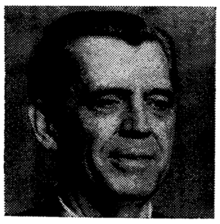
can be protected without a freeze.

"What Udall can do by executive order, I can undo," was one fast Hickel comment on this matter.

But later, under hammering in the Senate Interior Committee prior to his confirmation—and virtually as a price of confirmation—Hickel reversed himself and committed himself to the freeze. The question, among others, is likely to come up again.

Agriculture



Dr. Clifford M. Hardin, secretary-designate of the Department of Agriculture, has a reputation for quiet competence and toughness almost as conspicuous as is Gov. Hickel's renowned directness.

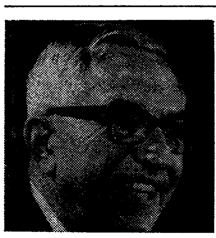
Dr. Hardin, chancellor of the University of Nebraska and a long-time member of the National Science Board, is every bit an academician who is coming into a hot spot focused on by consumers on one hand and producers on the other. Yet he is reputed to have a good grasp of farm problems, partly gleaned from a farm upbringing.

That he is tough and competent is evidenced by his performance as chancellor. When he came to the university in 1954 it had a student body only a little over 7,000 and was fast losing its faculty to better-paying jobs at other universities. Currently Nebraska's enrollment is nearing 30,000, the school is expanding its programs, and the faculty is among the best paid in the nation.

Under his administration the university has operated agricultural training programs in South America, Japan and Okinawa. Most recently it has sent a team to Colombia.

Dr. Hardin sees agriculture continuing its movement to fewer, larger farms with increasing automation. He has predicted that by the end of the next decade farmers will be using computers to plan their production.

Science policy



The Johnson Administration left a route marker in its budget requests for fiscal 1970 for the Nixon Administration to follow. These point to increased support for research into social problems and more or less holding the line on support for basic research in the hard sciences, with some shift in implementation to grants to institutions rather than individual researchers.

Institutions are geographically widespread—no self-respecting state is without a university—while deserving individuals tend to cluster in a very few places. Congress finds this porkbarrel aspect of science increasingly attractive; President Nixon and Dr. DuBridge will find it as hard to resist as did their predecessors.

Although social engineering research is hardly likely to stop under the new Administration, Mr. Nixon's attitudes and his choices so far give the impression that the hard scientists are likely to feel less out in the cold than they do now. Defense and related pacemaker budgets have kept many hard scientists in laboratory smocks over the past 20 years.

Ironically Mr. Nixon's campaign decisions on defense research probably accounted for a good deal of the opposition to his candidacy among members of the scientific establishment. These people belong to the so-called Los Alamos generation and have painful emotional scars about research related to weapons.

But the people who will be doing the research these days are more likely to belong to a younger generation that has fewer scars. To them the bomb is not something they were responsible for but something they grew up with. They are likely to take the money and go on working, as indeed they have been doing.

Oceanography

The nation's oceanographers have long regarded the sea as a potential source of food, fuel and minerals, and President Nixon shares this view.

In a letter to Dr. Edward Wenk Jr., director of the National Council on Marine Resources and Engineering Development—a letter he didn't have to write—Mr. Nixon has expressed his desire to see the nation move ahead in utilizing the untapped wealth of the oceans. In effect, the President is holding on to the council, and Wenk's first job will be to steer through the Congress a vastly expanded national oceanographic program.

The program was outlined in a report by the Commission on Marine Science and Engineering Resources, headed by Dr. Julius A. Stratton, chairman of the Ford Foundation. It recommends an independent Federal agency called the National Oceanographic and Atmospheric Agency (SN: 1/18, p. 62). The agency would unify the activities of 24 bureaus and 11 Federal agencies now conducting the nation's work in oceanography and related areas, such as weather monitoring and prediction.

The commission report also urges more basic research, to enable understanding of the oceans, predicting their behavior, exploiting the sea and assuring national security.

One task emphasized by the commission is developing technology to enable man to work as deep as 20,000 feet. Undersea operations are presently hampered by inadequacies in compact power sources, electrical systems and special equipment for vehicles and habitats. Instrumentation is graded "inefficient, unreliable and inadequate."

Closer inshore, the Stratton Report considers the problem of pollution of the nation's coastal waters and advocates research into the cause of the pollution and developing methods to handle waste collection and treatment. It singles out the Great Lakes as an area urgently in need of help. The rehabilitation of the domestic fishing industry is called for as well as research and development in aquatic farms.

All of these projects and many others envisioned will require billions of dollars. The 1970 budget allots $528 million for all marine science activities, $36 million of the sum going for military needs. The NOAA alone would require an annual operating budget of $2 billion by 1980. A total cost of $8 billion for the first 10 years of oceanographic effort is forecast, a sum approximating the present annual total for research and development in national defense. ◇

PULSARS

Optical signals at last

The pulsar in the Crab nebula, NP 0532, has been playing the part of a bellwether lately. At 33 milliseconds it is the quickest of the pulsars, and was the first to show that its period is slowing down (SN: 12/7, p. 574). It was also used by Prof. Thomas Gold of Cornell University as an example of what his rotating neutron star model for pulsars is able to predict (SN: 1/4, p. 9).

Now the useful NP 0532 appears also to be the first to show pulsations in visible light.

Drs. William J. Cocke, Michael J. Disney and Donald J. Taylor of the University of Arizona's Steward Observatory report that on the night of Jan. 15-16 they observed pulsations in visible light from a source they believe coincident with the pulsar. The optical pulse period is 33.095 milliseconds, "as close to the radio period as we could get our equipment," says Dr. Taylor. The width of the pulse is four milliseconds, and there are occasional secondary pulses midway between the primaries. The integrated visual magnitude of the object is 18; the peak magnitude is 15.

There have been reports of optically pulsating pulsars before (SN: 6/1, p. 519; SN: 6/8, p. 546) that turned out later to be mistaken. But the latest observation was soon confirmed independently both by the McDonald Observatory of the University of Texas and the Kitt Peak National Observatory in Arizona.

The Steward Observatory astronomers used recording equipment that takes signals from photomultiplier tubes and adds up waveforms. The optical pulses build up to one-sixth or one-seventh of the Crab nebula background. "When we shift off the location we get nothing," says Dr. Taylor. Every time they move the telescope off and back onto the location, the pulsing phenomenon "repeats on command," he says. Furthermore, since the detecting equipment cannot quite match the frequency of NP 0532's radio pulses, the optical pulses shift progressively with time as they reappear.

None of the theoretical pulsar models now under discussion provides for optical pulses. Though he feels its "a little bit early" to make definite theoretical statements, Dr. Disney says, "it's very surprising we're getting these pulses. Some experts on neutron stars say they should be quite impossible."

The discovery will add a new dimension to the information available about pulsars as well as complicating the theoretical problems. "If we had the spectrum of the light, it would tell us very much about the physical processes of the pulsar," says Dr. Frank Drake of Cornell University, another prominent pulsar watcher. That's a matter of time.

SYNTHETIC RIBONUCLEASE

Opening the enzyme door

Ten years ago Dr. Robert Bruce Merrifield told a colleague that he wanted to make an enzyme. "When he stopped laughing," Dr. Merrifield recounts, "he told me I was crazy."

Dr. Robert G. Denkewalter also wanted to make an enzyme, but kept his ambition to himself until about 18 months ago. He, too, thought friends would call it impossible.

"We wanted to make an enzyme," Dr. Denkewalter declares, "because they are a source of wonder and embarrassment to us as organic chemists." Enzymes, members of the protein family, amaze chemists with their ability to speed virtually all chemical reactions within the body, simply and automatically. "They're embarrassing," Dr. Denkewalter says, "because they can do at body temperature and in simple water solution what we organic chemists can do only with corrosive agents, at high temperatures, with laborious processes."

At least 1,000 individual enzymes are known to be involved in the body's biochemistry, triggering reactions that furnish energy for breathing, heart pumping, nerve transmission and digestion. There are probably more, but for all that are known, and for all that is known about them, fundamental questions about what they are and how they work remain unanswered.

But answers are forthcoming. Undaunted by skeptics' laughter, Dr. Merrifield, working at Rockefeller University in New York with Dr. Bernd Gutte, and Dr. Denkewalter, with Dr. Ralph Hirschmann at the Merck Sharp and Dohme research laboratories in Rahway, N.J., patiently pursued their course. Proceeding independently, each team developed separate methods of accomplishing their task, and simultaneously succeeded in manufacturing the enzyme ribonuclease. Its job is to destroy RNA (ribonucleic acid), the cell's carrier of genetic information, after it has been used.

Ribonuclease was chosen as the target enzyme because it is small, as enzymes go—it is made up of only 124 amino acid units—and because its complete three-dimensional structure was revealed two years ago (SN: 2/4/67, p. 119) by scientists at Roswell Park Memorial Institute in Buffalo and at Rockefeller.

Though the most immediate significance of ribonuclease synthesis lies in new explorations in basic research, its laboratory creation is also, in effect, the birth announcement of a new class of drugs. Neither Drs. Merrifield nor Denkewalter foresee any immediate therapeutic application for their achievement, but they agree that someday it could lead to important new treatments, even cures, of such enzyme deficiency diseases as phenylketonuria (which causes mental retardation), anemias, blood disorders and diabetes.

Only within the last two years have enzymes been used experimentally in disease. One, asparaginase, shows promise in treating childhood leukemia, and another, dextranase, is being studied as a tooth decay preventative. But, as Dr. Denkewalter emphasizes, use of enzymes as drugs is not a simple matter. Before a new generation of drugs even begins to take shape, numerous new discoveries and insights which cannot even be anticipated yet will have to come.

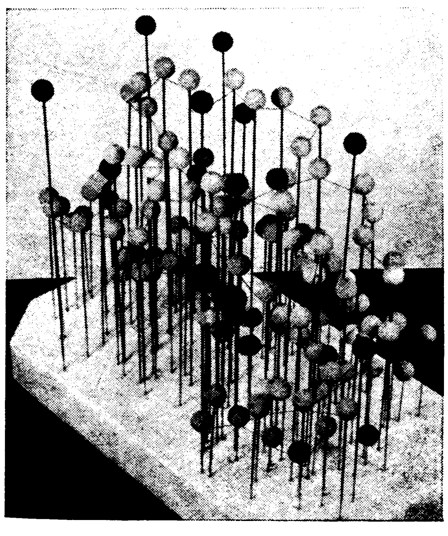
"You can't just make an enzyme and inject it into the bloodstream," he points out. Many enzymes work deep within the interior of a cell. "If you just pour new ones on the outside, the cell couldn't care less."

To make ribonuclease, the Rockefeller scientists used a polystyrene bead .002 inch in diameter as an anchor for the chain-like molecule. Through a series of 369 chemical reactions, performed in 11,931 steps by an automatic enzyme synthesizer working 24 hours a day for three weeks, they linked 124 amino acid molecules together in proper sequence, and then placed it into a solution in which it naturally folded itself into its proper three-dimensional configuration.

The Merck group made ribonuclease in stages, building first one fragment of amino acid molecules, and then another. Then, finally, the bits were hooked together into a linear molecule which, like its Rockefeller counterpart, obligingly took on its three-dimensional shape.

The configuration of the enzyme is essential to its biological activity and its inate ability to put itself in shape confirms a hypothesis proposed by Dr. Christian Anfinsen of the National Institutes of Health that information for the architectural configuration of an enzyme is built into the linear sequence of molecules.

Though the Rockefeller method has the advantage of speed—it is ultimately a month or two faster—the Merck method holds the possibility of manipulating the enzyme by leaving off certain amino acid fragments. That way scientists can test the active sites on the molecule in an effort to see whether or not a smaller, simpler molecule could be designed with equal enzymatic activity.



RNAse—from structure to synthesis.