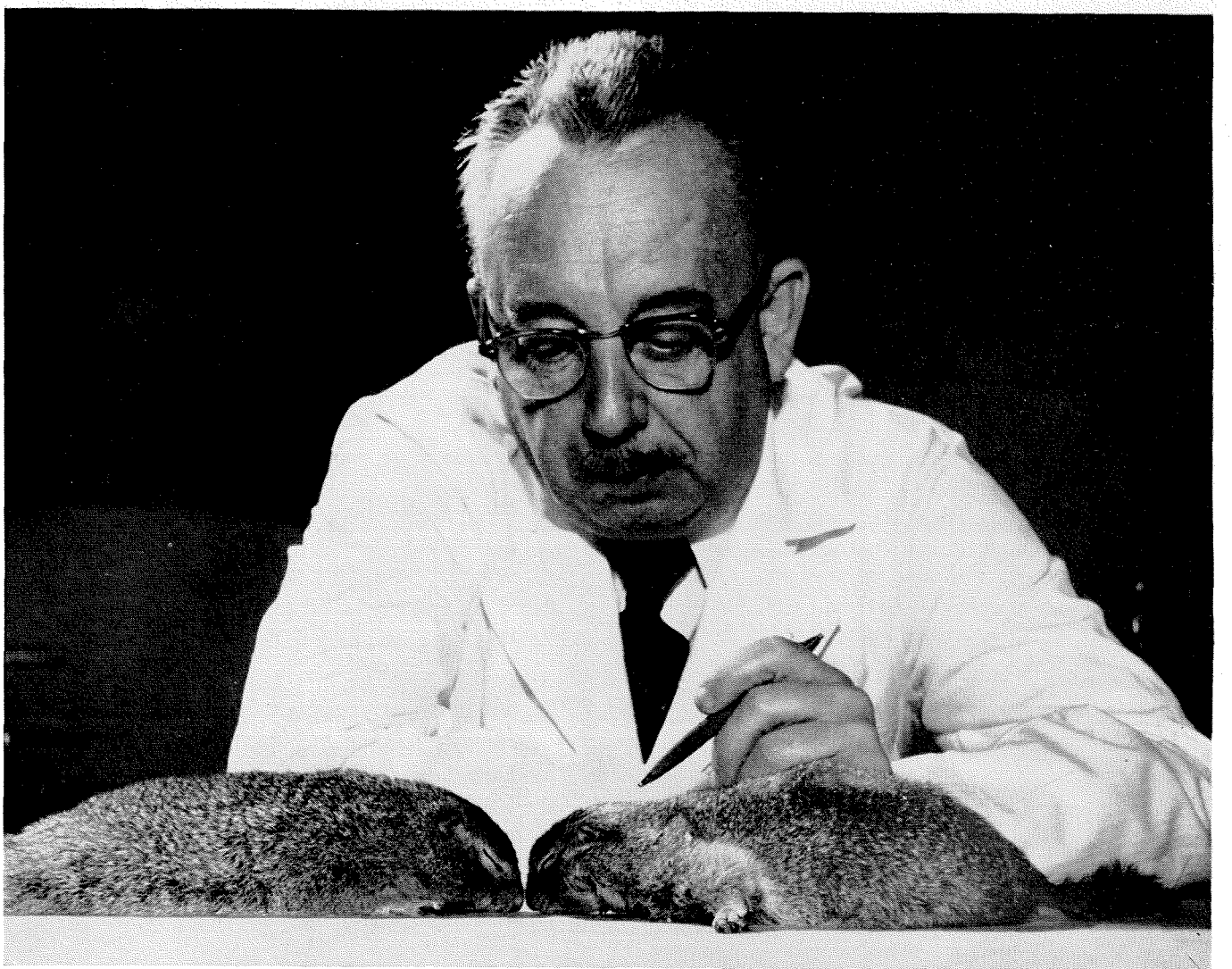

Dr. Campbell checks on two hibernating Arctic ground squirrels

SOME LIKE IT COLD

By studying how Arctic animals adapt themselves to cold, we are making a start towards solving problems dealing with man's survival in the Arctic.

by DAN H. CAMPBELL

ABOUT EIGHT YEARS AGO the Office of Naval Research initiated a program to stimulate research in the Arctic and on Arctic problems, by supplying facilities at Point Barrow, Alaska. Groups from several universities immediately became interested and began a variety of investigations which included everything from abstinence and acclimatization to zoography. From modest facilities which consisted of two small Quonset huts, and a few test tubes and thermometers in 1947, the equipment developed into a modern laboratory which comfortably accommodated about thirty research workers and contained all of the essential supplies, apparatus and services for biological, physical and chemical research.

Caltech became one of the early participants in this program when I was given a grant by the ONR to

investigate possible changes that might occur in the chemical and physical properties of blood and in the immunity responses of animals and man under conditions of Arctic stress. The first trip to the Point Barrow laboratory was made early in 1948. Naval Air Transport supplied transportation as far as Kodiak Island, and then it was necessary to "hitch-hike" plane rides to Fairbanks. At this point, a Navy contract commercial plane supplied transportation to Point Barrow. The air route "through" the Brooks mountain range via Anaktuvuk Pass was extremely spectacular but rather disturbing, owing to the closeness of canyon walls.

Getting under way

The crowded quarters and lack of supplies at the laboratory prevented any significant research accomplishments during this initial period of orientation. However, a clear idea was obtained with regard to laboratory needs and the problems that could be studied under these conditions.

One of the most interesting problems involved the chemical and physiological changes which occur in the common Arctic ground squirrel during its active and hibernating states. These animals have a remarkable mechanism which enables them to survive the long Arctic winters by going into a state of "suspended animation." When the winter sets in, they enter their burrows and go to sleep. The body temperature falls to about 0°C, and is maintained at this point until spring. Some observers have stated that if the body temperature falls much lower, a hibernating animal will partially awaken and shiver until the body temperature rises to around 0°C, then immediately go back to sleep.

The mechanism of hibernation

To date, no information has been obtained as to the factors involved in regulating the mechanism of hibernation. If the mechanism is determined, one can speculate on the possibility of application to humans during surgery, for instance. However, during the next few years in which research was carried on at Point Barrow, several interesting facts came to light regarding the physiology and blood chemistry of these animals.

For example, it was found that the circulation of blood was practically nil and heart beats could hardly be detected, even with a stethoscope. Respiration was so shallow and at such long intervals (one or two times a minute) as to be almost non-existent. As might be expected, metabolism apparently reached an extremely low rate. Animals which had been immunized during the pre-hibernation period contained circulating antibody protein when they came out of hibernation. Such proteins as appear as a result of immunization (vaccination) usually disappear within a few weeks after the last immunization "shot."

Another interesting finding was that the normal blood coagulation mechanism was drastically changed, so that, instead of clotting within a few minutes after removal from the body, it took many hours, and in some cases failed to clot completely even after standing for several days. An analysis of serums for their plasma protein composition showed that the total concentration increased during hibernation and that relative concentrations of the various components changed. Also new protein components appeared which were not present in serum taken from active animals.

"Cold stress"

Because of the rigors of Arctic conditions, it was impossible to carry on a sustained program, so that after the second year research was done intermittently at intervals of several months, and finally moved entirely to the Caltech campus. These studies during the past few years have concentrated on the effect of "cold stress" on the common laboratory rabbit with respect to changes in blood chemistry, antibody response to immunization, and the rate of formation and decay of blood plasma proteins.

Normal young rabbits have been placed in cold rooms at about 32°F and their "coats" removed gradually over a period of about a week by shaving off their fur. After about a month under these conditions it was found that such rabbits were active and healthy and gained more weight than a control group maintained under normal conditions.

One of the most significant findings was that the blood of animals subjected to the "cold stress" clotted at a much slower rate than that of normal animals. This finding suggests that studies should also be made on humans under Arctic conditions, since blood clotting is of great importance in maintenance of a normal physiological state as well as in guarding against severe hemorrhage following injuries or surgery. It was also found that when blood was removed from "cold" rabbits, plasma was restored at a normal rate, but red blood cell restoration was much slower than in normal animals.

Adaptation and survival

A great deal of folklore has been written about the behavior and physiological state of animals and humans under Arctic conditions, but sound scientific investigation of these problems has hardly been touched. It is obvious that with the increase in interest and activity in Arctic regions as a possible battle ground, or as a part in global transportation routes and perhaps as a new source of natural resources, the problems of adaptation and survival become more important. If we knew why birds are able to stand barefooted on a cake of Arctic ice in sub-zero weather or how Arctic squirrels are able to turn off their body heat and go to sleep when the going gets tough, we should be a long way towards the solution of problems dealing with survival in the Arctic.