R. Andrews

The Soviet ultradeep hole. *This drill rig enclosure stands over the 12-kilometer-deep hole on the Kola Peninsula.*

indication we are close to it."

What the Germans did find was a series of nearly vertical folds that failed to show up on seismic reflection profiles, the radar-like geophysical surveys in which man-made seismic waves are bounced off subsurface features such as layered rock. Compression and folding after the collision may have spoiled the classic picture of a suture, said Emmermann, or "perhaps we may have to think about our model."

Having put geology and geophysics to the test with these and other holes, geoscientists are finding all those high-tech geophysical tools such as seismic reflection profiling, which in recent years have filled in subsurface details for geologists, to be sorely wanting. "Geophysics is great," says one geophysicist, with just a touch of exaggeration. "You can devise all these models, and no one even tests them, except in sedimentary rocks. But, invariably, when somebody drills, it messes it all up."

Among geophysical techniques, seismic reflection takes much of the criticism. It was developed by the oil industry and adapted for study of the continental crust in the early 1970s. "It's ridiculous," says Karl Fuchs of the University of Karlsruhe. "We have these thousands of kilometers of reflection profiles, and we don't know what they show."

Thanks to drilling of seismic reflectors, researchers are beginning to find out, though. At the Siljan hole in Sweden, which was drilled in search of commercial quantities of methane seeping up from the mantle, one possible interpretation of four horizontal reflectors was that impermeable seals had formed in place and trapped gas in more porous rock beneath them. The three reflectors drilled so far turned out to be rock injected into horizontal sills as magma with no porosity beneath them. The prominent reflector penetrated by the German pilot hole seems to be created by fluid-filled fractures, something unexpected after drilling through 3.4 kilometers of dry rock. And at the French Sancerre-Couy hole, "we were expecting more or less horizontal layers," said Weber. "That interpretation is absolutely contradictory to the cores themselves, so we reinterpreted the seismic data."

The problem with seismic reflection profiling is that, although of all geophysical techniques it provides the most detailed picture of the crust, it was developed and tested by the oil industry in rock quite unlike the crystalline crust. The sedimentary rock of interest to industry is laid down in horizontal or nearly horizontal layers that reflect seismic waves at their boundaries due to the contrast between types of rock. The crystalline crust being probed by scientific drilling is a good deal messier. It was formed from lava flows and magma intrusions of every size and shape. It has been distorted, altered by heat and pressure, and fractured. Near-vertical boundaries, which must be common, tend to be invisible in seismic reflection, and researchers are only beginning to figure out how to determine the true nature of individual reflectors, short of drilling.

The rash of reflector misidentifications "just represents naiveté on our part," says geophysicist Robert Hamilton of the U.S. Geological Survey in Reston, Virginia. "We're going to need 10 years to recalibrate ourselves." Drilling to recalibrate seismic reflection and probably other techniques inevitably means more surprises. Drilling programs, from the Soviet and German ultradeep projects to the most modest kilometer-deep holes, are moving ahead in the face of such surprises. The difference is that researchers are approaching drilling, especially deeper holes, with a bit more humility.

■ RICHARD A. KERR

Circumcision May Protect Against the AIDS Virus

African studies suggest that uncircumcised men may be five to eight times more likely to get AIDS during heterosexual intercourse than men who have been circumcised

ALTHOUGH RESEARCHERS HAVE LEARNED a great deal about how the AIDS virus spreads, they are still wrestling with some extremely important puzzles: why, for example, are the patterns of AIDS virus infectivity so very different in Africa and North America? In Africa, almost all of the cases occur in heterosexuals, affecting men and women equally; in North America, the disease primarily strikes male homosexuals, who account for about 75% of the total cases.

A series of recent studies may now be helping to explain the apparent readiness with which the AIDS virus is transmitted among heterosexuals in Africa. The studies indicate that uncircumcised men run a greater risk of becoming infected by the AIDS virus during sexual intercourse than do circumcised men, although other factors, such as the presence of genital ulcers, also facilitate AIDS tranmission among heterosexuals.

"The results clearly point to a very important sociological aspect that may play a role in [AIDS virus] transmission," says Thomas Quinn, an epidemiologist with the National Institute of Allergy and Infectious Diseases who has been tracking the AIDS epidemic in Africa and other developing countries for several years. Quinn notes that he and other epidemiologists are adding circumcision status to the list of variables they are examining in the studies they are now conducting around the world.

And the discovery may also have implications for preventing AIDS, especially in developing countries where condoms—the first line of defense against AIDS infection—may not always be available or used. In Africa, prostitutes, especially those in the larger cities, have been identified as a major reservoir for spreading the AIDS virus. Quinn notes that in some areas 50 to 80% of the prostitutes are infected, putting their customers at great risk if they have unprotected sex.

And as many African men have left their

families in their rural homes and migrated to the cities in search of work, the demand for prostitutes' services is not likely to decline. "The finding suggests that circumcision should be advocated, just as we advocate condoms," he remarks. "We've got to do everything we can to decrease the rate of transmission of this disease."

The possibility that not being circumcised might be associated with AIDS virus transmission emerged about a year ago in a study conducted by J. Neil Simonsen, Francis Plummer, and their colleagues at the University of Manitoba in Winnipeg and the University of Nairobi and the Kenya Medical Research Institute. They found that men who were being treated for sexually transmitted diseases at a Nairobi clinic were more likely to be infected with the AIDS virus if they had had genital ulcers or had not been circumcised.

And Plummer says, "the two risk factors unexpectedly turned out to be independent of one another." The Plummer group had already shown that genital ulcer disease correlates with AIDS infection in female prostitutes and they anticipated finding a similar correlation for the men. The researchers further expected that if lack of circumcision had any effect it would be because uncircumcised men are more susceptible to developing genital ulcers than are circumcised men. But they found that uncircumcised men ran a greater risk of becoming infected with the AIDS virus whether or not they had had genital ulcers.

This observation has since been confirmed in another study conducted by Plummer, William Cameron, who is now at the University of Ottawa, and their colleagues. In contrast to the first study, the second one was done prospectively; men who were not infected by the AIDS virus were followed until they became infected.

In both studies, lack of circumcision alone increased the likelihood of AIDS infection some five- to eightfold, whereas a history of genital ulcers alone increased it four- to fivefold. There were also indications that both together might act synergistically to increase men's susceptibility to AIDS.

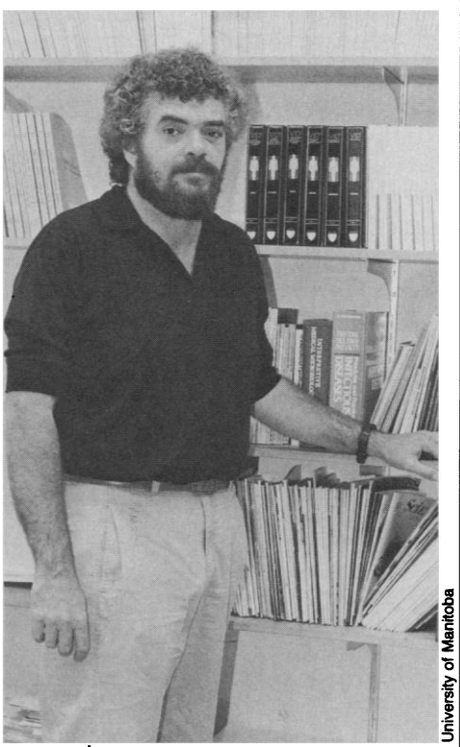
Another study suggesting a link between lack of circumcision and AIDS virus infection comes from John Bongaarts of the Population Council in New York City, Priscilla Reining of the American Association for the Advancement of Science in Washington, D.C., and their colleagues.

Reining had learned of the Plummer group's original study last year at the Fourth International AIDS Conference in Stockholm. Several years ago she had done population research among an East African tribe that has since been severely hit by the AIDS epidemic. The group's culture does not include circumcision, and Reining says, as soon as she heard the Plummer group's results she thought that this might be contributing to the high number of AIDS cases among the tribe members.

With Bongaarts and also Peter Way of the U.S. Bureau of the Census in Washington and Francis Conant of Hunter College in New York City, she then set out to compare the geographic distribution of circumcision practices, which vary from one ethnic group to another in Africa, with areas of high and low AIDS prevalence. In 37 countries, the correlation between areas of no circumcision and high AIDS prevalence was "very robust," Reining says. A similar study—with similar results—has also been performed by Stephen Moses of the International Development Research Centre in Nairobi, Plummer, and their colleagues.

Moreover, the association between lack of circumcision and increased AIDS susceptibility is probably not unique to Africans. Plummer notes that Margaret Fischl of the University of Miami School of Medicine and her colleagues have obtained similar findings in studies of AIDS transmission in heterosexual couples in the United States.

At least one group has failed to find a connection between lack of circumcision and AIDS infection, however. Mary Ann Chiasson, Ilona Surick, and their colleagues at the New York City Department of Health did not detect such an association in three studies conducted on patients at clinics for sexually transmitted diseases in New York City.



University of Manitoba

Out of Africa. *Francis Plummer and his colleagues at the universities of Manitoba and Nairobi have linked lack of circumcision to increased AIDS susceptibility in heterosexual men.*

Chiasson says that she does not currently understand the reason for this difference, although she points out that her group's studies have been criticized because the patients participating in them included a large number of drug addicts and homosexuals, for whom lack of circumcision may not be as important a contributing factor to AIDS susceptibility as it is for heterosexuals.

Drug addicts acquire the virus directly in the bloodstream by using contaminated needles, and the anal intercourse practices of male homosexuals may facilitate AIDS virus entry into the body by damaging the rectal tissues. Nevertheless, Chiasson maintains that the statistical methods used to analyze the New York data should have corrected for potential confounding variables, such as AIDS virus transmission by contaminated needles or homosexual practices, that would have obscured any circumcision effect.

It may have taken as long as it did to pick up on the possibility that lack of circumcision facilitates AIDS virus transmission because the major risk groups in the United States and Europe are male homosexuals and drug addicts. As mentioned previously, lack of circumcision may simply not be as important for AIDS transmission in these individuals.

Also, Plummer notes, some 85% of adult white males in the United States have been circumcised. With relatively few uncircumcised males available for comparison, the importance of this variable may simply have been overlooked. In Europe, the situation is reversed. There, almost no males are circumcised.

How lack of circumcision might contribute to AIDS virus susceptibility is not fully understood. One possibility is that the presence of an intact foreskin provides a warm, moist environment that allows a longer time for viral survival and penetration. The virus is very short-lived in a dry environment, as Simonsen points out.

In addition, after circumcision the head of the penis develops a cornified covering similar to the skin elsewhere on the body. This covering may help protect it from the small injuries that may occur during even genital intercourse and facilitate AIDS virus entry. The foreskin itself is also subject to trauma during intercourse. In any event, lack of circumcision has been linked to the development of other sexually transmitted diseases in men—and it now looks like AIDS can be added to the list. ■ JEAN L. MARX