ized his results to integration over circles or spheres of constant radius and to certain ellipsoids. Generalizations to spaces other than Euclidean were made, for example, by Helgason (*19*) and Gelfand *et al.* (*20*) in the 1960's.

In my 1964 paper I gave a solution to the problem of integrating over circles of variable radius which pass through the origin as shown in Fig. 10. Recently, Quinto and I (*21*) have given much more detailed results on this problem generalized to n-dimensional Euclidean space, and we have applied these results to obtain some theorems about the solutions of Darboux's partial differential equation. There is an intimate connection between our results and Radon's results, and we are presently attempting to find more general results which relate the solution of Radon's problem for a family of surfaces to the solution of Radon's problem for another family of surfaces related to the first in a particular way.

What is the use of these results? The answer is that I do not know. They will almost certainly produce some theorems in the theory of partial differential equations, and some of them may find application in imaging with NMR or ultrasound, but that is by no means certain. It is also beside the point. Quinto and I are studying these topics because they are interesting in their own right as mathematical problems, and that is what science is all about.

Of the many people who have influenced me beneficially, I shall name only a few. The late Professor R. W. James F.R.S. taught me a great deal, not only about physics, when I was a student and a young lecturer in his department in Cape Town. Andreas Koehler, director of the Harvard Cyclotron Laboratory, has provided me with friendship, moral support, and intellectual stimulation for over 20 years. On the domestic side are my parents, now deceased, and my immediate family. My wife Barbara and our three children have not only put up with me, they have done so in a loving and supportive way for many years. To these people and others unnamed I shall be grateful to the end of my life.

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The Cayo Santiago Primate Colony

William F. Windle

Plans for a National Primate Research Center and the subsequent establishment of Regional Primate Research Centers in the United States stem from the successful transplantation of a breeding colony of monkeys from India to tropical Cayo Santiago, Puerto Rico, in 1938. A modest grant from the private sector was the seed from which sprouted a multimillion-dollar federal program, catalyzed by three imaginative scientists, George W. Bachman, C. Ray Carpenter, and James Watt. Some previously unpublished information about the Puerto Rican colony illustrates its role in directing national attention to the use of nonhuman primates in behavioral and biomedical research.

The colony in Puerto Rico is not the only instance of New World introductions of Old World primates under conditions in which they are free to range much as they had in their natural habitat. During the 18th and early 19th centuries, African green monkeys were fortuitously introduced to Caribbean islands by sailors of slaving ships. Descendants of those monkeys still thrive on the islands of Saint Kitts and Nevis. After the Puerto Rican colony was established, about 1947, a second group of rhesus monkeys was placed on a small island at Rio de Janeiro, Brazil, with funds from the Rockefeller Foundation to the Oswaldo Cruz Institute (*1*).

Not only did the Puerto Rican colony encourage the Brazilian scientists, but it was cited by A. Kortlandt as a model for an International Laboratory of Primate Biology on an island in an African lake. The only previous major attempt to set up freely ranging colonies of nonhuman primates was that at Sukhumi, U.S.S.R., where the animals are confined in walled enclosures of an acre or more. That colony was established in 1927 and maintained even during the Second World War.

The use of monkeys in biological and psychological studies was not new in the late 1930's, but there were wide gaps in our knowledge of their behavior and social organization. Moreover, there was growing apprehension that war might break out in Europe and curtail exportation of animals from India to the United States.

An event that triggered the movement toward establishing the breeding colony in Puerto Rico occurred in 1937. The Asiatic Primate Expedition, conducted by Harold Coolege, Adolph Schultz, and Carpenter, brought back from the Far East seven gibbons (*Hylobates lar*). Carpenter was on the faculty of Bard College of Columbia University at that time, and Bachman, the director of the School of Tropical Medicine in San Juan, Puerto Rico, a component of Columbia University, stepped forward to provide quarters in San Juan for the gibbons. Moreover, he committed money from his limited budgets for their maintenance, and he encouraged his colleagues at Columbia to plan additions to the gibbon colony as

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well as to consider establishing other Old World primates there. He saw the advantage of having a breeding colony isolated to provide disease-free animals for his own laboratory as well as for those of other scientists.

To find a suitable home for the displaced gibbons, Bachman explored uninhabited islets off the south shore of Puerto Rico. He found one of approximately 37 lying five-eights of a mile by boat from the village of Playa de Humacao, a small port of entry with a customs house. That islet, Cayo Santiago, was owned by a family in Spain and could be leased; later it was acquired by the Puerto Rican government.

Summary. This is an account of the vicissitudes of the monkeys on Cayo Santiago. In it is described the relationship of the establishment of that primate colony to the development of the National Regional Primate Research Center Program in the United States and the Laboratory of Perinatal Physiology in Puerto Rico. The Cayo Santiago colony opened new aspects of biomedical research and stimulated the general use of nonhuman primates in behavioral as well as physiological investigations.

The next step was to raise money to buy animals in India, transport them to Puerto Rico, and provide for their maintenance there. Carpenter joined the Department of Anatomy at Columbia University College of Physicians and Surgeons. Phillip E. Smith, chairman of that department, and Bachman as principal investigators and Earl T. Engle and Carpenter as co-investigators, submitted a proposal to the John and Mary R. Markle Foundation for a grant of $60,000. The foundation solicited opinions regarding significance and feasibility of carrying out the project. Some of those who had studied caged monkeys warned that one should not expect Indian monkeys to breed in the tropics. The grant was nonetheless awarded early in 1938, and that summer Carpenter drew $5000 for an expedition to the East to collect animals.

Carpenter had observed gibbons in the field and had found the animal to be one of the most interesting primates. It is highly monogamous, with a family of one male, one female with infant, and three or more juveniles. This was reason enough to try to establish a gibbon colony in the New World. Carpenter, whose first effort failed, relates the experience (*2*).

> I went to India by way of Indo-China and collected 18 or 20 fine gibbons specimens, several siamongs and an orangutan from Sumatra and assembled them at Penang, Malaya. Then I committed a very grave error. There was a famous neurosurgeon at Johns Hopkins University whose nephew was stranded in Singapore. The boy had jumped ship in Singapore and was in trouble with the U.S. Counsel there. He could not get out of the city. I permitted a "halo effect" to operate. I thought that surely a distinguished neurosurgeon's nephew could be trusted, so I put him in charge of this shipment of animals from Penang—one of the finest shipments of primates that ever left the port. . . . The only animals that reached this country were the orangutan and two or three of the small gibbons. All the rest died in the Red Sea from the lack of food, high temperature, and poor care.

Carpenter's trip cost more than the amount budgeted, and the gibbons were sold to the Brookfield Zoo for $1000 to help cover the deficit. [Later the orangutan (*Pongo pygmaeus*) was also sold.] The rest of the story of Carpenter and Bachman's attempt to establish a gibbon colony in Puerto Rico is brief. The seven animals that had been sent there in 1937 were released on Cayo Santiago in 1940 after the rhesus monkeys (*Macaca mulatta*) had been freed. Soon it became apparent that their presence was incompatible with that of humans. The wives of both Watt and Micheal I. Tomlin, the resident primatologist, were attacked and bitten, and the gibbons were promptly recaptured and returned to cages. They created excitement in Puerto Rico in other ways, as well. Watt recalled that "the place really rocked when they were in full voice." An infant gibbon was born in San Juan, and somewhere there is a motion picture of the hairless baby with its mother in a cage near the School of Tropical Medicine. No publications relate to studies of the Puerto Rican gibbons, all of which were sold to zoos after they were removed from Cayo Santiago.

To effect the collection in India and shipment to America of monkeys for the Cayo Santiago colony, Carpenter established a base in Calcutta in September of 1938 and purchased rhesus monkeys from professional collectors in several regions. He planned to acquire six females of breeding age to each male. Actually there were 100 females with infants, 200 other females, 50 adult males, and 150 juvenile monkeys, all of which were intended for Puerto Rico, and 15 aged males of the same species for Smith and Engle at Columbia. A family of pigtail macaques (*Macaca nemestrina*)—composed of a male, a female, and an infant—was also obtained.

The hazard of shipping monkeys by sea was so great that it is remarkable that they arrived in Boston Harbor (and then New York) without great loss. No description of the journey has been published, but Carpenter gave a lecture in San Juan in August 1959, in which he said:

> I had to enter into an agreement with one of the powerful animal dealers in Calcutta and negotiate a unit price before any animals were trapped. The dealer in turn dealt with what we might call the animal unions, of which there are two. There is the Mohammedan union that collects the animals and the Hindu union that cares for them after they are collected. As you know, monkeys are sacred animals in India; therefore, the Hindus will not trap them, because it is rough, cruel business. The Mohammedans will do this, and there is an organized network of animal trappers out in central India. I had to deal with the chief man of that particular union through the animal dealer, Mrs. Chater.
>
> When the animals were trapped, they were brought to an estate house which was rented and used for this particular shipment of animals. The animals were brought in, sorted, cared for, and tuberculosis tested. Special cages were required for the large males and females with infants. Then we were confronted with the critical business of arranging for shipment.
>
> No shipping company wanted to transport the animals. You could tell them that you represented science and research, the College of Physicians and Surgeons, and the Markle Foundation, but to no effect. This argument left them cold. I learned that the arrangements had to be made with the captain of a ship. The captain expected an amount of extra money over and above the shipping charges, which were already very high. I think I promised my captain $150. I never paid $50 of it because I ran short of funds. This was not all. The first officer came in for his $50 and the deck steward expected another $50. I think they deserved the bonuses because 500 animals practically covered the whole deck of a large freighter. The nuisance to the officers of a ship was quite considerable. In addition to arrangements for shipping, there was the problem of arranging for food for the monkeys.
>
> The standard method of feeding animals in transit was to use cooked, unhulled rice. I thought I could do better than that, so I got the formula of the monkey biscuit that had been developed at Orange Park, Florida, and tried to have this duplicated in Calcutta. I had 500 pounds of food made up into biscuits, using ingredients that I could get around Calcutta, and put the lot on shipboard along with a very large supply of unhulled rice, thank God. Three days out of Calcutta the biscuits molded and soured, and a couple of more days I threw them overboard. By the time we reached Colombo I had learned more about the food consumption of 500 rhesus monkeys, particularly the big males, and I was able to stock up with large quantities of fruits and vegetables there.
>
> At Colombo we were informed that, instead of going through the Mediterranean as scheduled, the Cunard Line wanted us to make a

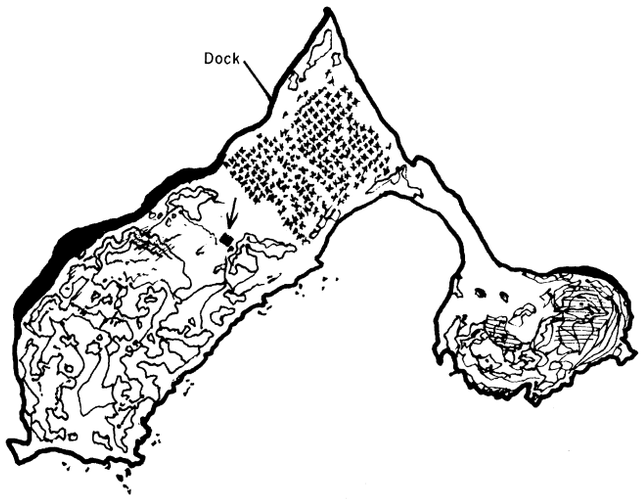

Fig. 1. Contour map of Cayo Santiago in 1940. An arrow marks the house. Today the island is heavily forested, the grove of coconut palms is smaller, and the north shore (top) has been extended beyond the end of the dock by tropical plant growth.

test run around South Africa. War was near. This was late September. All the animals were on the exposed deck. The ship was scheduled to dock first at Boston and then at New York, from where we would transship to Puerto Rico. So you can imagine something of the anxiety that developed with the responsibility for 500 animals caged on deck and with the uncertainties of weather around the Cape as well as near Boston and New York.

I worked 14- or 15-hour days. I cleaned cages and fed animals all day long, in rough weather or calm, and then I went to sleep. This trip required 47 days. We escaped possible severe cold weather around the Cape, and . . . for the first time in the history of that ship, we got into Boston and to New York in weather that did not fall below the tolerance levels of rhesus monkeys.

Few of the monkeys died during the long sea voyage. To relieve the financial deficit, 50 adult females were taken off in New York to be sold to Carl Hartman, of the Carnegie Laboratory in Baltimore. The rest were transshipped to Puerto Rico. Carpenter arrived in San Juan with the animals in December of 1938 and turned responsibility for them over to Tomlin. The monkeys were kept in cages until they could be tested again for tuberculosis, but, before the end of the month, 406 rhesus and the three pig-tail monkeys were released on Cayo Santiago.

During the time Carpenter had been away, colleagues in New York and San Juan had made arrangements for receiving the monkeys on Cayo Santiago. They had engaged Tomlin, who had been in charge of primates at the Philadelphia Zoo, and had funded construction of a house on Cayo Santiago for him and his wife. A general caretaker had been hired and a rowboat and other equipment purchased. Members of the Civilian Conservation Corps helped to clear paths and plant mahogany trees, bananas, and fruit-bearing shrubs. The preparations increased expenditures well above those expected when the grant application was submitted. It had been hoped that the grove of coconut palms on Cayo Santiago (Fig. 1) would provide much of the food required by the monkeys, but the animals devoured the blossoms and no nuts matured. It was soon realized that practically all food would have to be purchased on the main island. Moreover, until rain-collection facilities were constructed, it was necessary during the dry season to take drums of fresh water across the channel by boat. The Markle grant was for 3 years, but the money was running low. By the first of March 1940, the colony had been reduced to approximately 350 animals, and before the end of the year, more monkeys had to be sold.

Adjustment of the monkeys to their new habitat took many months. At first, turmoil reigned and a few swam across the channel to the main island. The animals did not regroup according to the regions of India from which they had been collected. Sexual activity during 1939 and 1940 was affected by colonial instability. Menstrual cycles had been disturbed by stresses of capture and transportation, but, according to Carpenter, "The suspense created by doubting Thomases . . . was relieved after six or eight months by the birth of the first baby. You cannot imagine how welcome that baby was." In the 1940–41 season, 91 infants were born, and in 1941–42, there were 103 births. Carpenter reported on reproductive activity of the monkeys in several articles that were later brought together in a book (*3*).

Watt became acquainted with the colony in January 1940, a year after the monkeys had been released on Cayo Santiago and just before the gibbon episode. He was stationed at the School of Tropical Medicine at that time, studying diarrheal disease in collaboration with the Puerto Rican Department of Health. An epidemic of undiagnosed illness had occurred in the animals on Cayo Santiago. The pathologist at the School of Tropical Medicine performed necropsies on the monkeys that died and suggested that cultures be made. *Shigella*, the organism found in the human population of Puerto Rico, was isolated from a high percentage of the monkeys. The simian epidemic was thought to have been to some extent related to an inadequate supply of proper food, and it cleared after better food was provided.

The U.S. Public Health Service authorized Watt to move his epidemiological research laboratory to Puerto Rico in the autumn of 1940, in part to investigate the naturally occurring *Shigella* infection in the monkeys of Cayo Santiago. By the next season, the colony had become stable and the monkeys were healthy. Tuberculosis was prevalent in India, but it soon died out in the monkeys transferred to Puerto Rico. When last tested for tuberculosis in September 1941, no positive reactions were encountered.

While Bachman was the director of the School of Tropical Medicine, only he and four or five other investigators were paid by Columbia University. The Puerto Rican employees felt that they were discriminated against and that they lacked voice in the operation of the school; this dissatisfaction led to the replacement of Bachman by a Puerto Rican (*4*). Columbia University then withdrew its support and left the island. Rexford G. Tugwell, the appointed governor, and Munoz Marin, the president of the Senate, used the Columbia affair as one issue in their drive to obtain commonwealth status for Puerto Rico.

While these events were taking place, the primate colony was left in the hands of the College of Natural Science of the University of Puerto Rico. Funds of the Markle Foundation grant ran out, and a year later the Japanese attack on Pearl Harbor ended research on Cayo Santiago for the time being.

During the first years of the colony, the Cayo Santiago monkeys received wide publicity and were visited by many people, including reporters. *Life* magazine published a cover article (Fig. 2). Tomlin was glad to show visitors around the island until the risk of being attacked by the animals became a deterring factor.

During the war years, support of the Cayo Santiago monkeys was perforce curtailed. The Tomlins left (*5*), and the university could afford only a pittance for the caretaker to row to the island two or three times a week to give the mon-

keys a little dry corn and some overly ripe fruit. An effort was made to reduce the number of animals on the island. I obtained a few of them for the Institute of Neurology of Northwestern University about 1943. At one time, consideration was given to offering the colony to any organization willing to take it off the hands of the University of Puerto Rico. Around that time, C. J. Herrick of the University of Chicago proposed that the Cayo Santiago colony be made available to Davenport Hooker of Yale University for his studies of behavioral development in the fetus, but, for lack of money, nothing came of that.

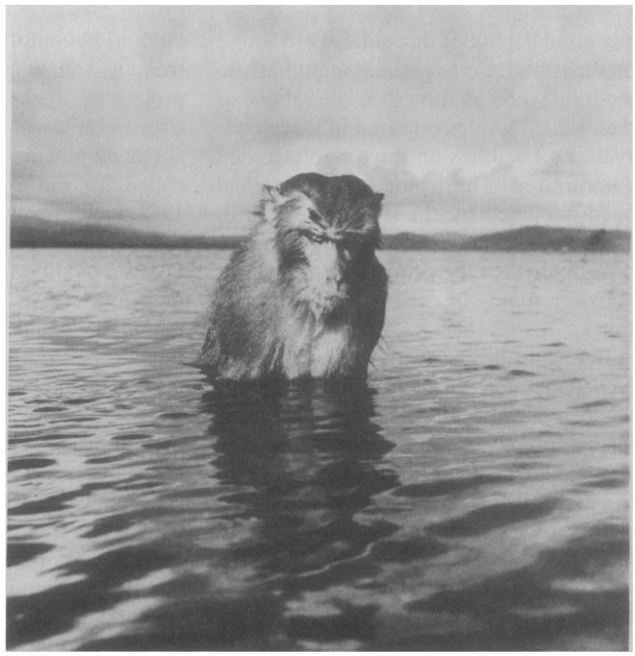

Fig. 2. Adult male pigtail macaque driven into the sea by his photographer on Cayo Santiago. This picture was first printed on the cover of *Life* magazine. [Hansel Mieth, LIFE © 1939 Time Inc.]

Inception of the National Primate Research Center Program

Interest at the National Institutes of Health (NIH) in research with nonhuman primates prompted a visit to Puerto Rico by David E. Price and Ernest Allen in the autumn of 1948. For the next 2 years, NIH provided some financial support for the monkey colony. After the School of Medicine of the University of Puerto Rico was established, it was given jurisdiction over the colony in 1950. The NIH grant, although only $15,000 a year, probably saved the colony from destruction.

Possibly the most important result of establishing the colony of Old World monkeys in Puerto Rico was its contribution to the birth of an idea. Watt, who had succeeded James A. Shannon as director of the National Heart Institute (NHI) in 1952, visited the Russian primate colony at Sukhumi in 1956 and found it to be much larger and more adequately supported than the one in Puerto Rico. It seemed to him that the size of the investment had much to do with ability to obtain support. Coupling that idea with his earlier experience with the monkeys on Cayo Santiago and Bachman's dream of a "proper laboratory monkey," he began to seek ways to create a major primate research facility in the United States (*6*).

Stimulated by reports by Russian scientists that conditioning had produced sustained hypertension in monkeys, NHI in 1957 initiated steps toward obtaining congressional support for a primate research center. The National Advisory Heart Council requested that a committee be formed to plan a center and to try to resolve questions of its location and categorical interests. I represented the National Institute of Neurological Diseases and Blindness (NINDB) at a meeting held under the chairmanship of Watt late in September 1957. Although the NHI took the lead in a drive for a "National Cardiovascular Primate Research Center," Watt expected that the facility would serve various categories of biomedical research. NINDB had already obtained the Cayo Santiago colony, however, and expressed little interest in another one. NHI's organizing committee decided that Congress should be asked to appropriate funds for a single center as the first step, after which a series of regional centers would be set up as needs developed.

After canvassing some members of the Senate, Lister Hill advised the group from NHI to start with a request for support of regional centers instead of the single national center they had hoped to obtain. The result was that the Congress voted support, beginning in 1960, for the first of six Regional Primate Research Centers, and finally for a seventh, which was expected to become the National Primate Center. The Primate Research Center Program was transferred to the Division of Research Facilities and Resources in 1962 (*7*).

A document prepared in January 1961 by NIH for presentation to the Congress in connection with appropriation hearings for fiscal year 1963 recommended expansion of the Primate Research Center Program to include new regional centers in the South (New Orleans) and the Northeast. Funds for the northeastern center were offered to several institutions around New York City and were finally accepted by a group in the Boston area. No mention was made in the document of the Cayo Santiago colony or of the primate research which was reaching its peak in Puerto Rico at that time.

The success of neurological studies with nonhuman primates in Puerto Rico in the 1950's may have helped the drive toward a National Primate Research Center Program at NIH, but the Puerto Rican colonies were not incorporated into that program. NINDB was a new institute, much smaller than NHI, and there were some differences in respect to territorial interests, such as the question of which institute was to have jurisdiction over stroke and the relation of stroke to hypertension. The research in Puerto Rico had little to do with that in NHI.

The Laboratory of Perinatal Physiology

Before the National Research Center movement got under way, an opportunity arose for NINDB to acquire the primate colony on Cayo Santiago and establish a field station in Puerto Rico. Early in 1955, J. G. Frontera, professor of anatomy in the University of Puerto Rico Medical School, described the unsatifactory status of the Cayo Santiago monkeys during a visit to NIH (*8*). In August of that year I spent a few days in San Juan and was permitted to visit the primate colony. I was told that there were about 150 animals organized into two groups, of which I saw evidence of only one. Most of the monkeys appeared to be healthy, but some were thin and a few had bleeding wounds or healed battle scars. When an accurate count was taken the next year, 114 rhesus mon-

keys and 1 pig-tail macaque were found on the island. Five females, including the pig-tail, were identified as members of the original group, released in December 1938 (*9*). Facilities on Cayo Santiago had deteriorated. The frame house that had been occupied by the Tomlins was riddled by termites; in the cellar, termite runs connected the ground with the floor above, some of them free-standing tubes.

Before returning to the Laboratory of Neuroanatomical Sciences in Bethesda, where we were studying the effects of birth asphyxia on the monkey's brain, I was asked by Harold Hinman, dean of the medical school, to consider the possibility of our using the Cayo Santiago monkeys. My report to the NINDB institute director led, in December 1955, to the decision by NIH to fund a collaborative research project in Puerto Rico, to be carried out by personnel from the medical school in San Juan and the Laboratory of Neuroanatomical Sciences in Bethesda.

An agreement was signed in February 1956, under which NIH purchased the Cayo Santiago colony. With the proceeds of the sale, the University of Puerto Rico built a temporary laboratory building adjacent to the anatomy wing of the medical school. This building contained rooms for surgery, histology, electroencephalography, and behavioral observations; some roofed space adjacent held cages for 20 monkeys. Research was transferred from Bethesda to the new laboratories before the end of March and continued there in collaboration with several members of the anatomy department.

Preparations for studies on Cayo Santiago began promptly. Saving the monkeys had first priority. Food pellets (Purina) were provided in metal hog feeders in several locations near watering founts. The house was demolished and its basement converted to laboratory and sleeping quarters for investigators. A new rain-collection slope was poured in concrete. The paths were cleared and the dock replaced; a boat and motor were purchased, and dockage was leased at Playa de Humacao. Rat extermination was begun. Cayo Santiago, though neglected, was surprisingly clean because of scavenging by hermit and land crabs, which abound on the island.

Behavioral studies were started even before the research at the medical school could begin. All activities moved so swiftly that, by midsummer, it was decided to organize a conference on neurological and psychological deficits of asphyxia neonatorum, principally to introduce the work of the collaborative project to other investigators in the field (*10*).

Developments in the project soon called for more space, and in January 1957, we borrowed a building on the reservation of the U.S. Public Health Service for additional laboratories and animal quarters. It had been learned that, although sexual activity on Cayo Santiago was strictly seasonal, matings occurred in the cages in all months of the year. Therefore, many more monkeys of breeding age were installed in the new space.

As news of the improvements in the colony on Cayo Santiago spread, ever-increasing numbers of scientists at other institutions inquired about opportunities to work there. A very limited number of requests could be granted in the early years of the collaborative project. The population on Cayo Santiago gradually increased to more than 400 monkeys by 1964, even though many animals had been removed from year to year. The governor of Puerto Rico offered several uninhabited offshore islets, and colonies of monkeys were introduced to 16-ha Isla Cuevas and 32-ha Isla Guayacan in 1960. Four years later a group of rhesus monkeys was placed on Desecheo. At one point we also considered Mono Island, lying between Puerto Rico and the Dominican Republic, as a site for a breeding colony of chimpanzees.

The success in the laboratories in San Juan was demonstrating the desirability of broadening the scope of the research beyond neurology. The rhesus monkey proved to be exceptionally valuable—as yet not too expensive—for several types of research in perinatal physiology. Relatively little of an experimental nature had been done previously with this species. By late 1958, a number of timed pregnancies in the caged colony became available to the first group of visiting scientists for studies in physiology and biochemistry of the fetal and neonatal monkey. Thereafter, as the breeding program was expanded, more teams of visitors came to work in Puerto Rico; after 6 years, 34 percent of published articles were written by visiting scientists; 14 percent of the groups were from abroad.

A change in directorship of the NINDB occurred in 1960, and I agreed to serve as the assistant director for 1 year. I moved to San Juan to try to form a closer relationship between our investigators and those of the school of medicine. The NIH operations in Puerto Rico became the Laboratory of Perinatal Physiology with five sections—primate ecology, neuropsychology, experimental neurology and electroencephalography, physiology and biochemistry, and cytology and embryology. The last section was located in Bethesda in order to maintain liaison with intramural programs of NIH. There were also seven service units. Fifteen professional positions were provided for in the table of organization, all but two of which were filled by 1963.

I was made an honorary professor and began to attend meetings of the planning board for the new medical center. Members of the medical faculty were eager to cooperate in effecting close ties between the school and the Laboratory of Perinatal Physiology.

Two organizational decisions were made in 1961. An invitation from the board of directors of the medical center of the University of Puerto Rico to affiliate was accepted by NINDB, and an agreement was reached by representatives of the university and NIH. A 2-acre building site in the new center was designated for the Laboratory of Perinatal Physiology. NIH was expected to seek construction funds from the Congress, but the director hesitated to go forward with construction of a facility that would provide for research seemingly far afield from neurology. NINDB was a categorical institute, charged with investigating disorders of the nervous system, and strict interpretation of the charge would not support a broad program in perinatal physiology. At the end of 1962, construction costs were rising and the money available for a new building at the medical center would buy less space than was then in use at the U.S. Public Health Service reservation. A possible solution soon appeared, but our hopes were short-lived.

The National Institute of Child Health and Human Development (NICHHD) was established as a noncategorical institute in January 1963. Many of its interests were similar to those of the Laboratory of Perinatal Physiology, and the first director of the new institute saw opportunities in Puerto Rico. He offered to help the Laboratory of Perinatal Physiology affiliate with the University of Puerto Rico Medical Center and issued an invitation to other institutes to assist "in meeting the financial requirements for construction in the amount of approximately $1,000,000." Within the year of the director's tenure of office, no acceptance of his proposal was forthcoming, and, as time passed, it became apparent that NICHHD would play no

more than a minor part in the Puerto Rican operation, which would be restricted as closely as possible to research on neurologically related subjects.

The director of NINDB began to exert stricter control over appointments and projects, perhaps wishing to avoid criticism that his institute was using funds appropriated for neurology to support research of an unrelated nature. For example, a request for a temporary appointment of a scientist from the Sloan-Kettering Hospital was denied on grounds that he intended to use monkeys for cancer research. The experiments, conducted without approval of the director, resulted in production of neoplasms in infant monkeys with the Rous chicken sarcoma virus for the first time (*11*). Soon after that, the director's office announced, without consulting anyone in Puerto Rico, that a member of his staff for whom there was no permanent position in Bethesda was being sent as an overseer of the operations of the Laboratory of Perinatal Physiology in Puerto Rico, although he would not engage in the research.

These developments led to my resignation in December 1963, after which no attempt was made to continue the affiliation with the medical center. Except for a letter to the dean requesting an office for the new representative of NINDB, there were no communications with the University of Puerto Rico. Moreover, further appropriations for money to support the growing programs on the several islands were curtailed.

Hope that disintegration of the relationship between the Laboratory of Perinatal Physiology and the University of Puerto Rico Medical Center might be prevented led a few scientists at NIH to propose one more effort. I was asked to return to Puerto Rico in July and August of 1964, under the auspices of NIH, to interview officials of the university. (My resignation from the professorship in the medical faculty had been declined.)

A new chief of the laboratory had been appointed to replace me, but was not yet in residence. All professional staff members were seeking new positions or had left. The dean of the medical school declared that there had been no contacts between personnel of NINDB and those of the medical center. The Chancellor of the University, Jaime Benitez, anticipating that support of the monkey colonies might revert to the university, inquired about the operation of the National Primate Research Center Program. He and I met again in Washington on 16 August with representatives of NIH and explored the matter further. But although the Cayo Santiago primate colony had provided inspiration for establishing the Regional Primate Research Centers in the continental United States, nothing could be done at that late date to incorporate it into the national program.

The Laboratory of Perinatal Physiology survived without the agreed-upon affiliation with the medical center, but within a few years NINDB closed its operations in Puerto Rico for reasons of economy and changes in priorities. The University of Puerto Rico took over the island colonies of monkeys, incorporating them into an independent Caribbean Primate Research Center supported by funds from various granting agencies.

After an absence of 14 years (*12*), I again visited Cayo Santiago, in October 1978 accompanied this time by Dr. Ramirez de Arellano and Chancellor Norman Maldonado, of the medical center (*13*). The monkey population has exceeded the projected maximum number of animals that can be supported on the island; there are now about 640 healthy monkeys there. They receive excellent care, and behavioral and ecological observations are being conducted freely. After all, perhaps the millions of dollars contributed by NIH to save the Cayo Santiago colony and establish research in Puerto Rico with nonhuman primates were not spent in vain.

References and Notes

1. I visited that island colony in November 1961, and Carl A. Koford was there in 1962. We found that the animals' season of birth differed from that in the Northern Hemisphere by about 4 months. Recently a 6-month difference has become established.
2. Quotation from a transcription of a recording of Carpenter's unpublished lecture at San Juan in 1959.
3. C. R. Carpenter, *Naturalistic Behavior of Nonhuman Primates* (Pennsylvania State University Press, University Park, 1964).
4. Bachman joined the Brookings Institution in 1947 and retired in 1955.
5. NIH purchased Tomlin's notes and records with the agreement that they be preserved for future scientific use only. They were deposited in the office of the director of the NINDB.
6. J. Watt, personal communications (1978–79).
7. *NIH Primate Research Centers: A Major Scientific Resource* (NIH Division of Research Resources, Bethesda, Md., ed. 2, 1978).
8. J. G. Frontera, in *Neurological and Psychological Deficits of Asphyxia Neonatorum*, W. F. Windle, Ed. (Thomas, Springfield, Ill., 1958).
9. Although many animals were removed from Cayo Santiago from year to year, no new monkeys were ever added to the colony; after 20 years, blood of the isolated descendants of the original monkeys lacked antibodies to certain human diseases.
10. The remarkable efficiency with which the collaborative project in Puerto Rico was established was due in no small measure to the dedicated efforts of Max and Maria Ramirez de Arellano, neurosurgeon and neurologist in Santurce.
11. J. S. Munroe and W. F. Windle, *Science* **140**, 1415 (1963).
12. I did participate in the Ross Conference on Pediatric Research at Las Croabas, Puerto Rico, in January of 1967, but the conferees were not invited to visit the monkey colonies.
13. On this trip, my wife and I were surprised with a reception attended by nearly all of the Puerto Rican members of the former Laboratory of Perinatal Physiology.
14. I am indebted to Chancellor Norman Maldonado of the University of Puerto Rico Medical Sciences Campus for suggesting that I write this article, material for which was drawn from records in my files.