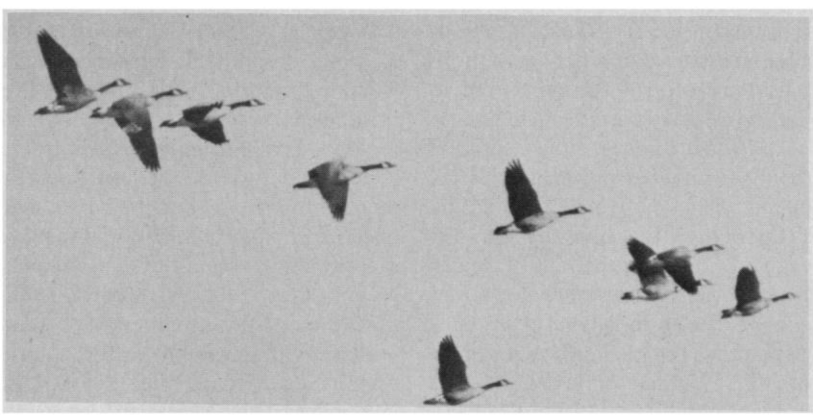
Birds Fly. Why Can't I?

Daedalus and his son Icarus strapped on wings made from wax and bird feathers and flew out of imprisonment. But in the joy of soaring like a bird, the legend says, Icarus flew too near the sun, the wax melted, and he fell to his death. Everyone knows, of course, that the legend is wrong. At the rarified heights routinely reached by birds, man and other mammals suffer and die. Physiologists have been intrigued for decades by the ability of birds to survive, even to thrive, at altitudes that are harmful to other species. Now, a young investigator at Duke University has found at least part of the way they do it.

At high altitudes, all animals hyperventilate—an involuntary mechanism of fast breathing in which carbon dioxide is expelled in large amounts. This loss of carbon dioxide causes the *p*H of blood to become alkaline and constricts blood vessels. This, in turn, reduces the flow of blood to the brain and brain cells become starved for oxygen, eventually dying. An alkaline *p*H in the blood can also produce other fatal effects. But this doesn't appear to occur with birds, says Barbara R. Grubb, a postdoctoral investigator in the laboratory of Knut Schmidt-Nielsen at Duke.

Grubb studied blood flow to the brain in a species of duck (*Anas platyrthyacos domesticus*), both because ducks are large enough for accurate measurement of blood flow and because they can readily tolerate altitudes



Scientists have been long intrigued by the ability of birds to fly at altitudes where man and other mammals suffer and die. [Photo: U.S. Fish and Wildlife Service]

of 9000 meters or more. Using a technique called xenon clearance, she injected the radioactive gas into an artery leading to the duck's brain, then monitored the rate at which the xenon moves out of brain tissues. This rate is proportional to blood flow.

During hyperventilation, Grubb observed, blood flow through the duck's brain was close to the rate observed when the animal was breathing normally. Under similar conditions, she says, brain blood flow in mammals would be 50 to 75 percent below normal and they would experience severe pain. It is clear, then, that birds have some mechanism which prevents constriction of blood vessels when carbon dioxide is expelled, and it is this mechanism which permits them, but not man, to survive at high altitudes. The nature of this mechanism is not known yet, but its existence is corroborated by other investigators, who have previously shown that birds can withstand a blood *p*H of 8. In mammals that *p*H would be fatal.

Grubb is now studying cardiac output of birds. The hearts of birds are proportionately larger than those of other animals, and physiologists have assumed, but have never proved, that they can pump blood at a higher rate. A faster blood flow would enable more oxygen to reach tissues, even if the concentration in the air inhaled by the bird is low. This might be another part of the mechanisms by which birds survive at high altitudes. Daedalus and Icarus, it is now becoming clear, just didn't have what it takes to be high-flyers.—THOMAS H. MAUGH II

year to procure additional computer facilities for the institute's private use. In fact, Kohn notes, the institute is not expected to be heavily computer oriented.

Would a roomful of theorists gathered together on the top floor of a building overlooking the blue Pacific tend to become isolated from the rest of the world? Officials connected with the institute are working hard to see that this does not happen. For one thing, the institute is regarded as a national facility. Only 3 of about 30 participants will be permanent Santa Barbara employees; the rest rotate after various periods of residence, as will the membership of the advisory board. Kayser emphasizes that a major purpose of the institute, one that distinguishes it from all others, is to get physicists to do research outside their current specialties. Finally, a call is being issued in the form of a letter to be printed in *Physics Today* for suggestions from all physicists for suitable research topics.

A special concern is to maintain contact with experimentalists. To this end, provisions are being made for visits to the institute by experimental physicists, and numerous symposia or other meetings are on the agenda that will allow experimentalists to help the institute plan upcoming projects or evaluate just completed ones. Regularly scheduled seminars given by experimental physicists are also under consideration.

For the present, there is no commitment on the part of NSF to fund the institute beyond the 5-year trial period. Continuation of support will be in part contingent upon whether the physics community judges the institute to be producing research that is so exciting that "physicists are knocking down the walls of the place in order to get in," says Kayser. The feeling definitely is that an only moderately successful institute will not be continued.

As has all of science, physics has come a long way since the days three-quarters of a century ago when a then obscure patent examiner in Switzerland working in his spare time could devise theories with the power to transform the way scientists view the world. Now a million-dollar-a-year facility is being established to allow the best minds in physics to concentrate on solving problems, many of which can trace their origin back to questions opened by the work of this one insightful man. It is perhaps a more fitting tribute than much of the public commemoration now in progress that the new Institute for Theoretical Physics coincidentally should be established on the one-hundredth anniversary of Albert Einstein's birth.—ARTHUR L. ROBINSON

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