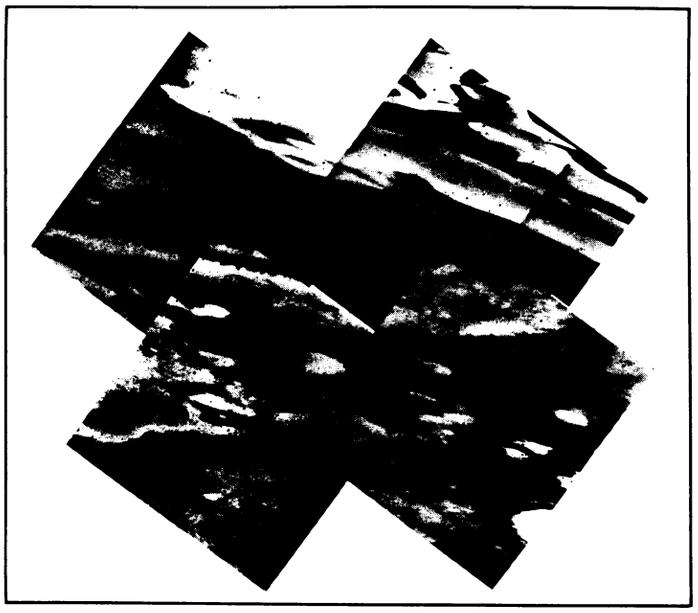

Ice-filled craters (white ovals in lower part of mosaic) below edge of Martian north polar ice cap (at top) raise estimate for thickness of the cap to hundreds of meters of frozen water.

on some models is down to about 800 millibars, with the minimum up to about 60.

But where is the rest of that primitive atmosphere hiding—the part that didn't escape into space? A leading explanation among pre-Viking theorizers had been that it was frozen into the residual polar caps, a vast blanket of dry ice perhaps equal to several times the carbon dioxide content of the entire atmosphere.

Last week, however, Viking experimenter Crofton B. Farmer of JPL provided additional data confirming his conclusion of a month ago that the residual north polar cap (and presumably the residual southern cap as well) consists entirely of water ice (SN: 8/28/76, p. 133). The conclusion is based on measured temperatures that would have long since caused the CO_2 to sublimate away.

The lack of a permanent CO_2 supply at the poles, says Hugh H. Kieffer of the University of California at Los Angeles, puts a large dent in the theory that the Martian atmosphere thickens cyclicly every few million years or so, since the poles were the prime storage candidate for the additional gas to do the job. "The only suggestion which we're still discussing," says Kieffer, "is that there's CO_2 somewhere—solid CO_2—but not only is it buried in the polar regions, it's completely out of communciation with the current atmosphere. That means it's sealed off somehow." That, he says, is a tall order. "It would have to have been made cold a long time ago and sit in the poles and get water covering it which seals it off somehow, and stay cold—colder than the average temperature of the environment—for a period of thousands or millions of years." It could perhaps be absorbed into the planetary regolith, he says, except that the regolith—the surface rocks—has such a vast surface area compared with the poles that there could be no positive feedback to sustain the process. Over the poles, such feedback would take the form of a little CO_2 coming off, which increases the heat-carrying capacity of the atmosphere over what is essentially a localized area, which sublimates more CO_2, and so on. But the poles, Farmer reminds, are water.

How much water? Estimating the thickness of the polar caps has been a goal of Mars-watchers for decades, and although there's still no ready answer, says Farmer, the Viking orbiters have now provided at least three ways of making smarter guesses. First, the caps have to be at least thicker than the scale of the roughness of the surface, so they're at least meters thick. Secondly, they are presumably at least as thick as the depth of craters that orbiter photos reveal to be completely filled with ice. As the roughest of generalizations, Farmer says, many craters are about one-sixth as deep as they are wide, so the white spots representing ice-filled craters seen by Viking raise the estimate for the caps to the hundreds-of-meters range. (One such crater, Korolev, is 90 kilometers across—and filled to the brim.) Finally, in the 100-millennium cycle of Mars's orbital precession, about one-fourth of that time represents the atmosphere freezing out onto the north polar cap each northern winter, leading to a ballpark calculation of a cap about 100 to 1,000 meters thick.

Yet another of Viking's studies may have yielded the first evidence from a U.S. spacecraft that Mars has a magnetic field. This would be an important conclusion because, among other reasons, it would bear on whether the solar wind has been able to get in at the top of the Martian atmosphere and sweep away some of the components that are so important in understanding the atmosphere's evolution. As the two Viking landers descended

Continued on page 220

Live polio vaccine: Debate over safety

During the early 1950s, some 38,000 Americans were victimized by polio each year. Then in 1954, the first polio vaccine, one made from killed polio viruses, was introduced. It drastically slashed the incidence of polio until 1961. That year, a polio vaccine made from attenuated live polio viruses started replacing the killed vaccine and has been the vaccine of choice since then. It too has kept polio to a minimum. There were only seven cases of polio in 1974.

Now there is a possibility that polio might once again sweep the United States because of a shortage of polio vaccine material. In mid-September, 14 states were critically short of vaccine. A major reason for this shortage, a Senate hearing revealed last week, is that the drug company making the live vaccine refuses to sign a new contract with the government unless all recipients be informed in advance of the vaccine's potential risk—that it may cause rather than prevent polio.

The live vaccine has indeed caused some cases of polio, several scientists testified before the Subcommittee on Health hearing, chaired by Sen. Edward M. Kennedy (D-Mass.). According to Robert Aldrich of the University of Colorado and former director of the National Institute of Child Health and Development, "Evidence for small numbers of cases of polio each year caused by attenuated live virus vaccine is conclusive." Jonas Salk, developer of the killed polio vaccine, said there have been 140 cases of polio in the United States so far because of the live vaccine, and that "in the last several years, the live vaccine has been the principal if not the sole cause of domestically arising cases of polio. In other words, it may be said that, at the present time, the risk of acquiring polio from the live virus vaccine is greater than from naturally occurring viruses."

So why did the live vaccine replace the killed one in 1961? According to Salk, the decision was largely made by the American Medical Association on the belief that more children would take the oral live vaccine than the injected killed one and on the belief that the live vaccine was somewhat more effective. But scientific evidence that has accrued since then shows that the live vaccine is *not* more effective, Salk insists. New data, for instance, reveal that booster doses of killed vaccine are not required any more than are booster doses of the live vaccine. The controversy now as then, essentially, is over benefits versus risks. Neither the live nor the killed polio vaccine is altogether ideal, a situation that exists for other kinds of vaccines as well (SN: 12/14/74, p. 380).

Meanwhile, the polio vaccine shortage

must be met if polio is not going to start claiming the lives of many Americans once again. James F. Dickson III, deputy assistant secretary for health, HEW, testified that the drug company making the polio vaccine, Lederle Laboratories, is about ready to sign a new contract. "The contract," he explains, "requires us to take appropriate steps to see to it that each person vaccinated or the parent or guardian receives adequate notice concerning risks and benefits." Thus, the temporary shortage of vaccine, he predicts, will soon be over.

But even when it is, some broader questions will not be answered. Who is going to pay for legal damages that polio vaccine victims incur? Who should be in charge of making sure that there is enough polio vaccine available at all times—HEW's Center for Disease Control in Atlanta? If so, it is certainly not doing its job. The same can also be said about recent shortages in measles and rubella vaccines and the difficulties of getting swine flu vaccine produced because of inherent risks. There is a need for a national vaccine policy, Kennedy insists, and he recommends that HEW, in collaboration with the National Academy of Sciences, set up a commission to establish such a vaccine policy.

He also recommends that parents be given a choice between the live and killed polio vaccine. Aldrich agrees, pointing out that the killed vaccine is now being made in Canada and could be made readily available in the United States. □

Gamma-ray bursts: From neutron stars?

It is now more than three years since R. W. Klebesadel and collaborators announced that satellites and spaceprobes equipped with gamma-ray detectors had been observing sharp bursts of gamma rays from somewhere in the cosmos. A number of suggestions about the astrophysics of the origins of these gamma-ray pulses have been made, but none is so far generally accepted. In the Sept. 9 NATURE, two astrophysicists at the Lick Observatory, S. E. Woosley and Ronald E. Tamm, elaborate a theory that attributes these bursts to explosions on neutron stars. They also suggest that the giant X-ray pulses that were recently discovered may come from the same or a similar mechanism.

The basic observed facts about the gamma-ray bursts are: They last between 1 and 10 seconds. At the earth, they deposit between a hundred-thousandth and a ten-thousandth of an erg of energy per square centimeter of detector. They have a spectrum that seems to be typical of a cooling black body with a temperature of 2 billion degrees K. Finally, they are distributed more or less randomly through the sky, and show no correlation with the locations of strong continuous X-ray sources.

Woosley and Tamm's theoretical picture begins with a neutron star that is a member of a close binary system or located in a dense cloud or nebula. The neutron star's gravity draws matter from its companion or its cloud, and if the neutron star is strongly magnetic this matter will not accrete all over the sphere but preferentially in polar caps covering about 10 billion square centimeters each or about a tenth of a percent of the neutron star's surface area.

The accreting matter is mostly hydrogen and helium, but as it is compressed, nuclear fusions begin, and the fusion process burns its way up the scale to carbon. A lot of carbon is made, and the peculiar conditions of the surface of the neutron star keeps the carbon hot and unstable. When a certain critical mass has accumulated in these hypothetical polar caps, the carbon is susceptible to a thermonuclear runaway, the polite term for an explosion.

This explanation of how the explosion happens parallels the theory of how a supernova explosion gets started in a white dwarf star that has made a lot of carbon. But there is one very important difference. The supernova explosion blows the white dwarf apart. But because of the neutron star's extremely strong gravity, the similar explosion on it is more like a pimple than a disintegration. Very little matter gets away, and most of what does is quickly pulled back. The major effect of the explosion is to heat a large amount of matter in a small volume. Cooling of this matter yields the gamma rays. Small blobs of it can break through the surface of the neutron star, and this action contributes the extremely short-timed variations that occur within the bursts.

Considering how well this picture accords with observations, Woosley and Tamm find that the explosions fit the duration of the bursts, the energy and the observed spectrum. Whether they fit the observed frequency and distribution of the bursts leads to a consideration of the statistics of neutron stars and how many may exist in the sort of binary system or dense cloud necessary. It appears that neutron stars made by supernovas of Type II will not do, but those resulting from Type I supernovas may.

This leads to another problem: distribution. The gamma-ray bursts tend to come from all over, but the progenitors of Type I supernovas are believed to be old stars found mainly in the flat disk of the galaxy. However, the day is saved by a reminder that supernova explosions can impart large velocites to the neutron stars they make, and so it is not unthinkable that in the time since Type I supernovas began to happen some of their neutron-star progeny might have gotten to distances of a kiloparsec or more from the plane of the galactic disk.

Of course there are many uncertainties, especially in the statistical arguments, and Woosley and Tamm conclude by remarking: "This subject is ripe for continuing experimental investigations and serious theoretical examination, and hopefully this somewhat speculative paper will encourage both." □

National Institute of Aging: A beginning

Two years ago Congress established the 11th unit of the National Institutes of Health—the National Institute of Aging—and since then the new institute has been getting underway. Last year it received the Gerontology Research Center in Baltimore as its intramural program and aging grants previously administered by the National Institute of Child Health and Human Development as its extramural program. In May it acquired its first director—Robert N. Butler, a psychiatrist and author of the Pulitzer Prize-winning book *Why Survive? Being Old in America* and a person with exceptional compassion for the elderly, since he was raised by his grandparents.

This month, at the 6th annual meeting of the American Aging Association in Washington, Butler spoke on the new institute and the directions it will be taking. He noted that "aging is the one biological condition common to all," yet it has been largely shoved under the rug in America. "A normal lustiness in a young man is considered lechery in an old one." Widows and widowers "live in sin" because the government will take away their pensions if they remarry. Only 15 out of 25,000 physicians on the faculties of medical schools have expertise in the progress of aging and how to care for the aged.

Yet the need for helping older people cope with aging is enormous. The Congress recognized the need by setting up the new institute. Other advanced countries are also recognizing the need and setting up comparable institutes. "We have reached a point," he says, "where there are 300 million retired people in the advanced nations."

In spite of the fears of sociologists and psychologists that the lion's share of institute money will go for research into the biology of aging, and the biologists' fear that most will go for research into the sociology and psychology of aging, Butler is reassuring both parties that he will devote ample research funds to both areas. In the biology arena, for example, the institute will undertake a research program next spring on senility, with the help of the National Institute of Neurological and