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COVER: A view along the San Andreas fault in Daly City, Calif. Despite warnings, people have continued to build their houses directly along the fault. Other new information about earthquake hazard reduction has also often been ignored. See article p. 90. (Photo by Robert E. Wallace and Parke D. Snavely Jr., courtesy U.S. Geological Survey).

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SCIENCE NEWS OF THE WEEK

U.S.-Sino Agreements on Science

The People's Republic of China plans to use color television in a campaign to quickly reverse its decade-long deemphasis of science, technology, foreign-language and advanced-education studies. Critically short of teachers, China is designing a national-education system where a single teacher can broadcast lessons nationwide. The American-made geosynchronous communications satellite and up to 3,800 ground-based receivers it will purchase under a cooperative "understanding" drafted by Chinese and U.S. officials in Washington last year is expected to cost on the order of \$500 million.

Purchase of the satellite was but one small provision included in the three agreements, three understandings and one accord signed January 31 by President Jimmy Carter and Vice-Premier Teng Hsiao-ping during the Chinese diplomat's week-long tour of the United States.

A five-year renewable umbrella agreement spells out ground rules for cooperative research and the scientific exchange of students and scholars in such areas as agriculture, energy, health, space, earth sciences, the environment and engineering. The agreement also sets up a joint U.S.-Sino Cooperation Commission to plan, coordinate and monitor programs and actions covered by the agreement. An executive agent will serve as a liaison for the commission in each country; the U.S. agent will be the Office of Science and Technology Policy, headed by Carter's science advisor, Frank Press.

Included under the umbrella agreement is an understanding for education drafted when a visiting Chinese delegation came to Washington last October. It confirms China's intent to enroll 500 to 700 of its students in this country during the current academic year; already 100 have arrived. Most will begin their stay in Washington with several weeks of intense English-language training. In return, 10 Americans will leave to study in China this year, followed by 50 more next year. Each country will pay the cost of its own participants.

Two areas of particular interest to the Chinese are high-energy physics and agriculture. There are already plans for the U.S. Department of Energy to assist the Chinese in design, construction and operation of a 50-billion-electron-volt proton accelerator. Fang-Yi, China's Deputy Prime Minister for Science and Technology, who accompanied Teng on his visit, said that the accelerator represented China's goal to pursue basic research on the cutting edge of science. Numerous agricultural exchanges already being planned will concentrate on farm machinery, citrus fruits, wheat, vegetables, seed research,



Bill Fitzpatrick

Teng and Carter in signing ceremony.

biological control of pests and veterinary science. Finally, mapping China's mineral and wildlife resources will become more accurate with the purchase of ground receivers to pick up data from the U.S. orbiting Landsat system. □

Paraphysics: Odds for psychokinesis

In gambling houses all over the world people are hunched over tables concentrating on red or black, on 11 or 7, on queen or ace. The ones who do this sort of thing at the races can be accused of attempts at telepathic (or maybe nontelepathic) communication with nonhuman species, but those concentrating on the turn of a roulette, a die or a card can reasonably be taxed with a belief in psychokinesis. Though the prophet Muhammad (among many others) scoffed, the belief in psychokinesis, in the proposition that people by taking thought can affect the behavior of inanimate objects, was widespread before his time and has been since.

In 1943 the pioneer systematic investigator of parapsychological phenomena, J. B. Rhine, reported that some people seemed able to affect the fall of dice by mental effort. Rhine's work has been brought into serious question in recent years, but now comes Helmut Schmidt of the Mind Science Foundation in San Antonio to say that his own work with random number generators of his own devising leads him to the qualified and somewhat troubled conclusion that there is statistical evidence in favor of psychokinesis.

He said this last week to the mixed consternation and fascination of a standing

room only crowd composed mostly of physicists, and where he said it is important too. He had been invited to talk on his work at a meeting of the American Physical Society by a section of the society, the Forum on Physics and Society. Although in another invited talk Ray Hyman of the University of Oregon issued a strong warning against overenthusiasm about parapsychology, the spirit of the session was not an attempt to lay a troublesome ghost (as the American Association for the Advancement of Science tried to do with Immanuel Velikovsky), but to raise a question whether there is something here for physicists to look at. As Paul Horwitz of the AVCO-Everett Corp., who chaired the session, put it, "it is a question whether we do not completely understand ordinary physical phenomena."

Schmidt is a physicist; he uses what physicists consider quite ordinary physical phenomena, and a statement he made at the outset started physicists' imaginations going. It seems that psychokinesis works only on random, acausal processes, not on strictly determined ones. It will work with something quantum mechanical, like the decay of a bunch of radioactive atoms, but not with something classical like the swing of a pendulum. Physicists have frequently to decide why a certain thing goes by quantum mechanics and another by classical physics, and even one who will have no truck with psychokinesis might have believed in telepathy to feel the vibes going around the room. Two or three gave voice to the result as they sought mechanisms by which the mind could affect quantum mechanics. One supposed it might be through the "hidden variables," the deterministic causes that are supposed to underlie the statistical uncertainties of quantum mechanics (according to a theory that developed after a suggestion of Einstein) and actually specify them in an unobserved way. Schmidt refused to make any theoretical speculations about mechanism (although he would later make a breathtaking one about means and ends).

The equipment starts with an unimpeachable quantum mechanical process, the decay of radioactive atoms. The times at which individual decays come are entirely random. No power on earth now known to physicists can determine them. The product of the decays is registered by a Geiger counter. The Geiger counter is interfaced with a fast oscillating switch so that occasionally the switch is stopped in the up or down position by a signal from the Geiger counter. This is what Schmidt calls "an electronic coin flipper."

The switch signals are read out by lights. In one version there are eight lights around a circle. They flash clockwise if the switch stops successively in the up position, counterclockwise if the switch stops in the down position and back and forth for alternations. The subject holds the readout device and concentrates on mak-

ing the lights run in one direction. Another version uses red and green lights, and the subject sits and meditates on red or green, hoping to influence the action.

For either configuration chance would give a 50-50 break. Schmidt reports a long-term over-all result of 49.1 percent on one side, indicating that the subjects' wills have a real, but small effect. (The best individual did 52 percent.) The work is done both with the subjects psyched up to believe they can do it and psyched down to believe they can't (hence the figure coming out below 50 percent). The deviation from 50-50 may not seem great, but Schmidt says the number of trials that went into the 49.1 percent leads to a statistical determination that there is only a 1,000 to one chance that this happened by accident.

Schmidt has added complications to the electronics to see if that makes a difference. Apparently it doesn't, and he suggests that that means that this is a goal-oriented process. That makes it radically different from the usual scientific experiment, which goes by means as well as ends. If you want to change the end, you put a change in at the beginning, and what you put in depends on what's in the process between beginning and end. In psychokinesis only the goal seems to matter.

More disturbing is that the experimenter's attitude seems to matter. Things go

better with certain personality types. "You could train car salesmen to do this," Schmidt says. This is experimenter effect. Experimenter effect is a dirty word in scientific experimentation, and it stirred up the audience. Here, perhaps too, Hyman's warnings are most relevant. He reviewed the history of prominent scientists (usually physicists and chemists) who got involved in parapsychology and often made fools of themselves. It seems that whenever there has seemed to be an experimental basis built up for some piece of parapsychology, along came a discovery of fraud, or bad statistics, or inadequate experimental premises to break it down.

Asked specifically about Schmidt's work, Hyman could find no fault. A hint of possible intentional bias drew an indignant response from "The Amazing Randi," a professional magician who has participated in the exposure of several fraudulent psychics. In Randi's view a distinction has to be made between a scientist and a performer. Like any scientist Schmidt seeks vindication in replication. He would especially like to get rid of the experimenter effect through replications by emotionally indifferent operators. A few successful replications have been done. Many more are needed. Horwitz suggested maybe 40 or 50, and he proposed that the Forum on Physics and Society might play a role in inspiring scientists to try them. □

Amniocentesis: Safe, reliable and accurate

The past decade has seen a revolution in the prenatal diagnosis of chromosomal and genetic diseases. For the first time, prospective parents can learn through a technique called amniocentesis (withdrawal of fetal cells through a needle placed in a pregnant woman's abdomen) whether their unborn child has any of a wide variety of chromosomal or genetic disorders. The four percent of women whose fetuses are found defective thus have the option of either a therapeutic abortion or of preparing ahead of time for the birth of a defective child. The 96 percent of women whose fetuses are found normal are spared months of anxiety over whether their infants will be born defective or not.

Now the largest study of amniocentesis yet to be performed shows that it is "safe, highly reliable and extremely accurate." The investigation was conducted by Mitchell S. Golbus and colleagues at the University of California Medical Center in San Francisco and is reported in the Jan. 25 *NEW ENGLAND JOURNAL OF MEDICINE*.

Golbus and co-workers examined 3,000 consecutive amniocenteses performed between 1970 and 1978 at their medical center. Aside from the possibility of causing a slight increase in spontaneous abortions among women who have it, amniocentesis was found to be safe for fetuses. As for reliability, 99.7 percent of

fetal cell samples withdrawn from the wombs of women who underwent amniocentesis were successfully cultured. And as for accuracy, errors in detecting chromosomal and genetic defects in the cultured fetal cells were made in only 0.4 percent of the cases. (However, of the 14 diagnostic errors out of 3,000 made, six were serious enough to affect the outcome of pregnancy. Four involved failing to detect a defective fetus, while two resulted in abortion of unaffected ones. There were also eight errors regarding fetal sex that did not affect the outcome of pregnancy.)

Most of the women currently taking advantage of amniocentesis, the study also revealed, are from middle and upper socioeconomic levels. In an accompanying article in the same issue, the Genetic Research Group of the Hastings Center, Institute of Society, Ethics and the Life Sciences, argues that amniocentesis should be made available to lower socioeconomic women at special risk of bearing defective children, even if Medicaid has to pick up the tab. The group, comprised of persons trained in medicine, genetics, law, philosophy, theology and the social sciences, also opposes the use of amniocentesis solely to determine the sex of an unborn child since it might lead to aborting fetuses of an undesired sex. However, the group admits that it would be impractical to legally forbid such use. □