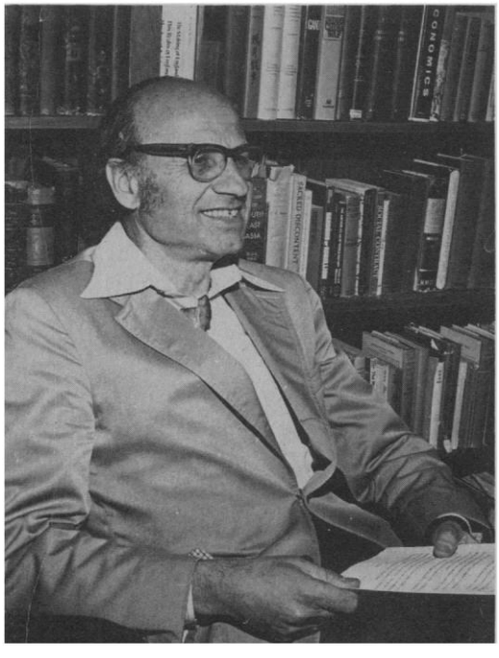
Theoretical Physics Institute Gets Go Ahead

West Coast theory center designed to facilitate cross talk between physicists working in different specialties

A nearly 2-year-long competition between academic and other institutions was ended in January when the National Science Board, the policy-making body of the National Science Foundation (NSF), unanimously approved the selection of the University of California, Santa Barbara, as the site for the proposed national Institute for Theoretical Physics. Planned to open for business this September for a 5-year trial period of operation, the institute will eventually house some 25 to 30 theorists from all fields of physics who will be able to pool their expertise in a concerted attack on certain theoretical problems that have roots in several different specialties. A director and a board of advisers have already been selected, and modification of a building on the Santa Barbara campus to house the institute is under way. The first director will be Walter Kohn, a solid state physicist from the University of California, San Diego, who has agreed to hold the post for at least 2 years, while the institute is being organized, and possibly longer.

Physicists give much of the credit for establishment of the institute to Boris Kayser of NSF, who has vigorously championed the concept within his agency, although the need for an interdisciplinary physics think tank has been widely bruited about for the last few years as a counter to the trend toward greater and greater specialization. It has become apparent, according to Robert Sugar, one of the four Santa Barbara physicists who put together the winning proposal, that there are a host of problems where interaction between theorists from different specialties would be very productive. But, he added, it is very hard to assemble new groups in the universities because physics departments are no longer growing.



Walter Kohn

In its first meeting in February, the new institute's 17-member advisory board discussed some of these problems and approved three for initial attention. The first program will deal with nonlinear field theories of the type used to describe elementary particles and also to treat certain occurrences, such as critical phenomena, in condensed matter (solids or liquids). This effort will be led by Roger Dashen of the Institute for Advanced Study, Princeton, and Douglas Scalapino of Santa Barbara. A second program on issues in quantum gravity, such as finding how elementary particles are created in the presence of the enormous gravitational fields near black holes, will be headed by Bryce Dewitt of the University of Texas, Austin. And the third program, under the direction of Gerald Brown of the State University of New York, Stony Brook, will focus on the properties of nuclear matter at high density and temperature, a subject that will bring together theorists in nuclear and astrophysics.

To accomplish these and future studies, the institute will encompass permanent staff, senior visitors, and junior visitors. The permanent staff, not yet selected, will comprise three individuals with positions on the Santa Barbara faculty and will help provide direction to the institute and establish the appropriate environment for research. The senior visitors, more than three-fourths of whom have already been chosen for the first year's studies, will be on leave from their home institutions for various periods up to about 2 years. Many of the junior visitor slots will be reserved for young (25 to 35 years of age) theorists who have not yet found tenured positions. In this way, what some see as a declining vitality due to a decade-long depressed job market that is preventing the incorporation of new blood into established research groups can be partially rejuvenated, according to Kohn. One indication of the vigorous recruiting effort under way to find people for these positions is that letters have gone out to every Ph.D.-granting physics department in the land advertising their availability.

Overseeing operation of the institute will be the advisory board, made up of leading theoretical physicists drawn from a broad range of specialties and from all parts of the country. The board members, all of whom have been selected and have agreed to serve, will meet only once a year, however, and an executive committee comprising five board members and the director will exercise closer control. Members of the committee, who are expected to be in attendance at the institute for at least 2 months each year, are Richard Blankenbecler of the Stanford Linear Accelerator Center, Subramanyan Chandrasekhar of the University of Chicago, James Hartle of Santa Barbara, J. Robert Schrieffer of the University of Pennsylvania, and Dashen.*

As for physical facilities, the institute will occupy the top floor (9000 square feet) of a building on the Santa Barbara campus. Architectural work to make the space conform to the needs of the theorists is in progress, and all changes are expected to be completed by the September start-up date. Several terminals, for example, will be available that connect to the Santa Barbara computer center. For now, there is no provision in the budget of approximately $1 million per

*The other members of the advisory board are: Gordon Baym, University of Illinois; George Bertsch, Michigan State University; John Cornwall, University of California, Los Angeles; Douglas Eardley, Yale University; Herman Feshbach, Massachusetts Institute of Technology; Murray Gell-Mann, California Institute of Technology; Leo Kadanoff, University of Chicago; Paul Martin, Harvard University; Michael Nauenberg, University of California, Santa Cruz; David Pines, University of Illinois; Malvin Ruderman, Columbia University; and Kip Thorne, California Institute of Technology.

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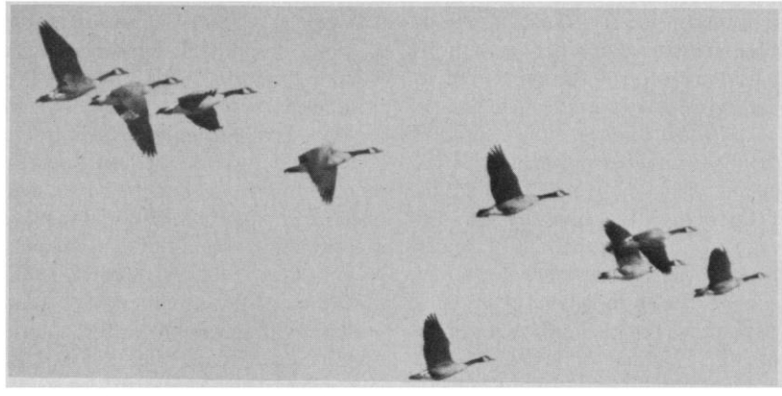
Speaking of Science

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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