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SCIENCE BULLETIN

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Recommendations for ROC-US Cooperation In Fermentation Engineering

A joint Seminar on Fermentation Engineering was held at the University of Pennsylvania from May 30 to June, 1978 under the ROC-U.S. Cooperative Science Program. Nine ROC participants, 13 U.S. participants and 19 observers attended the seminar, which was jointly organized by Dr. S.Y. Huang, chairman of the Department of Chemical Engineering at the National Taiwan University, and Dr. Arthur E. Humphrey, dean of Engineering and Applied Science at the University of Pennsylvania. There were 26 technical paper presentations by the participants and 8 research interest summaries by the observers. As a result of the presentation and information discussions the following recommendations for future cooperation are offered:

Fermenter Design and Operation
(Session I)

1. Fundamental studies on transport phenomenon and kinetics of reaction in semi-solid fermenting systems.

2. Fundamental studies on mass transfer in fermentors with special emphasis on non-mechanically agitated and non-Newtonian fluid systems.

3. A cooperative effort to test, on both small and large scale, the fundamental scale-up principles.

4. Fundamental studies to elucidate the effect of physical phenomena, such as mixing, pumping, shear, etc., on biological activity.

5. Studies on novel fermentor designs that minimize the total energy demand of the system.

Fermentation Process Modeling and Optimization
(Session II)

1. Investigation of the suitability of modern mechanistic model building and optimization techniques for biochemical process systems.

2. Development of efficient computer programs for implementing such techniques on relatively simple or inexpensive computers.

3. Laboratory, pilot-plant and/or plant scale verification of the results of computer-aided modeling and optimization of some fermentation processes of theoretical and/or practical importance.

Monitoring and Control of Fermentation Processes
(Session III)

1. Research is required to develop new and to improve existing methods for both direct and indirect monitoring of fermentation processes.

2. A cooperative effort to apply results from laboratory scale computer-mediated process control to large scale systems is needed. Cooperation between universities and industrial teams should focus on the fundamental problems of process scale-up and its effects on process control.

3. Efforts are required to better evaluate the dynamics of fermentation process including monitoring, modeling, and evaluation in the context of biological mechanisms. Results from this work then need to be applied to important fermentation processes.

4. Research is needed on the application of micro- and minicomputers to on-line fermentation monitoring and control. Efforts should focus on the fundamental problems associated with computer-fermentor interface and computer-mediated control.

Bioconversion of Agricultural Products and Wastes
(Session IV)

1. Cooperation on cellulosic waste conversion should emphasize solid state or semi-solid state fermentations.

2. In addition to the investigation into utilization of agricultural wastes such as cane, bagasse, corn stover, wood sawdust, other agricultural materials such as grain processing wastes, Jerusalem artichoke, and kudzu should be considered.

3. Fermentative conversion of wastes should emphasize such products as glucose, fructose, SCP, alcohol and other chemicals.

Novel Fermentation Products and Processes
(Session V)

1. Research on food pigments and flavors should be encouraged.

2. Research on biopolymers appears to have future attractiveness.

3. Investigations on the large scale production of SCP and its end product uses should be encouraged.

4. Research on enzyme production and their application is also of mutual interest.

Production of Food Materials by Fermentation
(Session VI)

1. Fundamental engineering studies be initiated on large scale and rapid production of specific food materials by fermentation. These should include soy sauce, vinegar, SCP, and mushrooms.

2. Kinetic studies should emphasize maximizing the unit productivity of foods by fermentation as well as maintaining the specific food flavor.

General Recommendations

It appears that R.O.C. academics have access to large scale fermentation facilities that are usually unaccessible to U.S. academics. Also, an area of common interest and with little attention is that of solid fermentation systems such as those associated with koji production, composting, etc. This sug-

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The Bakana Disease of Rice Plant

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Introduction

The bakanae disease is one of the oldest rice diseases in the Orient. It was first reported in 1898 by Hori in Japan who mentioned blast, brown spot and bakanae as the three major diseases of rice in Japan at that time. Twenty per cent or more plants were infected by bakanae. Hori also identified *Fusarium heterosporum* Nees as causal agent of bakanae disease. Sawada in Taiwan found the ascigerous stage of the rice bakanae fungus in 1919 and named the fungus *Lisea fujikuroi* disregarding the imperfect stage. The second word of the binomial was adopted in memory of Mr. Fujikuro who first found the disease in 1918. A comprehensive study of the bakanae disease was made in Hokkaido University, Japan in 1931 by Ito and Kimura who identified the causal fungus as *Gibberella*, and its conidial stage as *Fusarium moniliforme*. We think that the perfect stage of the fungus should be called *Gibberella moniformis* (Sheld.) Wineland with the synonym *G. fujikuroi* (Saw.) Ito.

Extensive studies on bakanae disease of rice carried out around 1932 in Japan included symptomalogy, bakanae phenomenon, pathogenicity, soil temperature and disease incidence and survival of the pathogen. Since Yabuta and Hayashi isolated a growth regulator Gibberellin from the filtrate of the fungus culture in 1939, all studies of the disease were concentrated on the production, purification, and physiology of Gibberellins. The disease itself was not extensively studied. A few articles were written from 1939 to 1950, and less than 20 papers were published in Japan, Taiwan, and Thailand from 1960 to 1976. A general review of the rice bakanae disease was made by Dr. Ou in his book of "Rice Diseases" in 1972. The present paper summarizes recent investigations of the disease on spore liberation, disease cycle, heterothallism, survival and inoculum potential of the rice bakanae fungus.

The Disease Symptoms

The most common conspicuous sysmptom is the elongation (hypertrophy) of the diseased plant stems. "Bakanae" is a Japanese word meaning bad seedlings. In Taiwan, diseased plants are called "Male seedlings," which means big plants but sterile. Chinese farmers call diseased plants "White pole." Diseased plants are taller, slender and pale yellowish in color. Diseased seedlings usually die during and after transplanting, but healthy seedlings may be infected in paddy field sporadically after transplanting. Besides elongation, bakanae symptoms include leaves bending over and adventious roots growing out of the nodes on the lower portions of the stem. White mycelium grows out of the nodes and spread over the lower half of the stems. Eventually the plants die covered with dull whitish to light pinkish mycelium and sporodochia (mostly microconidia). If it rains or becomes very humid, diseased stems turn bluish-black and blue-black spherical bodies, the perithecia, form on the surface of the stems. Not all diseased plants bear perithecia. It is estimated that about 50 per cent of the infected plants produce perithecia. When the weather is dry during harvesting time, only a few or no perithecia can be found.

In Japan, panicles are often infected, referred to as "Pink panicles". We found that some late-infected bakanae plants produced pink panicles, but many of the pink panicles are caused by *Fusarium roseum*.

(To be continued)

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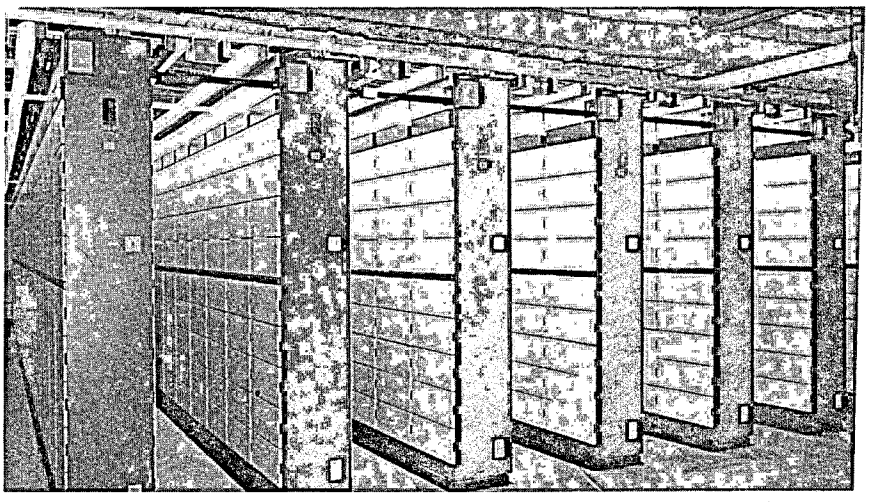
gests a general focus of cooperation should be as follows:

1. Verification of scale-up fundamentals in large fermentation equipment.
2. Focus on those fermentation systems involving solid substrates.

Means of Cooperation

Cooperation should be initiated on an individual basis through private communications. Once a common interest between investigators from both sides is identified, the form of cooperation should be established. This could take the form of visits, joint seminars, exchange of students, etc. This can be initial effected through the offices of the International Programs in NSF and NSC. This can be followed by submission of fundamental research grant proposals to the NSF and NSC for simultaneous support from both sides to cooperating scientists.



The fist locally made electronic switching systems are being installed at a telephone office in Kaohsiung. The two switching systems are designed, produced and installed by the Taiwan International and have a combined capacity of 30,000 lines. The system features a "hold" service, absentee service, call transfer service, hot lines and a centralized observation service. Each of the systems costs NT$200 million. Taiwan International is a joint venture of the Directorate General of Telecommunications and the International Telegraphy and Telephone Corp. of the United States. The new system, shown above, will be inaugurated early this month.

Recent Endeavors in Pharmaceutical Chemistry

The pharmceutical industry in Taiwan has been rather prosperous, and there are numerous pharmaceutical plants. However, most of them are operating at the packaging and distribution phase of imported drugs rather than the actual synthesis and production phase. In an effort to encourage the development of pharmaceutical industry, the National Health Administration has compiled a list of drugs for synthesis, and the National Science Council is supporting a number of investigators to study the synthesis of compounds on the list and to explore a feasible route to synthesis of the drugs in small quantities. This will serve as the starting point of scale up studies and eventually pilot plant tests by those interested in commercial production.

The report here covers the work at the Institute of Chemistry, Academia Sinica by Dr. Chao-tung Cheng and his associates, Yun-er Shih, Lian-fang Lin and Shwu-jiuan Lee. This research group has synthesized three compounds: Hydrochlorothiazide (6-chloro-7-sulfamyl-3, 4-dihydro-3, 2, 4-benzothiadiazine 1, 1-dioxide), a diuretic and antihypertensive agent; vitamin B6 (2-methyl-3-hydroxyl-4, 5-bis-methoxymethylpyridine hydrochloride), an enzyme cofactor vitamin for treatment of pellagra and peripheral neuritis; and vitamin K3 (2-methyl-1, 4-napthoquinone), a prothrombogenic vitamin. The following is a brief account of their methods of synthesis and the yield obtained:

Hydrochlorothiazide m-Chloroaniline was chlorosulfonated with a large excess of chlorosulfonic acid to give 4-amino-6-chloro-1, 3-benzenedisulfonyl chloride with 66.5 per cent yield. The chloride was converted into 4-amino-6-chloro-1, 3-benzenedisulfonamide with (62.4 yield by the action of aqueous ammonia containing ammonium carbonate. The amide was finally transformed into the desired compound, 6-chloro-7-sulfamyl-3, 4-dihydro-1, 2, 4-benzothia-diazine 1, 1-dioxide with 84 per cent yield by the reaction with formalin.

Vitamin B6 Propionic acid was brominated to form α-bromopropionic acid with 82.2 per cent yield. The bromoacid was aminated with aqueous ammonia to give α-aminopropionic acid (dl-alanine, 73.2 per cent in yield), which was esterified in ethanol and hydrogen chloride gas to afford ethyl dl-alaninate with 81.5 per cent yield. The ester was formylated in formic acid-acetic anhydride to give ethyl N-formylalaninate with 75.5 per cent yield. The action of phosphorus pentoxide converted ethyl N-formylalaninate into 5-ethoxy-4-methyloxazole with 34.8 per cent yield. Maleic anhydride was hydrolyzed to maleic acid (97.8 per cent in yield), which was esterified to diethyl maleate with 72.5 per cent yield. The ester was allowed to react with 5-ethoxy-4-methyl-oxazole to form diethyl 2-methyl-hydroxypyridine-4, 5-dicarboxylate hydrochloride with 74.1 per cent yield. The salt was made into the free base (86 per cent in yield), which was reduced with lithium aluminum hydride to afford the goal compound, 2-methyl-3-hydroxy-4, 5-bis-methoxymethylpyridine (pyridoxine, vitamin B6) as hydrochloride with 69 per cent yield.

Vitamin K3 Silica-alumina catalyst was prepared from water glass and aluminum sulfate acidified with hydrochloric acid; the resulting gel was heated to 140-180° and finally to 550°. Naphthalene in methanol was passed through the silica-alumina catalyst at 450° to form some 2-methylnaphthalene, which was oxidized with chromic anhydride to 2-methyl-1, 4-naphthoquinone (Vitamin K3) with 39 per cent yield.

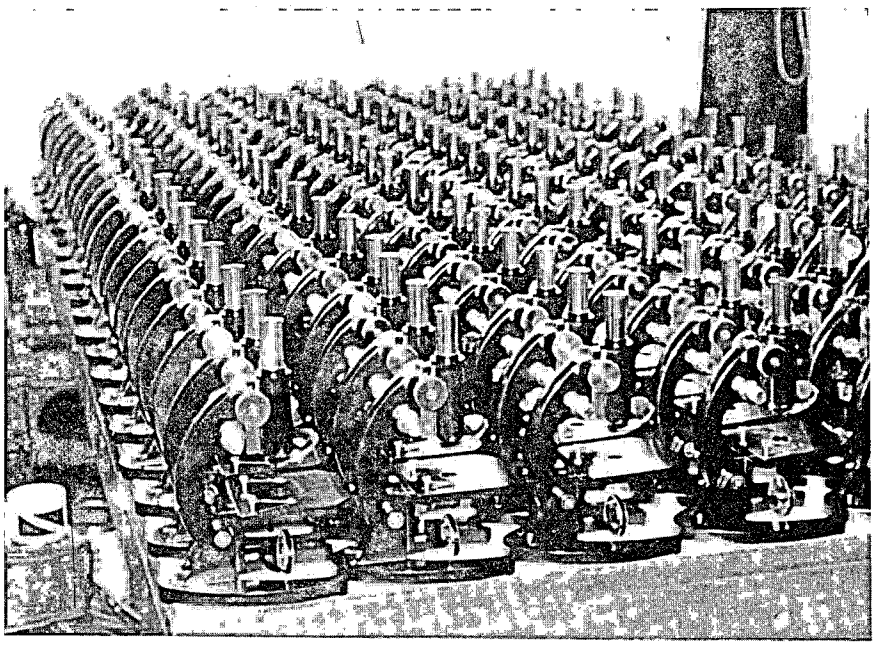
Locally Produced Microscopes Available

The Precision Instrument Development Center (PIDC) of the National Science Council has turned out the first batch of microscopes on contract with the Department of Education, Taiwan Provincial Government. They are the first microscopes made locally.

The 200 600X microscopes were made with all the optical and mechanical parts manufactured domestically. They are being distributed to the designated schools. It is hoped that private manufacturers of optical instruments in Taiwan will benefit from the PIDC know-how.

PIDC has been developing precision optical instruments in support of the rapid development of science education in the country. The program stresses the development of two major items—microscopes and microprojectors. All products are to be used by the various schools in Taiwan.

Pictured here are the newly manufactured microscopes.



Summary of NSC-Supported Research in the Field of Natural Sciences in Fiscal 1977

(*Continued from last issue*)

Extended and long-range weather forecast

In an effort to establish an objective routine-forecasting procedure and to improve the forecasting skill on both the extended and long-range weather forecast, operational research is being emphasized at Chinese Central Weather Bureau (CCWB) and Chinese Air Force Weather Central (CAFWC). Weather types in spring and fall are classified and put on punched cards. Analog method is now being used in the routine forecast at CCWB. Also, studies of the upper wave behavior in Asia during winter season and the application in the extended weather forecast are made at CAFWC.

Numerical weather prediction and numerical simulation

Equivalent barotropic model is being adopted in the routine weather forecast at CCWB. Research work on this model is continued in an effort to improve the forecast ability by incorporating the Tibetan Plateau as an internal boundary 500 mb. This model is also employed to forecast the typhoon track in western Pacific. Preliminary results indicate that the forecast capability of the model is comparable to the official subjective forecast. In addition, primitive equation model and various objective analysis techniques suitable for East Asia are studied for future operational purpose.

Typhoon research

Laboratory simulation on the dynamical interactions between typhoon circulation and the Central mountain range in Taiwan is continued. Efforts have focused on determining the deflecting effect of mountain on typhoon tracks. A synoptic analysis of local wind field under typhoon circulation is made. Results are being used at the operational forecast ability on both the wind direction and the wind speed. In addition, Doppler sounder array is established to investigate the effect of gravity-accoustic wave in ionosphere during the typhoon occurrence.

Establishment of the meteorological data bank

A cooperative research program is established to study the procedure of data-collecting, decoding, checking and storing as well as an objective data analysis in an effort to set up a complete meteorological data bank. The established data bank will provide the observational data in East Asia and its vicinity which is required in both the basic and operational research.

Applied meteorology

Research efforts have been focused on the agriculture meteorology, air pollution, satellite meteorology and instrument design. Effects of various radiation components and variation of CO_2 concentration in the surface layer on the growth of economic plants in Taiwan have been studied to provide the basic information in agriculture planning and operation. Land-sea breeze and the associated air pollution problems in Kaohsiung are studied. Brightness of the satellite picture is analyzed to estimate the rainfall amount. In addition, a multiple recorder and a rain gauge have been designed and calibrated.

Conference on Severe Weather In Taiwan Held

A Conference on Severe Weather in Taiwan Area was held at Nankang on May 27-28 under the joint auspices of the National Science Council and Academia Sinica. Two hundred and eleven meteorological scientists at tended the academic meeting.

The conference was divided into four sessions dealing with drought, typhoon, cold surges, and *Mei yu*, during which 16 scholars and specialists were invited to give review talks and make paper presentations.

In view of the great loss of properties and lives in Taiwan due to severe weather conditions, the participants agreed that increased government financial support for meteorological research is urgently needed. They also suggested the establishment of a Weather and Climate Modification Working Group as soon as possible.

A summary of the complete discussion in Chinese is available on request at the Natural Science Division, National Science Council.

Study on Fish Fauna In Taiwan Area Starts

A fish Fauna survey is generally regarded as essential to the development of fish resources in Taiwan. The latest work in this field was done by Prof. J.T.F. Chen during 1955-69. He recorded and collected 1382 species of fishes in Taiwan. Modern collecting techniques such as the application of ichthyocides and scuba were not yet available then. As a result, his work is far from complete.

In May, 1977, a new survey team was organized with the support of the National Science Council with a view to augmenting Prof. Chen's findings. The team plans to complete the work in three to five years. Their survey will cover such orders and families of the marine fish fauna as *Scopaneoidei, Gongiopodoidei, Gadiformes, Scombroidei, Apogonidae and Pomacentridae.* The scientists who make up the team include Drs. Lo-chai Chen, T.T. Kan, K.S. Chang, S.C. Lee and S.C. Shen.

The scientists have proposed a set of dependable keys for identification based on the specimens of marine fishes of Taiwan and plan to build up a complete collection of fish specimens with detailed information to be kept under the custody of the Department of Zoology, National Taiwan University for reference by interested parties.

The findings of the survey will enable the investigators to compare the marine fish fauna of Taiwan with that of the West Pacific Ocean. The fish fauna survey will yield information vital to the study of phylogeny, population genetics and life histories of fishes and integrated studies of recent and fossil fishes. The information is also considered vital to other branches of science including econology, zoogeography, evolution, anatomy, etc.

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