It is possible that the cyclic AMP receptor protein acts in a similar manner. In animal cells cyclic AMP increases the activity of various protein kinases which subsequently leads to the activation of phosphorylase or to the phosphorylation of histones (*8*). However, we have as yet been unable to detect any protein kinase activity in our preparation of cyclic AMP receptor protein. The finding that cyclic AMP stimulates gene transcription and enzyme synthesis in cell-free extracts promises to lead to the elucidation of the precise mechanism of cyclic AMP action.

Summary

Both cyclic AMP and a specific inducer acting in concert are required for the synthesis of many inducible enzymes in *E. coli*. Little enzyme is made in the absence of either. In contrast to the specific inducers which stimulate the synthesis only of the proteins required for their metabolism, cyclic AMP controls the synthesis of many proteins. Glucose and certain other carbohydrates decrease the differential rate of synthesis of inducible enzymes by lowering cyclic AMP concentrations. In the *lac* operon, cyclic AMP acts at the promoter site to facilitate initiation of transcription. This action requires another protein, the cyclic AMP receptor protein. The nucleotide stimulates tryptophanase synthesis at a translational level. The action of cyclic AMP in *E. coli* may serve as a model to understand its action on transcriptional and translational processes in eukaryotes.

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Notes on Science in Cuba

Ample moral and financial support may soon overcome the immaturity of Cuban science and technology.

Marcel Roche

In the Ilyushin turboprop from the Compañía Cubana de Aviación which flew us from Mexico to Havana, every seat was filled, mostly with long-haired students from the University of California and other schools, bound to Cuba to cut sugar cane for the Revolution. Enthusiasm was at a high pitch, and applause and cries of "Viva la Revolución" in strong North American accents broke out when the plane took off.

Fervor was indeed the keynote in Cuba among the many scientists and students I was able to interview, and I have allowed for this factor in the following notes. I was able, however, to visit all institutions that I requested to see after discussion with members of the Unesco staff. I was also able to roam about the city as I wished, and my wife often took the bus by herself and saw all of Havana that she wished to see (*1*).

Discussions with the Cubans were very free, and it was easy to obtain information. It was, however, almost impossible to obtain accurate data on budgets and expenses, except for the few examples that I give in the text. I was told that money means nothing in Cuba, that institutions do not have

a fixed budget, that resources are "limitless," and that apparatus and facilities rather than moneys are given to the institutions for the asking, "providing they show that it is for the national good." It was also not possible to get written statutes or bylaws of the various institutions. Much of what goes on in Cuba is written down nowhere and is said to spring from the "Direction of the Revolution." In fact, I was told textually by a high government official that "in Cuba, the Law and nothing are one and the same thing. . . . life creates Law here."

The figure of 1.2 percent of the gross national product is given as the proportion of moneys invested in research and development in Cuba. On this basis, the scientific effort of Cuba would be, relatively, on a par with that of Canada and would be four to six times greater than the effort of the Latin American countries (such as Argentina, Mexico, and Venezuela) that have given figures for their scientific investments. Cuban officials with whom I discussed this point shrugged off the figure as meaningless ("Unesco always is requesting numbers, and one has to give them out . . . ," I was told). Nonetheless, it is evident even to an outside observer that scientific and technological endeavor in Cuba is receiving considerable moral and financial support. The apparently high percentage of the gross national product invested in science may result from the large investment over the past 2 or 3 years in laboratory construction and equipment, which is obvious even to a rapid visitor. It is my impression, however, that the present level of support for science and technology is not in most cases older than 3 or 4 years. Laboratories are new and investigators are young.

According to figures obtained from the Grupo de Control y Planeamiento de los Recursos dedicados a la Investigación of the University of Havana, communicated to me by Research Vice Rector Mario Fernández Finalé, the total number of persons in research and development in 1968 in Cuba was 1,200, and it was estimated for 1969 at 1,600. According to the Ministry of Education, the number of students in institutions of higher learning for 1969 was 29,033 and the number of university professors was 4,335. These figures are still low in relation to the total Cuban population of approximately 8,000,000. The Minister of Education indicated, however, that there are now 80,000 pupils in secondary schools and that he expects many of them to enter the university within the next 5 years.

I was repeatedly told that science is not centralized or coordinated in Cuba and that there is no explicit science policy. It becomes evident after visiting a number of scientific institutions, however, that the greatest single centralizing factor in science and technology in Cuba is Prime Minister Fidel Castro himself. He has a personal and intense interest in the development of science, which, as he has repeatedly stated in his discourses, he deems essential for his country's development. All the higher institutions that I visited were created or maintained by his decision, and their policy was set directly or indirectly by him. The highest priority has clearly been given to animal husbandry, with the possible exception of sugar research. [I was unfortunately unable to visit the Sugar Research Institute (ICIDCA), which I was told was equally as important as the Centro Nacional de Investigaciones Científicas and the Instituto de Ciencia Animal.] On agricultural subjects, and especially animal genetics (his own pet subject), Fidel gives his opinion freely and, although a lawyer by profession, even carries out his own work. I was shown a farm near Havana, where cattle was being crossbred in accordance with "orders from Fidel," in the words of the cowhand who was conducting the visit. I wondered which scientist or technician "Fidel" might be, until it became clear that it was Castro himself. This was early in my visit!

Castro works informally; he has no permanent office and he leaves all routine work and protocolary functions to President Osvaldo Dorticós. In a car in which he carries a small library and a calculating machine, he roams about the country and often drops in on people and institutions for talk and a speech. He does not hesitate to reverse technical opinion when he feels that it is contrary to national interests. An incident that illustrates this fact occurred during the closing session of the First Cuban Congress on Animal Science on 13 May 1969. T. R. Preston, a scientist of British nationality who was then Head of the Instituto de Ciencia Animal, presented papers in which he purported to show that corn should be the basis of animal nutrition in Cuba and that the crosses between Zebu and Holstein cows were poor milk producers. In a long discourse in the closing session, Castro made his usual informal remarks interspersed with Cuban humor, but he added criticisms of Preston's work, which he termed of "low quality" and "superficial." He proceeded to present numerous technical tables, gathered from the experience of the Dirección General de Genética, which, he said, clearly showed that the Zebu-Holstein mixture was a good milk producer. "We are not scientists," said he, "but the elements of proof which we have are so overwhelming that not even a scientist to the fifth power could really defend such a thesis" (*2*). Castro also stated at length that Cuban cattle must be given a diet of pasture supplemented with molasses, but certainly not corn.

T. R. Preston, although he continues to work in Cuba and has remained scientific director of the Instituto de Ciencia Animal, has been superseded as general director by Manuel Padrón, a 31-year-old Cuban economist closely identified with the Revolution.

This is the only example of direct interference by Castro with technical work that I heard about. From the content of his speeches, it appears that he is, as a rule, respectful of academic freedom. The danger of interference is there, of course, because of the structure of Cuban government. It may be significant, however, in a parallel context, that at the School of Arts (situated in the former Country Club), where I also visited, students paint freely in a variety of idioms, and there is no attempt to impose restraints such as "socialistic realism."

There is an obvious admiration for Castro in all scientists and students with whom I spoke and a great faith in his opinion. I was told by the rector of Havana University that "Fidel Castro is the most enthusiastic investigator that there is in this country." Others assured me that there was no Castro personality cult and that occurrences like the Lysenko incident in Stalinist Russia could not possibly happen in Cuba.

Although there is no explicit centralization of science at a national level, the coordination of science and the internal formulation of priorities is certainly practiced at the level of the university and the Academy of Sci-

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ences, as we shall see later. I was also told that Castro is considering centralizing science through a special body, possibly the present Comisión de Colaboración Científico-Técnica, headed by Carlos Rafael Rodríquez.

Interest in a career in science and technology is stimulated quite early in education, as I discovered on a visit to a field school (Escuela de Campo) called Santa Amelia, near Havana. In this type of school pupils study in the morning, and in the afternoon they carry out agricultural chores in the fields nearby. In fact, all Cuban students and their teachers, even those in cities, must spend at least 45 days a year in agricultural activities, and thus a consciousness of the importance of agriculture is ingrained in all Cuban children. I arrived at Santa Amelia during a rest period close to sunset, when the students were milling about while they waited for supper. About 80 of them gathered around me, most of them 11 to 12 years old, and I asked a number of them what they wanted to be when they grew up. All whom I questioned knew the answer without hesitation: "mechanical engineer . . . physicist . . . chemical engineer" and, in the case of one girl, "military communications." When I asked specifically how many would take up a career in the humanities, law, history, or philosophy, no hands were raised. This trend, observed vividly in a small group, has clearly affected university enrollment (see Table 1). Although career choice is free, it is clear that the policy of the government and the general orientation of the schools have profoundly modified the motivation of students. Incidentally, the increase in total university enrollment has been far from spectacular as compared with increases in most Latin American countries.

Science is stimulated at the secondary level by means of study circles (círculos de interés) centered around a scientific subject, which are set up in all schools. (I was told that there are 16,000 such circles on the island.) The pupils are encouraged to perform experiments and to discuss their subjects with the teachers and their fellow students. Science fairs have been held since 1966 at the provincial and national levels, and the winners, provided they have a scholastic average of at least 80, are sent as boarders to the Escuela de Vento in Havana, where there are now some 800 pupils. At this special school each study circle keeps in touch with scientists from higher institutions, who directly supervise the students, suggest experiments to them, and often provide them with laboratory apparatus and reagents. I was able to talk to many of these students, who showed me their experiments and explained them to me. Most projects were closely related to national problems, especially in agriculture and animal science. For example, I was shown an experiment in which one group of pigs was fed leftovers, formerly the classic diet in Cuba, and, for comparison, another group was given molasses plus a supplement. The students were familiar with the problems of variability and with statistical analysis. Another experiment—on the transformation of pineapple brew into protein by *Torula*—was inspired directly by a suggestion made by Castro in one of his speeches.

Table 1. Distribution of students among fields of learning at the University of Havana in the academic years 1955–56 and 1968–69. The total enrollment in 1955–56 was 13,994 students; in 1968–69, 17,606 students. (Figures were obtained from the University of Havana.)

Field	Student enrollment (percent)	
	1955–56	1968–69
Humanities*	37.3	6.0
Medicine	28.0	30.2
Education	19.1	8.3
Science	7.2	16.0
Technology†	5.0	26.0
Agriculture and veterinary science	3.0	7.3
Economics	0.4	6.0
Total	100.0	100.0

* Includes law, political sciences, history, literature, art, and journalism. † Includes engineering and architecture.

Some typical study circles at Vento are insemination and veterinary science (supervised by the Instituto Nacional de Inseminación), cattle nutrition (Instituto de Ciencia Animal), mathematics (University of Havana), nuclear physics, soil science, and meteorology. No study circle in medicine has been allowed, however, since Cuba feels that there will soon be enough physicians in the country and that enrollment in the university medical school is already satisfactory. Even though one-third (about 2000) of the physicians left the country after the Revolution, I was told that an active teaching program has succeeded in filling the vacancies and that now there is one physician per 900 inhabitants; one physician per 450 is expected in the not very distant future. Students who are interested in medicine are assigned to study circles like biochemistry or veterinary science.

Although the number of schools and of students in Cuba has markedly increased, Cubans with whom I spoke admitted that quality has not paralleled the increase in quantity. There is still a great deal of learning by rote and repetition, cadres are lacking, and teaching is still below par. The Cuban government is quite conscious of these deficiencies, however, and is adopting measures to upgrade the quality of teaching. Unesco maintains an active program in this area.

English is taught extensively in the schools because of its importance in science and technology. The teaching of German, French, or Russian is only sporadic. In the university many American texts are used. Castro himself recommended the use of these texts in one of his speeches: "We are also going to study in American books and almost all that I know of cattle I have studied in American books. . . . You are going to study with books, almost all of them American, good books. . . . Of course these are good books because the Americans have a good technique . . ." (*3*). Most often, the books are translated versions. The Cubans produce and print their own editions without payment of copyrights, a procedure they call *fusilar*—"to shoot" the book for the purposes of the Revolution.

The University of Havana has a number of features that distinguish it radically from most Latin American universities. "Autonomy" is nonexistent. Although the university is under the Ministry of Education, in practice the rector is appointed by the Prime Minister and has strong ties with the "Politburo" and frequent and direct access to Castro. The deans and vice rectors are appointed by the rector and constitute the University Council, which is advisory, not executive; thus, the rector is extremely powerful. In the words of Rector José Miyar Barruecos, "Autonomy is not conceived as necessary in Cuba since the university is immersed in all the life of a developing society. . . . Students and professors strive to achieve the directives that the Revolution has assigned to the university. . . . There are cordial and fraternal collective discussions and harmony between students and professors. . . . University autonomy is lost when cultural autonomy of the country is won." Co-government was attempted at the beginning of the Revolution, but, again in the words of the rector, "It was chaos. . . . A government by majority

vote in this business cannot be admitted. In the university there is a single criterion, which is the product of reality. The university is not exactly parliamentary. In the last instance the direction of the university depends on the direction of the Revolution . . . that is, on the Prime Minister. . . ."

Research in the university is organized by project or field instead of through the individual departments, and multidisciplinary activities are encouraged. There are eleven research councils, in the fields of animal science, agronomy, industrial agronomy, chemistry, energetics, mechanics, metallurgy, electronics, social science, economy, and biomedicine. The head and the coordinator of each individual council, plus the vice rectors and the heads of individual projects (a total of some 30 persons), form the University Research Council, headed by the rector, which sets up policy and priorities for the university as a whole. The role of the council is advisory; the rector makes the decisions, which may be far-reaching. In the Faculty of Sciences, I heard several investigators mention that their project had been suggested directly by the rector. All faculty and students are full-time. Education is entirely free, and many students receive room and board and a small stipend. A total of 55 percent of the students at Havana University have fellowships. My impression is that identification with the Revolution is a requirement for a stipend and, in some cases, for entrance to the university.

In the Faculty of Sciences, I visited the departments of biochemistry and of physics. The laboratories are housed in the old neoclassical buildings in the center of town. In "biochemistry," there is very little biochemistry in the usual sense, and the work is more in the nature of industrial microbiology. Most of the research is centered around the development of new milk products, such as cheese and yogurt. At present, only infants and invalids are exempt from the strict rationing of milk. It is believed, however, that by 1972 there will be more of that product than can be consumed and that the surplus should be used to manufacture diversified products. In fact, Castro has stated that, after the goal of 10,000,000 tons of sugar cane has (hopefully) been reached, the next step will have to be the development of a strong food industry.

Bacteriology and virology are also included in "biochemistry." Work in these subjects is centered around such studies as the incidence of encephalitis and arbovirus in Cuba and, in collaboration with the National Institute of Hygiene, the manufacture of serums and vaccines. The production of proteins from bagasse by cellulolytic organisms and the manufacture of acid pickles for export are also being attempted.

The department of physics just started its activities at the beginning of 1969, and its field is solid state physics, particularly semiconductors. In both biochemistry and physics, research endeavor is incipient and equipment is rudimentary. This state of affairs is readily acknowledged by the dean, who hopes, with the help of an expert from Unesco, to improve the situation gradually.

I aslo visited the Facultad de Tecnología, which houses the Schools of Engineering and of Architecture. The center is physically most impressive. The attractive buildings, 60 percent completed, are situated on a flat piece of land measuring 60 hectares (138 acres). There are now 4,300 students at the center, but a total of 10,000 can eventually be accommodated. Laboratories are large and modern and are currently being equipped. Most of them are full of unopened crates, but a number of shining instruments are already on display, mostly from socialist countries, including China.

Priority in the Technological Faculty is definitely given to fields related to national economy and production. In the words of the university's vice rector for research, "the proportion of basic to applied science is of the order of 1 to 10 and of basic science to development, 1 to 1000." In fact, most of the projects and studies that I heard of constituted direct application of science rather than research. For example, in the Center of Energetics Research, three areas are covered: (i) Design and construction of electrical networks. Included is a short-wave communication system between the university and all its dependencies throughout the island. (ii) High tension and insulation, in close relation with the country's electrical industry. It was pointed out to me that prospective development of electricity was formerly in the hands of private enterprise but that now it is a function of the university. (iii) Evaluation of the feasibility of nuclear energy as a source of power. At the moment, Cuba has 45,000 kilowatts of installed hydroelectric power and 700,000 kilowatts of fossil fuel. I was told that a total of 2 million kilowatts of installed power was expected by 1980 and that by that time nuclear power could be justified.

Unesco is helping the Technological Faculty and has given 2.1 million U.S. dollars to the project; the Cuban government has pledged 23 million pesos (official exchange rate, 1 to 1 with U.S. dollars). The Unesco project is headed by Auduh Ofjord, a Norwegian engineer. Outlay for equipment in the Group for Energetics Investigation has totaled 250,000 U.S. dollars for 1969 and the Chemical Engineering Group has in 3 years acquired equipment worth 1.5 million U.S. dollars. A major weakness of this center, and indeed of all Cuban science and technology, is the lack of large computers. I was told by the people at the Technological Faculty that the only large computer available in Cuba is an old English Elliot model 803-B. Evidently, the U.S.S.R. has been unwilling or unable to supply a computer and most other sources are closed because of the U.S. embargo. However, negotiations are under way with France to acquire a large computing facility (IRIS-50 model).

Postgraduate studies in science have started in Cuba, but, because of the insufficiencies of the laboratories at the Faculty of Sciences, they are being carried out in specialized university institutions, of which I was able to visit two: the Centro Nacional de Investigaciones Científicas (CENIC) and the Instituto de Ciencia Animal (ICA) (see *1*).

CENIC (Fig. 1) is a beautifully planned institute that was founded in 1965 and is located in Siboney, a formerly exclusive suburb of Havana. It is directed by Wilfredo Torres, a 37-year-old hematologist. The buildings are elegant (floors in the corridors are of Cuban marble). Equipment is usually centralized, so that several departments may use it, and it includes the major items one expects to find in modern biological and chemical laboratories, such as preparatory and analytical ultracentrifuge, electron microscopes, amino acid analyzer, x-ray diffraction and nuclear magnetic resonance apparatus, and mass spectograph. I was told that total equipment at this center had cost about 1.8 million U.S dollars. Much of the equipment is of English make, but there is also apparatus from Japan and from socialist countries.

Although research at CENIC is variegated, it is mostly centered on biological and medical lines. Chemistry is

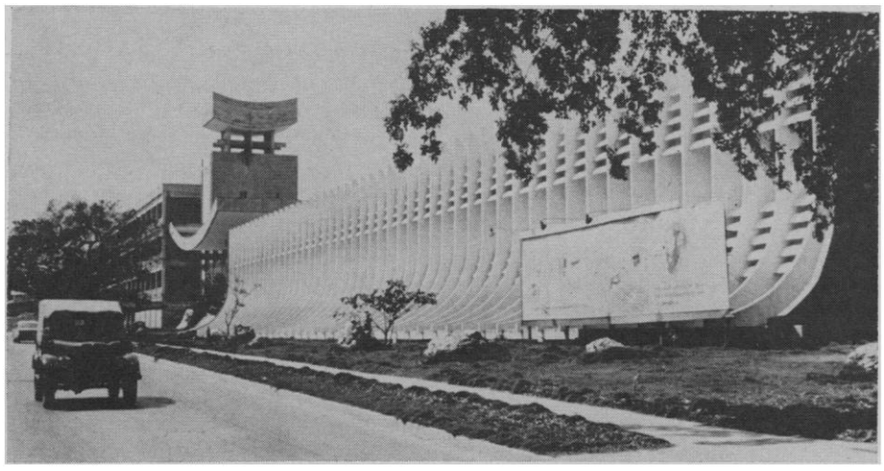

Fig. 1. The Centro Nacional de Investigaciones Científicas (CENIC). The billboard at the right carries, below a picture of Castro, this motto: "We must strive to have every revolutionary be a scientist" (*4*).

also important, however, and is to receive particular stress in the future—a large new wing is now being constructed for that purpose. According to CENIC's own classification, 5.2 percent of its research is fundamental, 48.8 percent is fundamental oriented, 44.3 percent is applied, and 2.1 percent is developmental.

Basic research is being performed mostly in biochemistry and in ultrastructure: for example, the behavior of lyzosome enzyme during the process of infection, the role of mitochondria in the synthesis of protein, ultrastructure of erythrocytes by the freeze-etching technique, the orientation of intraerythrocytic particles in a magnetic field, and the ultrastructure of macrophages. These investigations were the only pure research I saw in Cuba.

At the other extreme, extraction and characterization of essential oils, particularly from citric fruits, and applied research on electrolytic corrosion are being studied. Finally, some work of a highly practical nature is done with isotopes, on the motion of the sugar mass in the crystallization vat or on cigarette thickness as measured with a thalium source.

CENIC typifies the youthfulness and relative immaturity of Cuban science, which is, of course, a product of circumstances. All the departments are momentarily headed by Cuban postgraduate students, aided by foreign advisers. There are only 20 professors, all of them foreign (mostly Russian and East German), but there are also 197 Cuban postgraduate students (including the heads of departments), who work on their theses under the foreign tutors

Average age of the scientific personnel at CENIC is 28 years. Thus far only one of the students (a girl, Talia Harmony) has graduated, in April of last year. She presented her thesis to an international board composed of three scientists: one Russian, one Czech, one North American, and two Cuban clinical neurologists. The use of external examiners is intended to ensure a high level of excellence, and there was no hesitation in carrying out the examination partly in English for that purpose.

It is clear that CENIC is the Cuban institute where excellence is particularly stressed. It may well be that, as some of the departments devoted to applied science are moved to other institutions, CENIC will concentrate more and more on basic research.

Wilfredo Torres, the head of CENIC, has been asked to plan a new institute devoted to the study of animal health problems. The Centro Nacional de Salud Animal (CENSA) should be operative within 2 years (I saw the plans and the architectural models), and some of CENIC's departments such as that of animal science will probably be transferred to CENSA.

I also visited the basic medical science institute Victoria de Girón, which is closely connected with CENIC. It is housed in a palatial building, formerly the Sacred Heart Convent for Girls. Two multidisciplinary projects are about to start here; one is on the relationship between infection and nutrition (particularly hookworm, an important problem in Cuba), and the other is on different aspects of transplantation. I also saw projects actively in process at an acceptable level on intestinal ulceration, on bronchial physiology, and on cardiovascular physiology. Laboratories are not yet fully equipped, but CENIC's equipment is at their disposal.

The Instituto de Ciencia Animal (ICA) is located about 45 minutes from Havana, on 1000 hectares (2400 acres) of land. The institution does research and trains scientific and technical cadres at a high level. Besides the administrative and supportive departments, there are four large research divisions: (i) Animal Science Division, which performs nutritional and genetic studies in cattle, pork, rabbit, and also studies the production of milk; (ii) Division of Pasture, which studies the different pastures in various seasons, their resistance, their digestibility, the effects of fertilizers, and so forth; (iii) Division of Plant Science, which studies plants and soils and their relation to animal nutrition; (iv) Division of Biochemistry, which studies different aspects of cattle physiology, particularly digestion in relation to the pasture.

One of the fundamental objectives of the institute is to study by-products of the sugar industry—molasses, for instance—as a source of animal nutrition. As I mentioned earlier, this investigation springs directly from the interest of Castro. There are 1400 workers at ICA, but I was told that the number of independent investigators is only "about 26." Postgraduate studies lead to a master's degree, and the youthfulness of Cuban science is again evidenced by the fact that only one master's degree has been granted to date. However, 23 candidates will present their theses in the next few months and 40 more are taking the course. The number of foreign investigators (six), is definitely less than at CENIC. The scientific director is the British T. R. Preston; it seems significant to me that in the four issues I saw of the journal produced by ICA (*Revista Cubana de Ciencia Agronómica*), 40 percent of the papers on animal science were authored or coauthored by Preston.

The Cuban Academy of Sciences is totally independent of the university, although many of its research workers teach there. The head of the Academy of Sciences is Antonio Núñez Jiménez, a speleologist and a member of the rebel army from the days of the Sierra Maestra. At the beginning of the Revolution, Núñez Jiménez was head of the Institute for Agrarian Reform. He still dresses in the olive green of the

army and sports a beard; in fact, he is one of the few Cubans I met who, like Castro, carry this ornament. The academy, which is directly dependent on the Prime Minister, is situated in the capitol building of Havana, where the deputies and senators formerly sat. Its 32 research institutes, departments, and groups are shown in Table 2.

The academy also maintains a Museum of Science. There are 3000 persons working for the academy; 1000 of them are at the professional level, but Núñez Jiménez himself admits that more or less independent investigators total only about 120, the others being in training. The academy is not interested in speculative or basic science but in practical results and in supporting the country's development. Many of the different groups are directly related to other academies in the socialist world through bilateral agreements, and often the foreign academies have provided men and equipment free of charge. Thus, for example, the Institute of Geology was founded under the auspices of the Chinese Academy of Sciences, who helped them during a 4-year period to establish a geological map of the country. (I did not see Chinese scientists in any of the laboratories that I visited in Cuba, although there were many Russians and East Germans, and also a few Hungarians.) The academy has as yet no "academicians"; the feeling is that it is too early in Cuban science to appoint high-class investigators It has preferred to call its investigators simply "scientific workers."

I was not able to visit any of the academy institutes, but Núñez Jiménez showed me a large collection of colored slides on the various activities of these institutions.

Finally, I was able to visit a research institution unconnected with either the university or the Academy of Sciences, the Centro de Investigaciones Pesqueras (CIP). Fishing activities in Cuba have increased greatly, according to official figures. Thus, the national production, which was 21,900 metric tons in 1958, went up in 1968 to 66,032 metric tons and is estimated for 1970 at 175,000 metric tons. The CIP has been set up as a support for the fishing industry of Cuba, and it is therefore engaged entirely in applied research, specifically in the fields of (i) dragging, (ii) tuna fish and bonito, (iii) shrimp, and (iv) lobster and others (sponge, mussel, and turtle).

There are 187 persons working at the center. I was not able to obtain the exact number of investigators, but I would estimate from my visit to the laboratories that there are not many more than 20. The laboratories are housed in an old building, rather poorly equipped. The personnel did not impress me as highly motivated, in strong contrast with the people at CENIC or ICA, or at the university.

Table 2. Structure of the Cuban Academy of Sciences.

Agronomy Section	*Section of Operation Science and Technology*
Institute of Sugar Cane Research	Documentation Institute
Institute of Tropical Research	Cybernetics Institute
Institute of Soil Sciences	Electronics Institute
Institute of Food Chemistry	Group of Mathematics
Department of Plant Improvement	Nonconventional Energetics
Department of Insects and Diseases of Rice	*Earth Science Section*
Biology Section	Institute of Geography
Institute of Biology	Institute of Geology
Department of Botanics	Department of Geophysics
Department of Forest Ecology	Institute of Astronomy
Social Science Section	Department of Hydrology
Institute of History	*Atmospheric Science Section*
Institute of Literature and Linguistics	Institute of Meteorology
Institute of Ethnology	Institute of Atmospheric Physics
Institute of Neurophysiology and Psychology	*Marine Science Section*
National Archives	Institute of Oceanology
Department of Anthropology	Department of Subaquatic Investigation
Group of Philosopohy	*Nuclear Section*
Group of Social Economic Investigation	Institute of Nuclear Physics
	Teaching Section
	Cultural Section

It was rather difficult to find out about salaries. Money is commonly dismissed as being of no importance now, and in many ways this is so; almost everything is rationed and there is little to do with extra money except to go to a restaurant (usually expensive) or to the cinema. Persons who received a salary under the former regime or earlier in the Revolution continue to receive the same salary, which is termed "historical salary." Younger persons, who are in the majority, receive stipends that vary from 2400 pesos per year for a first-year postgraduate student to a top of about 7200 pesos. There are, of course, no income taxes, and medical diagnosis and funerals are free. House rents are 10 percent of salary as a maximum (it is said that they will be suppressed altogether around October of this year), and apparently enough food and clothing can be purchased with the remnant, always in accordance with the rations. All the postgraduate students and scientists with whom I talked seemed happy and their morale was high. They feel that they are useful to the community and they know that the level of support for their work is considerable. Life is austere for the Cubans, but, at least for the scientists, it is bracing and stimulating.

It is still too early for Cuban science to have produced many positive results. The fruitfulness of the considerable efforts now being made may only become apparent within the next 5 to 10 years.

References and Notes

1. I was able to see the following institutions: (i) Universidad de la Habana (rector, José Miyar Barruecos); (ii) Centro Nacional de Investigaciones Científicas (CENIC) (director, Wilfredo Torres); (iii) Instituto de Ciencia Animal (ICA) (director, Manuel Padrón); (iv) Facultad de Tecnología, Universidad de la Habana; (v) Centro de Investigaciones Médicas Victoria de Girón; (vi) Academia de Ciencias (president, Antonio Núñez Jiménez); (vii) Centro de Investigaciones Pesqueras (director, Antonio Bosques Abreu); (viii) Escuela de Vento (director, Francisco Chávez); and (ix) Escuela de Arte. I spent 4 half-days at CENIC; at each of the other institutions I spent ½ day. I was able to talk at length to the Minister of Education, José Llanuza Gobel; to the Head of the Comisión de Colaboración Científica y Técnica, Carlos Rafael Rodríguez, who is also one of the most prominent members of the Communist Party; and to the heads of the Institutes of Hematology, Endocrinology, and Radiology of the Ministerio de Salud Pública.
2. "No somos científicos, pero los elementos de prueba que tenemos son tan aplastantes que ni un científico elevado a la quinta potencia podría realmente defender dicha tesis."
3. "Nosotros también vamos a estudiar con unos libritos americanos y casi todo lo que yo sé de ganadería lo he estudiado en unos libritos americanos . . . . ustedes van a estudiar por libros casi todos americanos, libros buenos . . . . son libros buenos porque ellos tienen una buena técnica" [speech presented at the inauguration of the National School of Soil Science, Fertilizers, and Cattle Nutrition (1 February 1964)].
4. "Hay que procurar que todo revolucionario sea un científico."