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SCIENCE BULLETIN

National Science Council
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Coral Research Program Under Way

Marine biologists in Taiwan and their counterparts in the University of Guam have started a joint coral research program with the financial support of the Asia Foundation and the National Science Council. Their first task is a survey and study of the coral reefs off the Taiwan coast.

This program is particularly important since no such study has been made and yet coral is a very important part of the whole ecology of the sea coast of Taiwan. The coral supports various types of algae which are consumed by fish, and around the coral reefs are the young of many species of fish that are important to Taiwan. Coral is also collected by Chinese fishermen for sale at home and abroad. The Chinese government and the local universities so far have no notion of the extent or general characteristics of this important asset. There is a possibility that over zealous exploitation by coral collectors could seriously damage the environment. There has been no consideration given to the possibility of these reefs as a tourist attraction. This is a particularly interesting development since experts have pointed out that Taiwan reefs are more beautiful than those in Australia, Hawaii or any of the South Sea islands.

It is also important to survey the reefs to find out to what extent they have become infected with the coral-eating starfish. The first specimen of this starfish has just been captured off the coast of Taiwan. The infection is apparently just beginning. Since the Guam scientists have had extensive experience with the starfish, they will be able to make a firm statement about the situation and maybe possible solution.

Three scientists from the University of Guam are taking part in the program. They are Dr. Robert S. Jones, Professor Richard H. Randall, and Mr. Harry Maki. Working with them are seven scientists and staffers of the Institute of Oceanography, National Taiwan University and the Tournism Bureau of the Ministry of Communications. They are Mr. David Shumway, a visiting researcher, Professor Chen Yung-ming (geologist), Professor Tan Tien-hsi (zoologist), Mr. Mak Shiu-man (graduate student of zoology), Mr. Mok Hin-kiu (assistant), Mr. Pan Shiu-ming (mechanic), Mr. Yu Han-ting and Mr. Lu Chung-cheng.

The area of their survey covers both sides of the coastal waters in southern Taiwan and some offshore isles. Depending on the weather, they will work up to 45 days. They have set the following objectives for the program:

a. Survey the extent of reef corals.
b. Characterize reef types.
c. Begin a reference collection of marine organisms (primarily fishes, corals, and other invertebrates).
d. Determine the condition of the reef and associated community or organisms to establish a baseline for assessment of future damage, whether man-induced or natural.
e. Define the limits of the present crown-of-thorns, *Acanthaster planci*, population.
f. Train Chinese graduate students in survey and collecting methods.
g. Publish results of expedition in a Chinese journal.

Two Short-term Visitors Okayed

Dr. Che Su, assistant professor of pharmacology, University of California, Los Angeles, will be in Taiwan October 5-29 as a short-term visiting scientists under the China-U.S. Cooperative Science Program.

The National Taiwan University, Dr. Su's alma mater, will be his host institute during his tour in Taiwan. He will give lectures on "Pharmacology of Blood Vessels". Other activities include consultation on graduate student research related to autonomic nerves and smooth muscle, and discussion of a possible joint research project on poisons and adrenergic mechanisms.

Another short-term visiting scientist expected here is Dr. Yaohan Chu, professor of computer science, University of Maryland. He is scheduled to be in Taiwan from November through January next year.

Dr. S. S. Shu, president of the National Tsinghua University, will act as Dr. Chu's host and has arranged for him a series of lectures on computer science and engineering.

Another short-term visiting scientist completed his tour in the United States last month. Dr. Tsai-hsin Yin of the National Defense Medical Center, visited the University of Pennsylvania in late August to compare the results with Dr. John R. Brobeck of their cooperative research project entitled "The Effect of Intragastric Lipid on Food Intake in Rats with Hypothalamic Hyperphargia" and later on exchanged information in recent research of feeding and weight control with scientists in the Department of Physiology and in the Monell Foundation. Finally, he visited the University of Rochestor to study methodology of electrical recording from the central nervous system at Dr. Robert Doty's laboratory.

Report on Graduate Centers in Engineering and Science, ROC

by Dr. Joseph B. Platt

(Continued from Vol. 3 No. 8)

Recommendation: That the National Science Council consider establishing a non-profit scientific equipment corporation which would in due course be self-supporting and which would meet some pressing scientific needs in the Republic of China. This corporation might:

a. Undertake service contracts for maintaining complex scientific apparatus;

b. manufacture limited quantities of specialized scientific apparatus;

c. build, test and undertake pilot production of scientific apparatus which could be manufactured in Taiwan by industries under licensing arrangements, and

d. severe, in cooperation with appropriate schools, as an apprenticeship training program for skilled scientific technicians.

It would require initial funding (the equivalent of venture capital) sufficient for perhaps two years' operation before profitability, but thereafter with aggressive entrepreneurial management, the first three activities should be profit-making. The salary schedules should be high enough to compete with local industry for the necessary skills. In time it might become necessary to limit the return on a sheltered monopoly by putting a cost plus fixed fee limitation on service contracts, a similar limitation on direct manufacture and to scale licensing fees, but these would be good problems to deal with if they arise.

The next question is whether the concept of "the Center" has outlived its usefulness. The original idea was that the Republic of China could afford only one doctoral level program in, for example, physics, and that all available faculty and equipment should be pooled to give that Center as much strength as possible. I saw little evidence that graduate work was this completely "pooled", and indeed each university took pride and reported frustration in its individual effort to upgrade graduate level research and teaching. I nevertheless feel that the Center concept has been useful and will continue to be so. In the first place the concept of a Center forces the National Science Council and the universities to plan and fund the total effort in a particular field together. It may make sense to allcoate block grants to several universities for advanced research and teaching, and to have some funds reserved to be granted to particular research or teaching proposals on merit. In fact, I hope this procedure is followed. But it should be done in view of the total national need for people and for research. For example, if the national "need" for Ph.D. level physicists is 24 each year it makes more sense to me to plan the faculty and facilities for 10 at Tsing Hua and 8 at National Taiwan University, giving some measure of competition, than it would to permit two other universities also to compete for Ph.D. candidates, equipment and faculty. There is not much difference in cost between an effort that produces one Ph.D. each year and one that produces ten.

There is some exchange of faculty and students between cooperating universities in the Center, and I hope this cooperation can be encouraged. Travel grants for students and faculty can help here. It is much less expensive to move an experimental nuclear structure candidate from Taida to

Zoologist to Initiate Course in Radiation Biology at NTNU

Dr. Sidney C. Hsiao, professor of zoology at the University of Hawaii, is coming to Taiwan in October for a 10-month tour as a long-term visiting scientist under the China-U.S. Cooperative Science Program. His host institute will be the National Taiwan Normal University, where he will teach developmental biology at the graduate level.

Dr. Hsiao's teaching project consist of the following parts:

A. A graduate course in developmental biology. In this course he plans to discuss the patterns followed by the developmental sequence of events in representative species of animals. The laboratory portion of the course will be investigative in nature. Four-fifths of the laboratory time will be devoted to experimental work on fertilization,. including the examination of the interactions between gametes and the physiology of activation, (2) the role of the nucleus and cytoplasm in cleavage, gastrulation and early cell differentiation studied by the use of artificial parthenogenesis, hydridization, and nuclear transplantations, (3) regeneration experiments, for the light they may throw on the problem of determination and its reversal, and on the field theory in ontogensis.

B. An embryology-related course in radiation biology. This is a specialized course in radiation biology in the sense that its major aim is a study of the effects of ionizing radiations on developing biosystems. The course will consist of three sections: (1) the physical processes in radiobiology, (2) the biological aspects of ionizing radiations, and (3) the basic radiobiological principles derived from the examination of irradiated developing biosystems (including tissue cultures and regenerating systems).

The main goal of the laboratory work of this course is an investigation of how energy packets (photons and particles) are absorbed, distributed and utilized by the biological systems. The students will, first of all, learn the essentials of protection against radiation and good laboratory practice in handling radiation sources.

C. Seminar. A seminar on special topics in developmental biology will be offered if there is a need for it. The nature of the topics will depend upon the interest of the students registering for the course.

The course in radiation biology will be the the first offered in the Republic of China. In view of the light water reactor and the associated nuclear engineering, nuclear physics and radioisotope production programs in the National Tsinghua University and the anticipated nuclear electric plant on order, there is a need for radiation biology, Professor Hsiao pointed out.

Tsing Hua than it is to buy and staff another Vander Graaf accelerator.

Recommendation: I hope that attention is being given to granting graduate credit in one university for work in another (I heard rumors to the contrary). There certainly is graduate level work in solid state physics at Chiao-Tung which is worthy of graduate credit in physics at Tsing Hua and conversely. Our experience in Claremont, where each College is certain the others fail to meet its intellectual standards, is that students nevertheless get a good education by shopping among colleges for courses.

Dean Frankel suggests the Engineering Center become several Centers, and I agree. I believe the strength now exists at Chiao Tung to produce several well qualified doctorates in electrical engineering each year, and as more faculty return from advanced training in the United States this strength will increase. How far the doctoral programs in electrical engineering should be spread among Cheng Kung and National Taiwan Universities depends on the expected demand for Ph.D.'s in electrical engineerenig; if the expectation is that twenty or thirty will be required each year this spread may be desirable. If so, I would hope each university would develop its own individual strengths in electrical engineering, and not simply copy Chiao Tung. In any event, electrical engineering has developed far enough to review the total productivity, funding and program with the attention a Center requires. Electrical engineering is a particularly important field for Taiwan and graduate work in this field should have careful attention. In general, it seems to me that in any engineering field where the total number of master's candidates (in all universities) approaches 100, and the Ph.D. candidates approach 10, and there is substantial industrial interest and prospect of support, when these conditions obtain, that field should have the planning, funding and coordination of a separate center. Civil engineering is clearly approaching this status, and chemical engineering may be next.

I have a few other thoughts I would like to share on the most important question of the engineering centers. The present Engineering Center has an able and distinguishad board of consultants, slanted perhaps a bit too heavily toward aerospace engineering for Taiwan's immediate needs.

Recommendation: That fullest possible use be made of these consultants over the next critical year, both individually and, in questions of overall strategy, collectively; it may be useful to seek a few additional consultants in fields important to Taiwan. Also, the ability of industry to use engineering to advance the economy of Taiwan may be limited by management skills as well as by engineering skills.

Recommendation: It is not my assignment to advise on the development of graduate schools of management, but I do urge that the graduate schools of engineering and of management cooperate in developing student-faculty "problem solving teams" that can demonstrate to industry their usefulness in customer engineer, quality control, market analysis and product design and similar joint activities. It is not easy to bring about such inter-disciplinary research and education—and practice—in a university, but I believe its importance to Taiwan may justify the administrative problems the university undertakes.

(Dr. Platt also made several other important recomendations which can be separated from the main body of the report. Since they are intended for more limited distribution, they will not be published in the Bulletin—Ed.)

A Program for Development

(*Continued from page* 4)

As soon as operations begin there will be a need for sustained, in-residence advisory services, including the presence of an experienced senior counterpart to the team leader—a systems analyst with substantial experience in work in the developing countries, a development economist with systems analysis experience, and a less senior but highly trained and capable systems analyst of relatively recent academic vintage. These three should be backed up by the resources of one of the large international research and consulting organizations of multidisciplinary character, upon whom the resident advisor can call for the wide range of specialized, short-term talents that will be needed as particular systems problems are tackled.

D. Scarcities of Data and Qualified Leadership

In comparison with other countries in Asia, the Republic of China is relatively well off so far as availability and quality of economic data is concerned. The fact that further improvements and refinements in data collection are needed makes it all the more desirable to begin thinking about and working on quantitative models for using the data because this is the most efficient manner for determining the types of data needed and the level of accurracy required.

As to technical leadership, ADL experts are of the view that there are well-trained people in, or available to, the Republic of China who possess many of the characteristics required for conducting and managing the type of work being suggested. This is particularly true in terms of fundamental technical capability. The qualification most noticeably absent is experience—both in the application of technical knowhow to real problems and in managing efforts of this type. As with the problem of improving the data, the most effective way to overcome this limitation is to begin work, accepting some difficulty in the early stages. The use of experienced foreign technical assistance in the initial period of the program will go far to minimize even these problems.

E. Sources of Financial Support

It seems likely that, in the interest of moving forward promptiy, finance of the initial, intermittent, phase of foreign technical assistance, will need to come from Chinese government sources. The longer-term, more extensive and expensive effort should be an attractive program for support by bilateral or multiliateral aid agencies Quite apart from its obviously constructive and high-leverage effects on the growth of the Taiwan economy, the systems analysis program will be a pioneering effort in practical application of comprehensive systems analysis to the economic planning and management at a national leve in a fast-developing country.

A Program for Development of Systems Analysis

(The program is recommended by Arthur D. Little, Inc. in its report to the Council for International Economic Cooperation and Development after a survey of the present state of the practice of systems analysis in support of economic planning and decision making within the civilian sector of the Republic of China. ADL experts define the term "systems analysis" as "the study of the structure and behavior of complex assemblages of interacting components." It is technically feasible only through the use of electronic computers, guided and controlled by certain well-developed mathematical methods. Its power consists in its ability to illuminate relationships that cannot be perceived by unaided intuition, and to predict behavior that on less penetrating inspection appears to be either incomprehensible or paradoxical. They believe it is possible to make percepible advances within a two- or three-year period, more substantial ones in four to six and profound changes over a decade.—Ed.)

A. Steps in the Basic Program

1. Design and create an institutional framework

It is deemed necessary during the initial stage to create a government-sponsored non-profit corporation along the lines of China Engineering Consultants, Inc., and Sinotech Engineering Consultants, Inc. It would be the principal function of this corporation (which is referred to as Systems Analysis Consultants, Inc.) to recruit and place at the disposal of the key ministries and agencies, on a contract basis, a small, highly-competent professional staff, trained and experienced in the practice of systems analysis. It is essential that key members of this staff be utilized, from the start, at the highest level of government economic policy-making.

2. Obtain foreign technical assistance (see C.)

3. Recruit a team leader

It is firmly recommended that the leader must be Chinese. He can most likely be recruited among the overseas Chinese community. The leader should have responsibility as the chief operating executive of SAC as well as be a professional of the highest stature.

4. Recruit a small initial team of technicians

This would be the first order of business, and a critical responsibility, of the team leader.

5. Begin work on selected problems

This should be started as early in the life of SAC as possible.

6. Initiate training activities

This will be a prime responsibility of SAC from its earliest days. The following programs are proposed for consideration:

*Training the leading staff of the systems analysis team;

*Training the analysts;

*Developing an appreciation of systems analysis among government officials.

7. Expand and extend in accordance with need

While self evident, this step is mentioned to stress the fundamental concept that the activities of SAC should be visualized as open-ended and experimental rather than finite. It should seek to institutionalize functions it initially performs by training and guiding its clients to perform them for themselves, continuing on ahead of them to develop more advanced techniques and original insights.

8. Coordinate the government-based program with university

The development of systems analysis as a component of the economic planning process requires a reservoir of workers that, taken as a whole, embraces a broad spectrum of skills. These range from the skills of practical government, at one pole, to those of pure research at the other. Therefore, ADL experts recommend the inclusion of relevant courses in the curricula of Chiaotung University, Cheng Kung University and National Science Hall.

B. An Interim Program

Pending the creation of the new corporation, it is suggested that CIECD take the following steps:

1) The search for and (if CIECD is able to provide interim employment), recruitment of chief executive and principal staff.

2) Selection of and contracting for the services of an appro-private foreign technical as-assistance organization.

3) Execution of the training programs identified above.

4) Actual work on selected problems as staff is brought on board.

The length of the interim period will depend upon the time rejuired for formal organization of SAC. However, serious efforts should be made to limit this to a maximum of two years.

It is emphasized that, in the early stages, the problems selected for attention should be those in which successful solutions would contribute directly and promptly to efficiency in the economy and have as high a degree of visibility as practicable. Examples are project evaluation of important proposed investments, analysis of smaller subsystems such as the competitive demands of power and irrigation for scarce water resouces, and the like.

C. A Note on Foreign Technical Assistance

It will be necessary to have foreign technical assistance for at least the first five years after a decision has been made to go forward with the program outlined in the report. During the interim such assistance can be of an intermittent, non-resident character. Assistance will in all probability also be needed in the training of the leader and the key professional personnel.

(*To continue on Page* 3)