

40. Existing forms of therapy leave much to be desired.

During the last couple of years, two new therapeutic agents have been proposed and have attracted considerable attention in the medical community and in the press. One is urea; the other, cyanate. Each attacks the problem of sickle cell anemia where it counts—at the molecular level, by reversing sickling, at least in vitro. Each comes from an understanding of the molecular basis of the disease. Whether either actually works in patients is very much open to question. Many investigators say it is not at all clear that these agents will reverse sickling at dosages that are safe in human beings.

Sickle cell anemia is among the first diseases to be dissected at the molecular level. Initial inroads into an understanding of sickle cell anemia were made by Linus Pauling and his colleagues, who first showed in 1949 that normal adult hemoglobin and sickle hemoglobin are structurally different molecules (*Science*, 25 November 1949). In a paper titled "Sickle cell anemia, a molecular disease," Pauling correctly suggested that sickle cell hemoglobin molecules are capable of interacting with one another, that upon deoxygenation, the molecules can aggregate into rods that twist fragile red cells out of shape.

By 1957, V. M. Ingram, now of the Massachusetts Institute of Technology, had taken molecular studies of the sickle cell further. He demonstrated that, structurally, sickle cells differ from normal ones at only two positions in a molecule that is made up of 574 amino acid residues. Following up on this information, a physical chemist at the National Institutes of Health who had once studied under Pauling explained how the substitution of valine for glutamic acid in the two positions affects the cell in such a way as to allow sickling. Makio Murayama, who has made a precision model of sickle cell hemoglobin, published the "Molecular mechanism of red cell sickling" 6 years ago (*Science*, 8 July 1966).

Working with Murayama's molecular explanation, a Michigan physician set about finding a chemical that would break the bonds which form to distort hemoglobin into a sickle shape and came up with the observation that urea, commonly used in chemical and medical experiments, appears to do so. This observation by Robert M. Nalbandian of Blodgett Memorial Hospital in

## Turnover at CEQ

Two new members have been sworn in on the Council of Environmental Quality (CEQ) to replace Robert Cahn and Gordon J. F. MacDonald, who have resigned. They are Beatrice E. Willard, president of the Thorne Ecological Institute of Boulder, Colorado, and John A. Busterud, deputy assistant secretary of defense for environmental quality.

Willard, 47, will be the scientist as well as the woman in the CEQ triumvirate. An ecologist educated at Stanford and the University of Colorado, she taught biology at South Oregon College for a year before joining the institute as executive director in 1965. Thorne Ecological Institute, founded in 1954, is an educational organization that does applied research for private industry and supplies advice on how companies can conduct their operations in a manner harmonious with environmental considerations.

She is also the author of several books on alpine ecosystems and has served on a number of Colorado state committees concerned with the environment. She is, among other things, chairman of the Sierra Club's Rocky Mountain chapter.

The Administration's eagerness to get Willard on board is evinced by the fact that they started pursuing her in May. But it was not until August that she decided that the institute, something of a "one-man" operation, could survive without her.

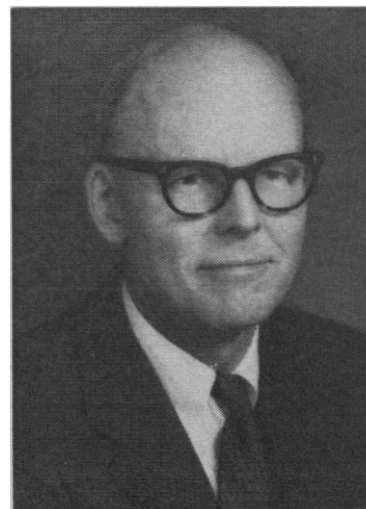
Busterud, 51, is a lawyer, conservationist, and native of Oregon. Before coming to Washington in 1971, he was a senior partner in a San Francisco law firm specializing in conservation and antitrust law. His was the first appointment to the Defense Department post that was created by Secretary Melvin Laird to help the military conform to the aims of the National Environment Policy Act. Busterud's office has been working on "getting the military to think environmental quality" from early planning stages onward, and it reviews environmental impact statements on controversial matters such as the storage and disposal of the phased-out Herbicide Orange.

Busterud is frankly "thrilled" at his new job at CEQ, which he sees as "the environmental conscience of the nation."

As for the pair who left the council, Cahn has returned to his job on the *Christian Science Monitor*, and MacDonald is director of the Environmental Studies Program at Dartmouth College. Last month MacDonald was also named chairman of the Environmental Studies Board of the National Academy of Sciences.—C.H.



Beatrice E. Willard



John A. Busterud