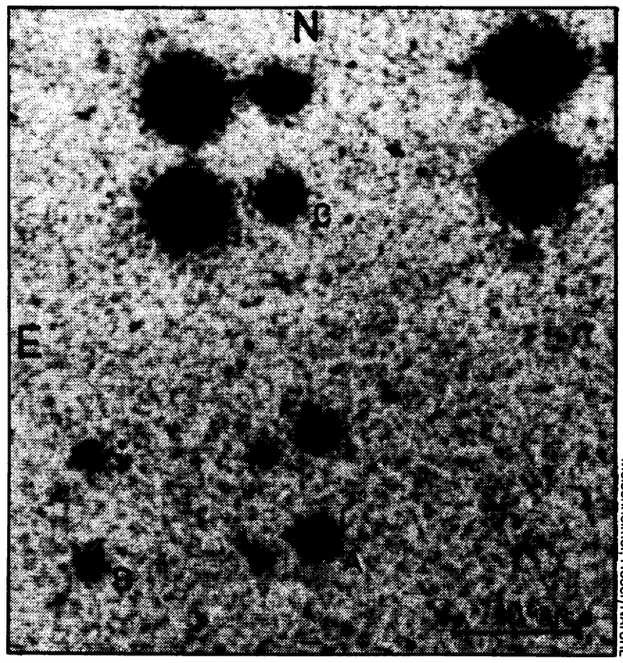
Acceleration in radio galaxy lobes

Viewed by their radio emissions, galaxies appear a good deal larger than they do in visible light. The visible part of the galaxy usually lies in the center between two huge lobes of radio-emitting material, which are many times the size of the visible portion. Astrophysicists believe that extremely energetic processes produce these radio lobes. Now, in the Feb. 6 NATURE, two astronomers from the Max Planck Institute for Astronomy at Heidelberg, West Germany, report an important piece of direct evidence for such processes.

The scientists, K. Meisenheimer and H.-J. Röser, have measured the polarization of the light from a visible hotspot on the outer edge of one such radio lobe, the southern lobe of the galaxy 3C33. This is the first time the optical polarization of such a hotspot has been measured, they say, and the optical polarization exactly matches the polarization of the radio waves from that lobe. Such a match is evidence that the hotspot belongs to the lobe and is not a chance association of some completely different object shining through the lobe. Moreover, detection of synchrotron radiation over such a wide range of frequencies from radio to optical is evidence that highly energetic processes are accelerating electrons in the lobe.

Synchrotron radiation comes from accelerated electrons that are forced by an ambient magnetic field to follow helical paths. The corkscrewing motion of the electrons gives their emissions a strong polarization in a particular direction, and to an astronomer the finding of such polarized radiation indicates the presence of this synchrotron mechanism. According to Meisenheimer and Röser, the importance of finding the optical polarization is that the electrons that produce the optical frequencies must move in very short paths. Their radiation, therefore, maps the regions where the acceleration is happening more closely than does that of the radio waves, whose source electrons move much farther from the place of acceleration while they are radiating.

Meisenheimer and Röser did this work at the European Southern Observatory at Cerro La Silla, Chile, using the Max Planck Society's 2.2-meter telescope located on La Silla mountain. The very high sensitivity of charged coupled devices (CCDs), the photoelectronic sensors now used for the most delicate astronomical imaging, enabled them to determine the optical polarization of the hotspot. To determine polarization, these astronomers inserted into the telescope a rotatable plane-parallel double-calcite plate. Calcite separates a beam of light into two parts polarized at right angles to each other and sends them over slightly different paths. On the CCD this procedure makes two images of every object.



Meisenheimer, Röser/NATURE

Double images produced by a polarizing plate in the 2.2-meter telescope. The heavy, dark images are reference stars, and they show little or no evidence for preferential polarization. The hotspot of 3C33 is the fainter pair of images to the left (southeast) of the star labeled A. A significant difference in brightness is apparent in them.

If the light from a given object is predominantly polarized in a particular direction, and if the calcite is rotated properly to align with it, the two images will show a marked difference in brightness; most of the light will take one path, the one corresponding to the dominant polarization. "After the first 30-minute exposure, a highly polarized optical object near the hotspot of 3C33 south was immediately conspicuous," Meisenheimer and Röser write.

It is therefore possible for the first time to discuss the nature of the radiation-producing processes in such a hotspot on the basis of a range of frequencies emitted that runs from 1 billion to 100 trillion hertz, Meisenheimer and Röser say. On that basis, considering the probable physical characteristics of the neighborhood, they think it reasonable that the electrons are accelerated in shock waves.

This concurs with a belief based on the shapes of the lobes that they are material forcefully ejected by some high-powered "engine" in the center of the galaxy. (There is much other evidence for such an engine.) As such material moves outward through the tenuous gas in intergalactic space, it should produce shocks at its leading edges. — *D.E. Thomsen*

Stomach butterflies scramble EGGs

Butterflies in your stomach aren't all in your head, according to Larry VandeCreek. Using an electrogastrograph, an external electrical monitoring device that is to the stomach what the electrocardiograph is to the heart, he and his colleagues at Ohio State University in Columbus have been able to measure the "butterflies." The technique is also being used to study other conditions, among them motion sickness, which Pennsylvania State University researchers have linked to erratic electrogastrograms (EGGs).

Like all muscles, the stomach muscle is stimulated by electricity. While the electrical signal in the stomach is minuscule compared with that in the heart, it can still be picked up by electrodes placed on the skin.

Electrical signals from the stomach were first measured in 1922, but the much stronger heart signal made external recording difficult. In the past several years, however, sophisticated electronics has enabled the stomach signal to be isolated from the heart's.

VandeCreek and his colleagues tested 20 people who claimed they were prone to stress-related stomach upsets, and 20 people who said they were not. In the study, which has not yet been published, electrodes were placed on the skin over the stomachs of fasting volunteers. The readings were initially identical, with amplitudes averaging 50 to 70 microvolts. But when the butterfly sufferers were asked to imagine themselves in a stressful situation, their wave forms intensified to as much as 500 microvolts. "It's a little storm in there," VandeCreek says. Readings from people without the problem remained steady.

He and his colleagues are currently looking at anorexics; preliminary data indicate they get butterflies just thinking about food. He also hopes to use the technique in biofeedback experiments to see

if upset-stomach sufferers can be trained to normalize their stomach contractions.

Robert Stern at Penn State in University Park recently studied normal subjects sitting still within a rotating cylinder lined in black and white stripes. The EGGs of the 14 who suffered motion sickness went from a normal level of three electrical discharges (initiating three contractions) per minute to between five and eight. The others did not, he and his colleagues reported in the November 1985 AVIATION, SPACE, AND ENVIRONMENTAL MEDICINE. The readings returned to normal about nine minutes after the cylinder stopped.

Stern, who began working with EGGs 25 years ago, says the cylinder procedure could be used to screen astronaut candidates. NASA has sponsored some of his research, and "unofficially," beginning attempts to use EGGs in space have been made, he told SCIENCE NEWS.

Stern has done what he terms "very promising" preliminary work on using EGGs to increase resistance to motion sickness. By removing a person from a motion-sickness-inducing environment as soon as the EGG looks irregular, which happens before the person feels ill, he hopes to break up the stimulus-response association and gradually increase the amount of time before the person gets nauseated. — *J. Silberner*

Knowing little about how things work

At a time when television broadcasts, newspapers, magazines, advertisements and political speeches are regularly sprinkled with technical terms, the U.S. public often has little idea what the terms mean. A recent probe of technological literacy conducted for the National Science Foundation (NSF) shows that only 31 percent of about 2,000 people surveyed by telephone have a clear understanding of radiation, 27 percent understand what gross national product (GNP) means and 24 percent understand what computer software is. Just one in five think they know how a telephone works.

The same poll, conducted late last year by Jon D. Miller, director of the public opinion laboratory at Northern Illinois University in DeKalb, shows that about two in five people believe that rocket launchings have affected the weather, that space vehicles from other civilizations have visited the earth and that lucky numbers exist. Overall, on a rough index of technological literacy, people from 18 to 24 years old — those most recently in high school — had a significantly *lower* rating than all other age groups except those over 65.

"It is clear that young Americans just emerging from their formal education are not as likely to be technologically literate as somewhat older adults," says Miller. He presented his preliminary survey results last week in Baltimore at a conference on technological literacy.

"The technologically literate person should understand how basic technologies work, which aspects are changeable and which are not, and some of the impacts and implications of major technologies," Miller says. "Increasingly the issues on the public agenda are going to be issues that involve some aspect of technology."

Ironically, these results come at a time when public interest in science is relatively high. In another recently published NSF survey, almost half of the respondents report great interest in new inventions and scientific discoveries. Young people, regardless of grade level, are particularly interested.

Nevertheless, "interest is not the same as literacy or competence," says Erich Bloch, NSF director. About three quarters of those interested in science and technology admit they don't know very much about either one, he adds.

"What we have," says Miller, "is a large number of people who believe in science, who have unrestrained faith in it, but who haven't the foggiest notion why it happens." The biggest problem is not hostility to science, but that people deal with it as if it were magic, he says. Moreover, people tend to confuse real or likely technologies and fictional ones.

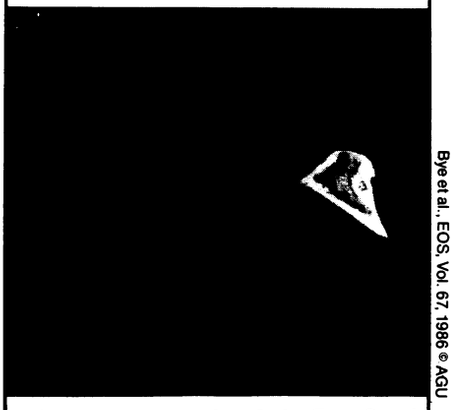
"Our concern," says Rustum Roy, who chaired the meeting and directs the NSF-funded "Science through Science, Technology and Society" project at Pennsylvania State University in University Park, "is that we have not been able to educate 99 percent of the public to appreciate technological issues." A larger segment of the population should understand the choices and values inherent in today's and future technologies, he says. "We must insist that school systems teach it."

"What we're talking about is a redefinition of what's fundamental for learning," says Cecily C. Selby of New York University. Technology studies are generally not part of school curricula. Too much emphasis is put on the theoretical, she says, and too little on how things work.

However, notes F. James Rutherford, education officer for the American Association for the Advancement of Science, based in Washington, D.C., "It's not clear at all what we need to know collectively across the whole range of science, technology and social behavior . . . in order to lead rich, full lives."

"You don't have to be a scientist or a technician to vote," says Gov. Richard D. Lamm of Colorado. But, he adds, "we have to make sure that we are making our science and technology decisions correctly." — *I. Peterson*

This lake is a natural lab



Bye et al., EOS, Vol. 67, 1986 © AGU

It's a rare event when Lake Eyre South in Australia is inundated with a major flood; the lake's water usually escapes through one of the continent's largest inland drainage systems. So when J.A.T. Bye of the Flinders University of South Australia in Bedford Park and his colleagues went to study the lake in March 1984, two months after it experienced major flooding, it was a special scientific opportunity to learn more about the lake. Indeed, Bye's group was treated to a wonderful discovery: The lake acted as a huge natural laboratory for studying the flow of fluids. The swirling pattern near the island shown in this aerial view of the lake is one of several different kinds of fluid structures observed by the researchers.

Bye and his colleagues think the visibility of the fluid patterns springs from the two different kinds of solutions created in the lake as it floods. In some regions the salt crust of the lake bed is dissolved to form a saline solution, while in others a fine silt is stirred up. The two solutions don't mix very well, possibly because the silt clumps up in the salt water, and so the boundary between them remains fairly distinct. This enabled the researchers to see a variety of fluid phenomena as wind-induced currents pushed one kind of fluid into another over different kinds of lake bed surfaces.

The researchers note that, in experiments conducted on much smaller scales, they and others have been able to reproduce the major types of mixing patterns in the lake with remarkable fidelity.

When the researchers returned to the lake in July 1984, none of the striking flow structures were apparent, probably because the silt had settled and the salt crust had completely dissolved. Now Lake Eyre South is a dry salt marsh again, the researchers write in the Feb. 4 EOS. "Nature has closed the theater," they say, "and it may be some years before there is another performance."

— S. Weisburd