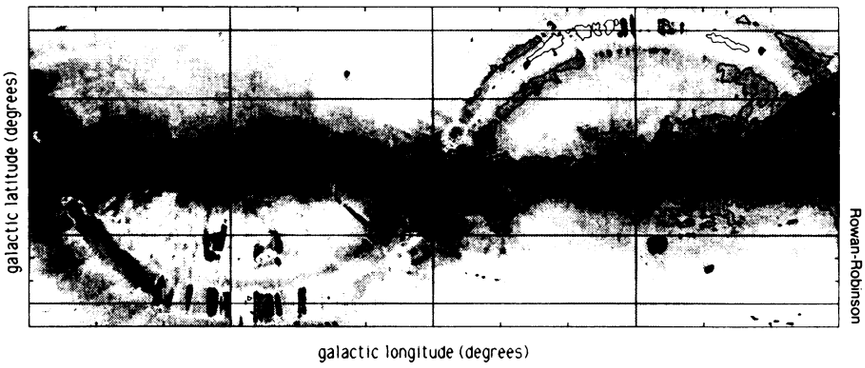
Lifting a dusty veil to clear IRAS' view



Observations made in 1983 by the Infrared Astronomy Satellite (IRAS) during its 10-month mission have helped astronomers map emissions of infrared radiation (heat) from distant interstellar and interplanetary dust clouds. But researchers have had to settle for a relatively fuzzy picture, because a thin haze of dust around Earth obscures distant and faint emissions. Now astronomers have employed computer tricks to effectively lift that veil of dust clouding IRAS' vision of our galaxy.

In the Sept. 15 MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY, Michael Rowan-Robinson and his colleagues from Queen Mary and Westfield College in London calculated the average size of dust particles between Earth and a belt of asteroids that orbit the sun between Mars and Jupiter. This dust cloud contains remnants of asteroid collisions that occurred millions of years ago. Drawn by gravity, the cloud slowly spirals toward the sun, enveloping Earth along the way.

The new calculations enabled the team to deduce the interplanetary dust particles' contribution to the infrared energy recorded by IRAS – and to subtract it from the data used to compile IRAS' images.

An example of this computer processing, for emissions in the 60-micron wavelength (above), reveals a large, faint S-shaped curve. This wave-like feature – which traces the path of the solar system as it rises above and falls below the Milky Way's plane (dark horizontal band) over nearly a year – marks the dusty debris from relatively recent asteroid collisions, shown here in greater detail than ever before. Below the lower edge of the dark band are emissions from the Orion constellation, just right of center, and the Pleiades cluster, just left of center.

– R. Cowen

Putting the move on primate Parkinson's

Preliminary research indicates a new surgical technique eases the symptoms of a Parkinson's-like disease in monkeys and adds to evidence suggesting at least two areas of the brain play a crucial role in this debilitating movement disorder. If confirmed, the new finding may lead to more effective treatment for persons with the disorder, especially those resistant to drug therapy.

Parkinson's disease develops when an as-yet-unknown process destroys certain dopamine-producing neurons in the brain's substantia nigra. Some researchers have hypothesized that this process somehow affects another brain region known as the subthalamic nucleus, causing its neurons to fire too rapidly and thus producing the muscular tremors and rigidity that plague Parkinson's patients. A study reported in the Sept. 21 SCIENCE now provides the first direct evidence linking Parkinsonism's movement difficulties with the subthalamic nucleus.

Mahlon R. DeLong, then at the Johns Hopkins Hospital in Baltimore, and his colleagues gave two African green monkeys intramuscular injections of MPTP, a synthetic drug known to cause a primate disorder that resembles human Parkinson's symptoms. A week after receiving the injections, the monkeys sat largely motionless in their cages, unable to feed or groom themselves.

When the monkeys had developed a severe and stable form of the disease, the team injected a neurotoxin called ibotenic acid directly into the subthalamic nucleus of each animal's brain. The treatment brought a "dramatic improvement," DeLong told SCIENCE NEWS. Within minutes, he says, both monkeys moved about their cages and resumed feeding and grooming.

These findings hint that the disease's crippling effects result from neural overactivity in the subthalamic nucleus, says DeLong, now at Emory University in Atlanta. The ibotenic acid destroyed some neurons in that region of the monkey brains, slowing the neuron-firing rate, he speculates.

Scientists don't understand the function of the subthalamic nucleus in normal individuals, but suspect it is involved in movement regulation. By learning more about the subthalamic nucleus and Parkinson's disease, investigators may unravel the mystery of the healthy subthalamic nucleus and glean clues about other movement disorders such as Huntington's disease, comments Peter L. Strick of the State University of New York Health Science Center at Syracuse.

"This is a fantastic report," says Edward H. Oldfield of the National Institute of Neurological Disorders and Stroke in Bethesda, Md. While DeLong predicts the new treatment may benefit at least that third of Parkinson's sufferers who can't take the drug L-dopa, a natural precursor to dopamine, Oldfield believes it may eventually prove useful for all Parkinson's patients. However, before investigators attempt the potentially risky technique on people, more research must confirm these new findings.

– K.A. Fackelmann

Bird brains display tuneful cell surge

Adult canaries and zebra finches generate a fresh supply of brain cells to replace those lost with age in forebrain regions that control song learning and production, according to a report in the Sept. 21 SCIENCE. The newly formed cells, known as projection neurons, extend their message-bearing axons over roughly 3 millimeters and link two related structures in the birds' cerebral song-control center.

The findings suggest that adult avian brains possess considerable potential for self-repair as neurons grow old and wither away, says study director Fernando Nottebohm, a neuroscientist at Rockefeller University Field Research Center in Millbrook, N.Y. "But we're not sure if or how these findings apply to humans and other mammals," he adds.

For now, the data indicate a relationship between the development of avian memories for either the perception or production of distinctive songs and the appearance of substantially more neurons in song-control regions of the brain.

Twice daily for two weeks, Nottebohm and his co-workers injected birds with a substance that labels newly emerging brain cells. Four months later, when the labeled population of neurons in the forebrain area concerned with song control had grown and stabilized, they injected the birds with another substance that stained the previously marked neurons. The animals were then killed and neuron counts were conducted.

Four adult male canaries, all 1 year old, received their first injections in May, a time of stable song production. Another

six adult males were injected at 17 months of age in October, when songs undergo seasonal modifications. Two additional males, slightly more than 4 years old, entered the experiment in October.

Canaries injected in October generated significantly more projection neurons in the song-control center than did the May group. Moreover, the 4-year-old October duo displayed considerably more new projecting neurons than did the 1-year-old May quartet. Either a lower rate of cell production or a higher rate of cell death may account for the slower generation of new projection neurons in May, the researchers maintain.

Testing of six adult male zebra finches, which do not modify their songs, revealed projection neuron increases roughly comparable to those observed among canaries injected in May.

Although the October neuron increases in adult canaries apparently stemmed from learning new songs, even zebra finches experienced noticeable, unexplained jumps in neuron generation, the scientists report.

Nottebohm says his team plans to investigate possible ways to boost the natural process of self-repair and neuron generation in the brains of adult birds. Little evidence exists for new cell growth in the forebrains of mammals, he adds. But if scientists eventually extend the avian observations to mammalian species, they can then seek methods of reversing neuron degeneration in memory-destroying conditions such as Alzheimer's disease, Nottebohm suggests.

– B. Bower

Stronger support for equivalence principle

The equivalence principle – a cornerstone of the general theory of relativity – dictates that all forms of matter and energy fall with the same acceleration in a uniform gravitational field. Researchers can test this principle by comparing the accelerations of the Earth and moon toward the sun, but there's a catch. Such experimental tests are accurate only if no long-range, nongravitational force interferes with the measurements in a way that happens to mask any anomalous gravitational effects.

Scientists have now closed that loophole. Drawing on precise laboratory experiments designed to ferret out a nongravitational, "fifth" force, Eric G. Adelberger and his colleagues at the University of Washington in Seattle conclude that such a force – if it exists – would be too feeble to affect significantly the results of experiments designed to detect differences in the accelerations of the Earth and moon toward the sun.

Tests of the equivalence principle hinge on the idea that the moon's orbit would be distorted in a particular way if the Earth's gravitational binding energy, which contributes about 5 parts in 10^{10} to the Earth's total mass, doesn't behave in the same way as other forms of mass and energy. The effect should be large enough to appear in precise measurements of variations in the distance between the moon and Earth – if no other, unknown force gets in the way.

The new analysis, reported in the Sept. 20 NATURE, shows that a nongravitational, fifth force would contribute no more than 1 part in 10^{12} to an acceleration difference. So far, lunar-ranging measurements – which involve bouncing laser beams off a reflector on the moon's surface – have established that these accelerations are identical to within 14 parts in 10^{12}, in agreement with the equivalence principle and general relativity.

"We've been working in this whole business of trying to detect a long-range [fifth] force for a long time," Adelberger says. "It has to be very, very weak compared to gravity, and it's interesting that it has to be so weak that it wouldn't upset, for example, a test of the moon and Earth falling toward the sun."

Because any potential contribution from a long-range fifth force would be small at best, researchers can now try to improve the precision of lunar-ranging data without having to worry about some unknown force negating their efforts to test the equivalence principle with greater precision. The new findings also furnish encouraging news for researchers interested in pursuing high-precision, space-based tests of the equivalence principle.

At the same time, laboratory experiments sensitive to the existence of a fifth force are bound to improve (SN: 10/1/88, p.214). "We anticipate about a factor of 10 improvement," Adelberger says, "and it will probably get better than that."

– I. Peterson

Strong quake expected east of Rocky Mountains

Easterners who fantasize about California sliding into the sea may be in for a jolt. Chances appear high that a damaging quake will strike east of the Rocky Mountains in the next 30 years, according to new calculations.

"We wanted to tell people in the East that there is a level of earthquake hazard here. While it's nowhere near California's and you shouldn't be frightened or alarmed, you should be aware that the hazard is probably greater than you think," says G.A. Bollinger of the Virginia Polytechnic Institute and State University in Blacksburg.

He and Stuart P. Nishenko of the National Earthquake Information Center in Golden, Colo., have formulated the first estimate of earthquake risk for the eastern half of North America by analyzing historical records going back to 1727 and seismographic data accumulated over the last 15 years. Using the frequency of past quakes, they calculated the chances of a shock occurring within coming decades.

The region east of the Rockies stands a 40 to 60 percent chance of experiencing an earthquake of magnitude 6 or greater before the year 2020, the seismologists conclude in the Sept. 21 SCIENCE. Noting that seismic waves travel particularly well through the less-fractured rock in the eastern half of the continent, Nishenko and Bollinger say this region faces about two-thirds California's risk of suffering a damaging earthquake within 30 years.

Their forecasts do not predict where earthquakes might occur, but seismologists are keeping a close watch on several seismically active areas, including New Madrid, Mo. (which spawned the country's most violent known earthquakes in the winter of 1811-1812), Quebec's St. Lawrence River (site of five strong quakes in the last three centuries) and Charleston, S.C. (severely damaged in 1886).

Archibald C. Johnston, a seismologist at Memphis State (Tenn.) University, says Nishenko and Bollinger's forecasts probably underestimate the East's quake hazard. Johnston has analyzed seismic activity around New Madrid and calculated a 40 to 60 percent probability that this fault will produce a magnitude 6 earthquake within 15 years.

Bollinger says the discrepancy underscores the primitive state of earthquake risk estimates for eastern and central North America. Geologists cannot directly study faults in this region because they lie buried deep below ground, whereas many California faults break the surface. Eastern faults also accumulate stress more slowly and can remain quiet for several hundred years, further hampering study.

Despite the difficulties, seismologists have succeeded in convincing some state and municipal officials of the earthquake hazards in their areas. In the last several years, many states and cities east of the Rockies have incorporated seismic regulations into their building codes for the first time. New York City is currently considering its own set of seismic standards.

– R. Monastersky