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Research Institutes and their activities

D03942

Belgium

Government Assistance to Applied Research

By Dr. Louis A. M. Henry, Director*

Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture

Immediately before World War II, good research activity in some areas of industry and agriculture was already evident in Belgium. Modest assistance to a limited number of research projects came through the "Science-Industrie" office of the "Fonds National de la Recherche Scientifique" in the Ministry of Economic Affairs. On the whole, however, medium and small-sized firms had no clear idea of the importance of research and many larger firms did not consider it an investment as important as factory equipment.

During the years of war and occupation, research activity became disorganized and practically stopped. Production equipment was in disrepair; research equipment had been destroyed or dispersed; many of the younger scientists had disappeared. Industrial development had been stagnant for this period. Thus, industry and to a less degree agriculture, were faced with the task of catching up with what had been accomplished in other countries under the pressure of the war effort. Financial resources for both industrial and agricultural research were small in Belgium and something had to be done to recover a normal level of research in preparation for future demands.

On 27 November 1944, following the advice of a small group of men of vision, the Belgian Government established an organization called the "Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture", in brief "I.R.S.I.A."

Its objective, as expressed in its Statute, is "to induce, promote and encourage by way of grants, the scientific and technical research which could most effectively aid the progress of Industry and Agriculture".

The Institute's activities cover all fields of applied research, with the exception of the coal industry, nuclear energy and space technology. Placed under the dual authority of the Ministers of Economic Affairs and of Agriculture, the Institute nevertheless exists as a public institution, although its financial resources come from an annual allocation in the budget of the Ministry of Economic Affairs.

The Institute began operations at the end of 1945. The original allocation of 20 million Belgian francs (approximately equivalent to 7 million dollars) has increased as follows:

1946	20 million Fr.
1951	70 "
1955	140 "
1960	233 "
1961	235 "
1962	283 "
1963	300 "
1964	285 "
1965	380 "
1966	342 "

The activity of the Institute is supervised by an Advisory Board of 21 members composed of leading scientists and research men in industry or agriculture. The work of the Board is prepared by a Committee of 7 members which normally meets ten times a year, while the Board meets 5 or 6 times.

Representatives of the Minister of Economic Affairs and the Minister of Finance attend all meetings of the Board. Through them the Ministers exercise the right to veto decisions of the Board contrary to the law, the Statute of the Institute or public interest.

The accounts of the Institute are audited at the end of each year, by the Cour des Comptes.

The administrative structure consists of a director, assisted by a secretary general and five scientific advisers (engineers, doctors in science or agronomists) all of whom are trained research scientists. Such a small staff naturally requires a high level of diversification on the part of individuals in the executive branch.

As the total personnel of the Institute, including the accounting section, amounts to less than 25, this results in

* For a biographic sketch of Dr. Henry, see MEN IN RESEARCH.

both flexibility in action and a low administrative overhead. The allocation for administrative services at present is about 3 per cent of the total budget.

When I.R.S.I.A. was created, the Government entrusted its Board with formulation of research policy, methodological decisions of study and selection of research projects, as well as administration of grants. It became clear, however, that post-war conditinns and limited funds—a problem which still exists—coupled with the limited natural resources, its restricted inner market, and the keen competition with outside markets, dictates the conditions under which research must be developed in Belgium. Thus, the necessity of working as quickly as possible, in the most economical and efficient way, has been the basic principle of action of I.R.S.I.A.

At the beginning, the most urgent task was to raise Industry and Agriculture to a normal degree of research activity, and to develop a better understanding of the importance of research as an investment for the future. At present, the task of the Institute is essentially to promote research leading to the improvement of existing products; to increase the number of new products or new uses of existing products; to explore fields leading to totally new productions. Special emphasis is given to research leading to highly technical production.

1. *It gives grants to finance research projects.*

Grants are given to research laboratories and organizations carrying out research on new problems. It was found that this principle was the most effective incentive to producing new ideas, new lines of interest and better use of the investment in research facilities and scientific personnel.

In principle, the grant covers only part of the budget of the research project. The beneficiary of the grant must cover the balance, thus showing both his positive interest in the project, and his willingness to take the risk and make the efforts to succeed. Although the basic ratio of financing for industrial projects is "50-50", this is not yet the case for agriculture. At the beginning, research expenses in agriculture were covered practically in full by I.R.S.I.A., but through better organization, agriculture is now able to carry about 15 per cent of research expenses and this percentage is increasing.

A departure from the "50-50" rule may be considered in other special cases; for example, to help start research activity in a branch of industry in financial difficulty, or to pursue research of more general interest, like the compilation of the soil map of Belgium. A greater departure is a necessity when I.R.S.I.A. itself initiates research in a totally new field where potential applicants are still remote.

2. *It does not have research laboratories but urges and helps industrial and agricultural research organizations to establish their own.*

Establishing multi-disciplinary government research laboratories would have been practically impossible twenty years ago. In order to get applied research underway quickly, it seemed more logical and more economical to make use of laboratory resources, equipment and scientists in industry and the universities. With the development of technological research activity and "research mindedness" in general, industry and agriculture were more inclined to have their own research laboratories.

Having invested in research, any research association, just as a private firm, wants to make the most of its investment and to guarantee full activity even in times of economic difficulties. I.R.S.I.A. assists non-private groups doing research in industry and agriculture in building laboratories by subsidizing their research programmes, at a very liberal 100 per cent rate, for a two to four year period. This generous financing is based on the requirement that the research organization itself build a research laboratory at its own expense during this time and spend for it an amount at least equal to the special research grant. Several laboratories have been built in such a way, for instance, by the paint, the explosives and the building industries.

3. *It is active in promoting and helping co-operative research.* Initially a choice had to be made between two alternatives: assisting competitive, or co-operative research.

Competitive research is certainly a necessity for industry, and in many cases represents the last stage before proceeding with development and production. There were, however, substantial grounds for objection to its choice as the Institute's main course of action: it implied the existence of well-developed research laboratories in a few selected firms, which was not generally the case after the war; it presented a difficult problem in dealing with confidential subjects and the risk of duplication; there was great difficulty in finding specialists whose work would be restricted to the interest of one firm only; and above all, it meant concentrating resources on the specific projects of a limited number of firms already aware of the importance of research, and leaving without help the small and medium-sized firm, as well as agriculture in general, the latter of which were certainly the most in need. The Institute's main task, that of the "promotion of research", would have been neglected.

Thus, it appeared more logical to choose the "co-operative research" solution. Principally, I.R.S.I.A. is to open research projects, whatever their origin, for any firm willing to take part in the financing, able to define its own problems within the general frame of the project and having either the necessary research facilities or intention of acquiring them. This approach eliminates, of course, all strictly competitive problems, but helps solve problems of general interest to all participants. It leads to exchange of information, avoids duplication and enables the use of specialists in industry and the universities.

On the other hand, this does not necessarily imply that all the research projects sponsored by I.R.S.I.A. are co-operative. It happens quite frequently that no potential partner is willing to participate, in which case the promotor may receive the grant alone. It can happen also that the project comes from a firm which is the only representative of a special activity in Belgium and can, therefore, be the only grantee. Even in such cases, exchange of information or results with other firms takes place. The most important fact is that the possibility of co-operation is always open.

Co-operative research is profitable to all enterprises whatever their importance. For small and medium-sized firms it is a necessity and practically the only possibility of participating in important research work. Even if many of them have at present some sort of research organization, their limited resources makes it impossible for them to study problems of wide scope, and their efforts would generally be below the threshold of efficiency. The only solution for them is to join their efforts by co-operation.

Co-operative research brings an increase in scientific production, even in the case of larger firms with well developed research facilities and scientific staff. In some circumstances it is an absolute necessity, especially for research projects requiring extensive investment in special equipment and labour. A recent example is the creation of the Committee for the Study of New Materials. The field is so large, the investment in special equipment so large, the risks so high that no single firm could have considered the possibility of entering it even with an important grant from I.R.S.I.A. Only co-operation between six important firms made it possible.

The number of participants in any given co-operative project can vary considerably. In the case of the "Centre Scientifique et Technique de la Construction" a project can interest hundreds of members; in the case of the "Groupe d'Etude des Pieces Composites" (a project on a steel foundry) only five firms are involved. A most important project in steel casting involves only two.

In Industry, associations of firms for co-operative research can take various forms. It can represent the grouping of all the firms of one sector of industry in a pattern recognized by the State and organized by the law of 30 January 1947, such as the "Centre Technique et Scientifique de l'Industrie Belge du Verre", or the "Centre de Recherches Routières". Such centres are permanent and financial participation is compulsory for members. Research programmes are established by a scientific and technical committee in accord with the members. A number of them have their own laboratories, established sometimes with the help of I.R.S.I.A.

It can also take the shape of a free and permanent research association, in which case, participation is not compulsory. A most active one is the "Centre national de Recherches Métallurgiques" ("C.N.R.M." which groups the majority of the firms active in iron and steel and non-ferrous metallurgy). Others are "Centexbel", for the textile industry and the recently established "Laborelec" created by the producers of electricity and electrical equipment. C.N.R.M. and Laborelec have important independent research laboratories, while Centexbel uses research facilities at Gent University.

Sometimes firms belonging to various sectors of industry create a research association to solve problems of common interest. A typical example, and a most successful one, is the "Comité d'Etude de l'Etat Solide". This committee, composed of firms active in electronics, semi-conductors, refractory metals, photography, special crystals production, dielectric layers and gas lasers, works in close co-operation with two very active university laboratories in Gent and Liége. Another interesting example of this approach is the "Chance" project, for the study of optimal achievement in industrial process which groups a specialist in hybrid computers, a producer of computing equipment, and several electric power plants. Research work is carried out primarily at the University, in an industrial research laboratory and at the electric power plants.

The exchange of information about independent projects in not too remote a field of activity: this happens quite often in chemistry or pharmaceutical chemistry. The firms are so specialized that co-operative research would be difficult to establish, except in fundamental subjects like catalysis or high polymer structure problems. I.R.S.I.A. helps them by grants for individual projects; however, all research projects are first discussed at the Institute before a committee consisting of the leading scientists of those firms who act in an advisory capacity for I.R.S.I.A. The results have been: a better definition of the research projects; lack of duplication; and the exchange of useful information and research facilities.

In agriculture, co-operative research can be carried out by groups of producers in the agricultural industries. Some, like the "Centre de Recherches de Gorsem" (fruit production), "Institut Belge pour l'Amélioration de la Betterave", "Centre de Recherches Scientifiques et Techniques des Conserves de Légumes et des Industries Connexes" (CERCOL), "Institut National Belge du Houblon", have their own laboratories or research stations. Others, like the "Comité pour l'Etude Scientifique et Technique du Lait", the "Centre Technique et Scientifique de la Brasserie de la Malterie et des Industries Connexes" make use of research facilities in universities or agronomic faculties, and work in close co-operation with professors in charge of various research departments in those institutions.

An even more important amount of research is placed under the responsibility of *"ad hoc"* groups created by I.R.S.I.A., in co-operation with interested producers' associations, to investigate subjects of general interest and need in agriculture. One of the oldest is the "Comité pour l'Etablissement de la Carte des Sols et de la Végétation de la Belgique" (the soil mapping of the country). Those research groups rely for their direction on scientific committees consisting of scientists from agronomic or veterinary faculties working in co-operation with farmers or producers. Research is carried out in the faculties and in pilot plants, or in farms.

Co-operative research would have little meaning if measures were not taken to ensure the dissemination of technical information among the members of the group. For firms with a strong scientific staff, scientific reports are an adequate means of information. In small and frequently medium-sized firms, it is often necessary to attach "liaison officers" to the research group. Their task is to establish contacts between the research scientists and the technicians in charge of production in the smaller firms, and to send their problems to the laboratory. A number of research centres like the "Centre Technique et Scientifique de l'Industrie Belge du Verre" count among their members quite a number of small firms and have a permanent staff of

liaison officers established with the special financial help of I.R.S.I.A.

4. *It plays the role of a counsellor and of a liaison agency.* As a counsellor, the Institute's task is to help small and medium-sized firms define their problems, to urge them to participate in co-operative research, to find the laboratories and scientists to help them, and to assist them in assembling a research staff. In its role as liaison agency, besides developing co-operative research, I.R.S.I.A. establishes contacts and co-operation between industries in related fields. This is done by personal contacts with both directors and research activities in various firms and by frequent visits to their factories and laboratories. Committee meetings of specialists are held and results of research are discussed. Such meetings are profitable for industry and an absolute necessity for agriculture.

Frequent meetings of research groups in the same or in related fields, along with questions and criticisms of the results, are an incentive to high quality and efficient work.

5. *It initiates research in new fields.* Industry is not always aware of the possibilities offered by the opening of new scientific fields. Even if such possibilities are apparent, industry frequently cannot afford the risk of starting research which, if successful, will lead to industrial application only in the remote future. I.R.S.I.A., therefore, initiates research in new fields preparatory to future development. Such an action requires a constant flow of information about new scientific developments and the location of a scientist in the new field, who will agree to act as a leader in training assistants and pursuing research with a view to practical application. He must also accept the responsibility of solving problems originating from industry while absorbing the new developments and re-organize research accordingly.

Two examples illustrate this: The "Comité d'Etude de l'Etat Solide", developed around a scientist, Prof. Willy Dekeyser of Gent University. Some of the most important industrial development as well as the nucleus of an internationally known group of solid state physicists originated there; the "Comité pour l'Etude des Matériaux Nouveaux", created at the initiative of I.R.S.I.A. and with the assistance of industrial research directors, has been able to initiate a project for co-operative research between three producers of special metals and special alloys, and three potential users of the new products.

The objective of the latter project is to acquire a better knowledge of materials, with the aim of producing new alloys of high mechanical strength at high temperature or under highly corrosive conditions, re-inforced matrices, and glass-metal compounds. This is both a high risk and high cost project on account of the special equipment it requires. If successful it will open new fields of applications of products of sophisticated technical character.

The "Chance" project referred to earlier, is the indirect result of the financing by I.R.S.I.A. of the development and construction of a large digital computer. The aim of the Institute was to awaken interest and to induce firms specialized in electronics to start development on the subject. It has led to the development of hybrid computers and to the possibility of producing equipment for the most efficient use of industrial processes.

Ten years ago, I.R.S.I.A. urged a machine tool factory to co-operate with a firm specialized in electronics and electrical equipment, in developing a lathe with digital command. Besides the problem of automatic control, a number of mechanical problems had to be solved in order to make use of the speed of production and the higher accuracy made possible by digital control. This practical result convinced the old and traditional minded machine tool industry, formerly flourishing in Belgium, to engage in research. Extremely active research groups have been formed, under the leadership of Prof. O. Peters of Louvain University, and important results and new developments have already been achieved.

In agriculture, a good number of research projects have been initiated by I.R.S.I.A., in co-operation with scientists of agronomic faculties.

Whether in industry or in agriculture, a necessary condition for the development of a new project by I.R.S.I.A. is to engage the services of an outstanding scientist who is willing to carry out research in relevant subjects, and to co-operate with the industrial or agricultural sectors.

6. *I.R.S.I.A. Fellowships.* The increasing volume of research undertaken by industry and agriculture brought about an increasing need for well-trained, highly-qualified scientists. Special training for research is best acquired by the preparation of a Ph.D. thesis, or by post graduate research work in a scientific establishment. To help fill this need, I.R.S.I.A. has established, for the benefit of Belgian students, three kinds of fellowships:

(*a*) Specialization fellowships. Open to students with a degree in science and to engineers, agronomists and pharmacists who wish to prepare a Ph.D. thesis. Applicants must have graduated with honours. The fellowships are awarded for one year and can be renewed twice. More than 1,200 fellowships have been granted since 1946.

(*b*) Research fellowships. Open to holders of Ph.D.'s or equivalent degrees, for one or two year periods to undertake advanced research in a scientific establishment. Research fellowships are in less demand than specialization fellowships. Only 109 have been granted since 1947.

(*c*) Travel fellowships. Open to scientists engaged in applied research to work for a period of up to six months for the study of a specific scientific or technical problem in a research centre abroad. About 100 fellowships were granted between 1947 and 1953; 50 between 1954 and 1964.

Selection, Evaluation and Handling of Research Projects

Immediately after the establishment of the Institute, it did not appear necessary or feasible to apply a selective policy in choosing research projects. All tasks at hand were priority projects.

As the importance of research was generally accepted and technology developed, the number of research projects submitted to I.R.S.I.A. increased. Institutes, regardless of

financial resources, must select those projects considered more important for the economic and social development of the country. At the same time, methods of evaluation and management of projects, including scientific and technical requirements have to become more strict.

A clear and accurate classification, based on the relative importance of various branches of industry and agriculture and the most promising lines of research, is most valuable for long-range planning of research activity. Often, factors influencing the classification are difficult to evaluate or even to foresee. Well-planned research can end in bitter disappointment by the appearance of unpredictable elements; or, although increased research in a certain branch of industry may appear logical and advisable, industry itself might not respond to it and consequently offer little.

Valuable information for selecting areas of activity may come from many sources. Economic studies and comparisons with other countries' experiences are important. Regular contacts with industrial leaders to ascertain their problems, evaluate their needs, and estimate future developments in new fields are essential. Discussions with scientists and up-to-date knowledge of their technical progress, through scientific literature, are also useful. A study of the evolution of the research budgets of various sectors of industry helps in determining areas of rapid development and those requiring special help. Even a fact as apparently minor as the presence of a prominent scientist in a laboratory can justify a special expenditure for research in his area of specialization.

Within the framework of its assigned role, and making the best possible use of current information, the Institute gives high priority to projects which could result in new technology or open new fields of specialized production.

About one-third of the resources for grants have been spent for research in agriculture; the balance for research in Industry. The following demonstrates the relative importance of grants for research to the various branches of industrial activity on a percentage basis:

	1959 to 1964
Ferrous and non-ferrous metallurgy	24.7
Chemistry (including photography and pharmaceutical chemistry)	27.4
Machine tools and metal constructions	13.1
Electronics	12.8
Buildings and road-building	6.4
Textile	5.2
Glass and silicate	4.7
Research in co-operation between various branches of industry	3.7
Other branches of industry	1.7
Production and distribution of electricity	0.3
	100.0

A more detailed study covering a longer period shows clearly that this relative distribution is not static. It indicates, for instance, a constant increase (9.9 per cent in 1958 to 15.9 per cent in 1964) in electronics, proving that in certain areas of activity, industry is capable and willing to respond to the incentive of increased grants for research in highly technical fields and in those leading to specialized production.

Project Evaluation and Management

The procedure used by I.R.S.I.A. in evaluating and managing projects from introduction to signing a research contract will be sketched briefly. In this procedure the Institute plays the dual role of advisor and liaison agency.

Projects can emanate either from the Institute or from other sources; namely, research associations, individual firms, scientists from universities, and potentially international projects. In many cases, before the actual application for a grant, exploratory contacts are made by the applicant with the scientific staff of the Institute. It is thus possible to estimate if the project is feasible and corresponds to the interests of the Institute, to clearly define the field and methods of investigation; and to estimate the research budget and the equipment required for such a project.

After the application has been introduced officially, the programme is examined and appraised in detail by members of the staff. An economic evaluation of the project is undertaken, along with discussions of scientific and technical problems. At this stage of evaluation the opinion and advice of eminent scientists is sought.

The adequateness of research facilities is estimated by visits to the laboratories and discussions with the research staff. Former research activity is taken well into account and carefully appraised at this point. The duration of the research contract (generally two years) and the cost are agreed upon. A report is then prepared for examination by the Institute Board, presenting aims and economic, scientific and technological assets. The programming of the research project is defined in precise detail, including timing, facilities and the budget. Conclusions are drawn by the Director of the Institute, along with his recommendation for acceptance or refusal by the Board.

The contract which binds I.R.S.I.A. and the grantee specifies the amount of the grant, the portion of the budget to be covered by each party and the general description of the project. It also provides for the issuance of interim and final reports, as well as for strict accounting of all expenses. Slight changes can be made in the original programme and in the budget, with the approval of the Institute.

Scientific and Technological Research Survey in Norway

The Norwegian Parliament asked the Royal Norwegian Council for Scientific and Industrial Research to carry out a comprehensive review of the status of research in science and technology and of measures to be taken to increase co-operation between industry and research.

The Ministry of Industry is reviewing a one hundred-page report for submission to Parliament. Some of the recommendations have already brought concrete results.

India

Central Glass and Ceramic Research Institute, Calcutta

By I. P. Bhattacharyya
Member of the Institute Staff

The Central Glass and Ceramic Research Institute was established by the Council of Scientific and Industrial Research, under the auspices of the Government of India. In addition to fundamental and applied research on subjects relating to glass and ceramics, the Institute offers technical aid to the indigenous industry; assists in standardization and testing; disseminates technical information; and provides specialized training to industry and institute personnel.

Organization

The organizational structure of the Institute is akin to the "Linking Pin" concept of Renesis Likart.

The Director of the Institute is assisted by several scientists who guide the various research projects conducted by Specialist Groups. In the discharge of its functions, the Institute is advised by an Executive Council comprising eminent scientists, technologists and leaders in industry.

The principles of research control and management are used selectively, in individual cases, according to the intrinsic requirements of the research projects being handled. There are no divisions in the laboratory since in technological research to solve a problem may require free collaboration of more than one discipline, something that can be better achieved in a non-divisional system. There are Specialist Groups and problems are assigned to them. Group discussions stimulate thought and the pooling of knowledge occasionally catalyses new creative departures.

Workshops, stores, processing of materials, etc., are centrally looked after and freely available to every worker.

The Institute maintains a close relationship with the industry and frequently holds discussions with manufacturers, consumers, scientists and technologists to identify and analyse problems which require prompt action. The Institute functions in close co-operation with the professional technologists for smooth adaptation in commercial practice. Laboratory research findings are tried out in factories, using their equipment and personnel. Occasionally, the universities send their members to study the work carried out at the Institute and to use the Institute's resources. The Institute staff takes an active interest in international co-operation.

Research Management

The applied research programme of the Institute can be broadly classified into the following categories:

a) Survey, evaluation and beneficiation of raw materials;
b) Substitution of indigenous products for essential imported raw materials and articles;
c) Improvement in the quality of industrial products;
d) Development of processes for the manufacture of hitherto imported articles and new processes and materials;
e) Studies on mica, with special reference to industrial use of waste.

While pursuing its programme of applied research, the Institute does not neglect fundamental research, but purely academic problems are avoided.

The Institute's policy is to concentrate on certain selected investigations of direct national importance rather than spread out its limited resources on a wide field.

Research projects are mostly initiated by Institute staff but careful consideration is given to the suggestions of users—industry (public and private), public utilities, etc. The Government sometimes entrusts specific problems to the Institute. An instance in point is the special assignment given by the Indian Planning Commission to develop new processes for the production of optical glass, to make the country independent of imports of this vitally strategic material. The Institute succeeded in establishing detailed manufacturing operations, without the help of manufacturing firms; the entire equipment was designed and manufactured at the Institute.

Security, the recognition of good service, a proper working atmosphere, and a congenial social environment are vital to the stimulation of staff creativity; these receive close and careful attention from everyone concerned. An atmosphere of freedom to work prevails in the laboratories and as far as authorship of research publications and patents is concerned everyone taking part in the investigations, up to Junior Scientific Assistants, is included. Sometimes even assistants have independent authorship. The work of ancillary and junior staff is recognized in the distribution of royalties received on processes.

Financial Status

Funds are provided by the Ministry of Education to the Council of Scientific and Industrial Research which in turn distributes the grants to the Institute and to other national laboratories. Royalties and receipts from individuals or industrial groups for services rendered are credited directly to the Government of India.

Industrial Extension Service

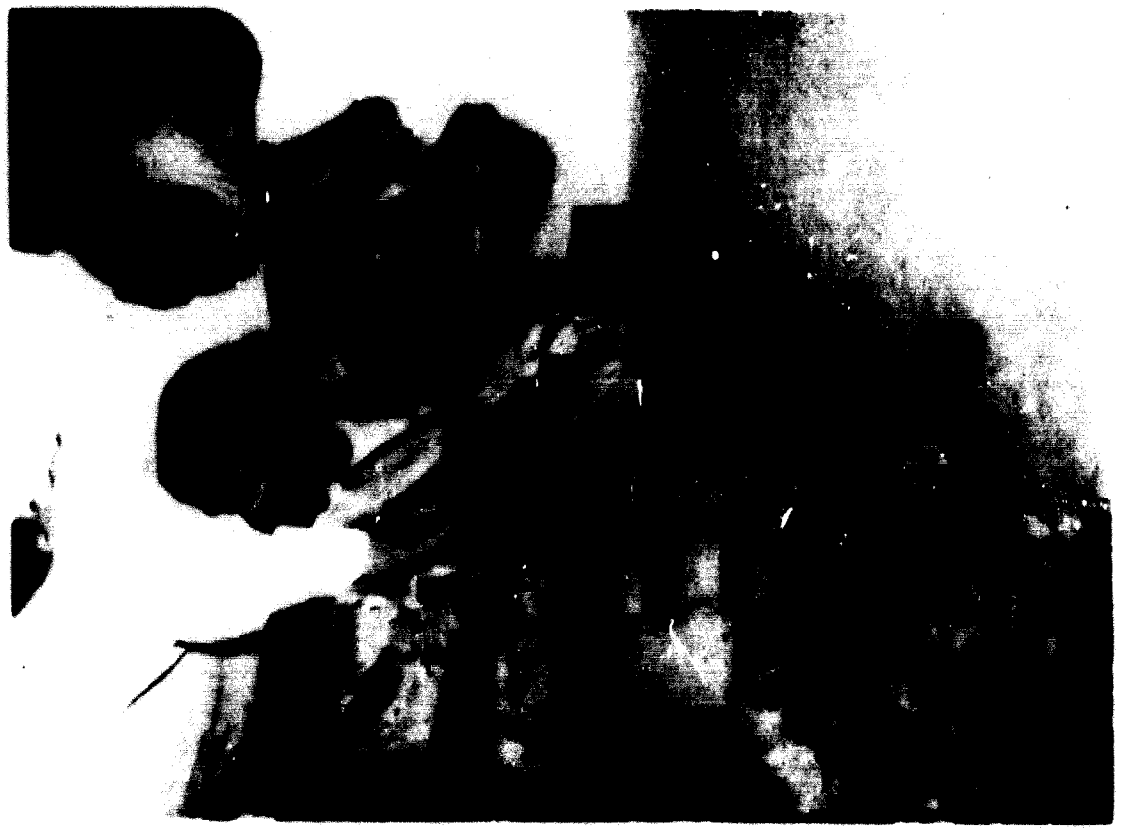
Usable results of research are made available to the industry either on payment of premia or royalties or releasing them free of charge for the benefit of the entire industry.

The Institute offers a counselling service which is readily available to the industry. Problems concerning the industry as a whole are investigated free of charge and the findings are disseminated through public discussions and publications. Special investigations are charged for. Discussions among the technical staff are kept confidential.

Field studies of raw materials are undertaken in order to determine their suitability for utilization in industry. The Institute has published a comprehensive survey of glass-making raw materials, with simple processes for beneficiation adoptable in works practice. Two monographs on "Indian Clays" describing the results of the examination of about 700 samples of clay have also been published. Survey, evaluation and beneficiation of indigenous resources of glass and ceramic raw materials, such as glass sands, quartz, felspar, clays, talcs, magnesites, chrome ores, etc., have established that these materials are available in abundance in the country and that they are suitable for use in the industry. In fact, it was found that Indian quartz is counted amongst the purest in the world.

On the spot studies are undertaken whenever the industry faces problems in the commercial application of processes developed by the Institute.

The Institute extends its facilities for technical training to personnel of industrial organizations, universities and other sponsoring bodies.



Testing of optical glass developed at the Central Glass and Ceramic Research Institute, Calcutta, India.

Experimental set-up for washing and beneficiation of clays at the Central Glass and Ceramic Research Institute, Calcutta, India.

A section of the pilot plant for the production of heat insulating brick from waste mica at the Central Glass and Ceramic Research Institute, Calcutta, India.

Thailand

Department of Science, Ministry of Industry, Bangkok

By Yos Bunnag, Director-General

Organization

The Department of Science is a multipurpose government institute, one of four departments under the Ministry of Industry. It is composed of six divisions:

The Office of the Secretary is responsible for all secretarial work, accounting, library services, statistics, and information.

The Division of Chemistry is responsible for chemical analyses for the benefit of various governmental departments, industry and the public.

The Division of Biological Science concentrates on biological research and analyses, including research work on Food Technology.

The Division of Physics and Engineering carries out research work pertaining to Physics and Engineering, including Industrial Processes and Formulation of Industrial Standardization and Testing. The Division also provides workshop services to all other divisions of the Department.

The Division of Analytical Chemistry Training provides training for students of analytical chemistry of the various governmental and industrial laboratories.

The Division of Research is concerned mainly with research and with a small amount of analytical work requiring special methods or instruments.

Research Management

Type of Research: The Department is interested mostly in applied research. However, background and fundamental researches are not neglected, especially when the answer to a particular question cannot be found in the literature.

Project Selection and Formulation: The Selection of a project is based on its objectives, in the following order of importance:

To solve the technical problems of local industries;

To find indigenous substitutes for imported raw materials;

To improve the quality of industrial products and to reduce production cost;

To use natural products as well as industrial and agricultural wastes.

Projects are formulated briefly initially, then gradually developed, depending on the results of preliminary studies.

Initiation of Research Projects: Research projects are initiated both internally and externally.

Allocation of Time and Resources: It varies. It is limited by budgetary allowance and dependent on the urgency and importance of the project in question.

Creativity of the Staff is stimulated by the granting of awards, such as: special raises in salary; monetary prizes; decorations, etc.; and royalties.

Financial Status

Financial Support comes mostly from the Government; occasionally from an individual industry, which will benefit by the finding.

The Budget is about US $500,000 annually, from which about US $400,000 covers operating costs. The remainder goes in the capital budget.

Cost Analysis of Institute's Operation: The Budget Bureau is interested in and has attempted to carry out cost analysis but has not been very successful so far.

Dissemination of technical information is one of the main functions of the Institute. A quarterly *Bulletin* brings the results of research to the notice of the industry and to other research workers; the *Bulletin* is exchanged with almost all the important journals on glass and ceramics. Besides the *Bulletin*, the Institute periodically publishes technical information circulars concerning the results of investigations not included in the *Bulletin*. Communications from noted investigators outside the Institute are also published. Articles in leading Indian newspapers and journals, radio-talks, occasional seminars and symposia, and lectures and discussions are organized by the Institute to keep the public and other interested parties informed on current activities and achievements in research. The Institute also takes part in industrial fairs and exhibitions.

Research Projects Handled

Over 30 projects are currently under investigation, among them: Indian magnesites, with particular reference to Almora deposits; pyrophyllite refractories; casting pit refractories; beneficiation and utilization of low grade kyanites; high alumina refractories; forsterite refractories; high temperature DTA and expansion characteristics of refractories raw materials; and utilization of low grade chrome ores.

Several processes developed by the Institute have been put to industrial production; among them are the following: heat insulating bricks from waste mica; foam glass; pink enamels; enamels for wire-wound resistors; hot face insulation refractories from kyanite; and optical glass.

Services Offered

Technical assistance to industry and other organizations is a regular feature of the Institute's programme. The number of such cases averages nearly 700 a year, covering a wide range.

With the introduction of mass production methods in the silicate industries, quality control on manufacturing operations has gained added importance. Since the classical methods of analysis of silicate materials is time consuming, the Institute has initiated polarographic and other

physico-chemical techniques for rapid estimation of different constituents in silicate materials. Methods have also been developed for simultaneous estimation of iron and titanium; polarographic determination of arsenic and selenium; and complexiometric estimation of aluminium, calcium and magnesium.

Industrial Extension Services

Application of Research Results No problem, as long as the project is intended for existing industries. Little success has been found however, when trying to use the results of research to establish a new industry.

Consulting Service is being given mostly free of charge

Establishment of Quality Controls has not been done to a great extent. But quality certification of locally made products is one of the main functions of the Department.

Field Studies are frequently made for various purposes such as trouble-shooting, and the improvements of processes and materials.

Training of Technical Personnel is a regular part of the programme of the Department. A formal three-year course in Practical Analytical Chemistry is provided for high-school graduates who wish to work as technicians in governmental and industrial laboratories. Individual and group training on special subjects and techniques are often given to industry's technical personnel and university graduate students.

Transmission of Technical Information is occasionally made through personal contacts by individual staff members; regularly by bulletins reporting on the work of the Department and sometimes by seminars, meetings and industrial exhibits.

Projects Being Handled

Research and Development

The utilization of agricultural and industrial waste;
Manufacturing agar from Thai sea-weed;
Making a palm sugar preservative from Cotylelobium;
The development of industrial formulas;
Study of the enzymatic hydrolysis of fish meal;
Study of organic acids in vinegar from various raw materials;
Development of concentrated fruit juices;

Raw Material and Product Studies

Pulp and paper raw materials;
The suitability of indigenous raw materials for ceramics;
Keeping the quality of coconut-palm sugar;
Keeping the quality of canned pickles.

Manufacturing Operation

Aluminium Sulphate;
Paper Mucilage.

Staff Training

Present Programme

See under Industrial Extension Services.

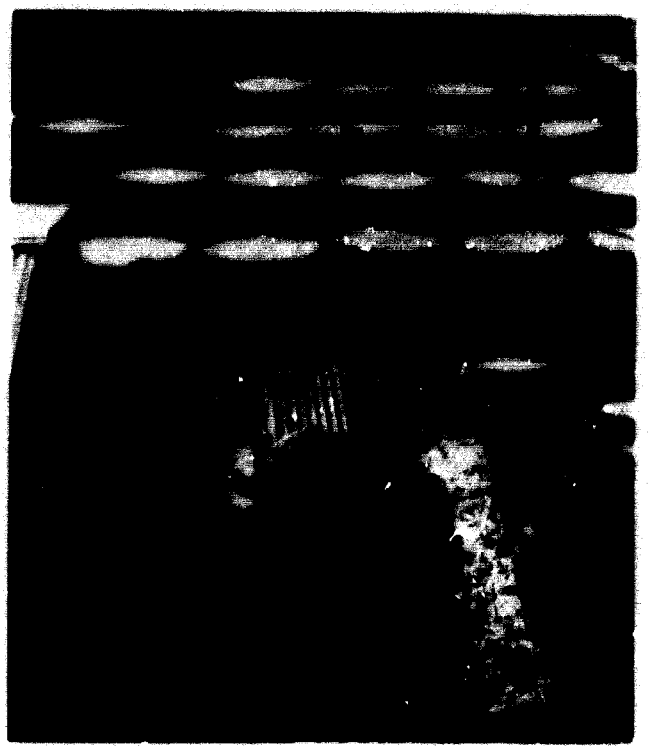
Needs from Industry are great and have been far from fulfilled.

Upgrading of Institute Personnel is done by sending them abroad to receive training. Selected personnel are allowed, with full pay, to work for advanced degrees both in the country and abroad.

The Services Offered are as Follows:

Chemical and Physical Analyses
Consulting services
Process development and improvement
Testing of raw materials and finished products
Standardization
Quality certification
Technical inquiry services
Training on specific topics
Trouble-shooting
Investigation on raw materials substitutes

Development of Sponsors for Research Projects is still in its early stages. Usually the Department makes itself known to the industry by personal contacts by the staff. Good service, with little or no charge, is a means the Department is now using to gain the confidence of the industry. It is believed that once the industry has been convinced of the usefulness of research work it will no longer hesitate to become a sponsor. So far the Department has not yet carried out a sponsored research project but it has been rewarded for a few completed projects.



Preparation of brine for fish maceration, an early step in setting up a protein and fish meal industry.

Directories

Institutes of Industrial Research and Technology in the Republic of China*

Government Sector

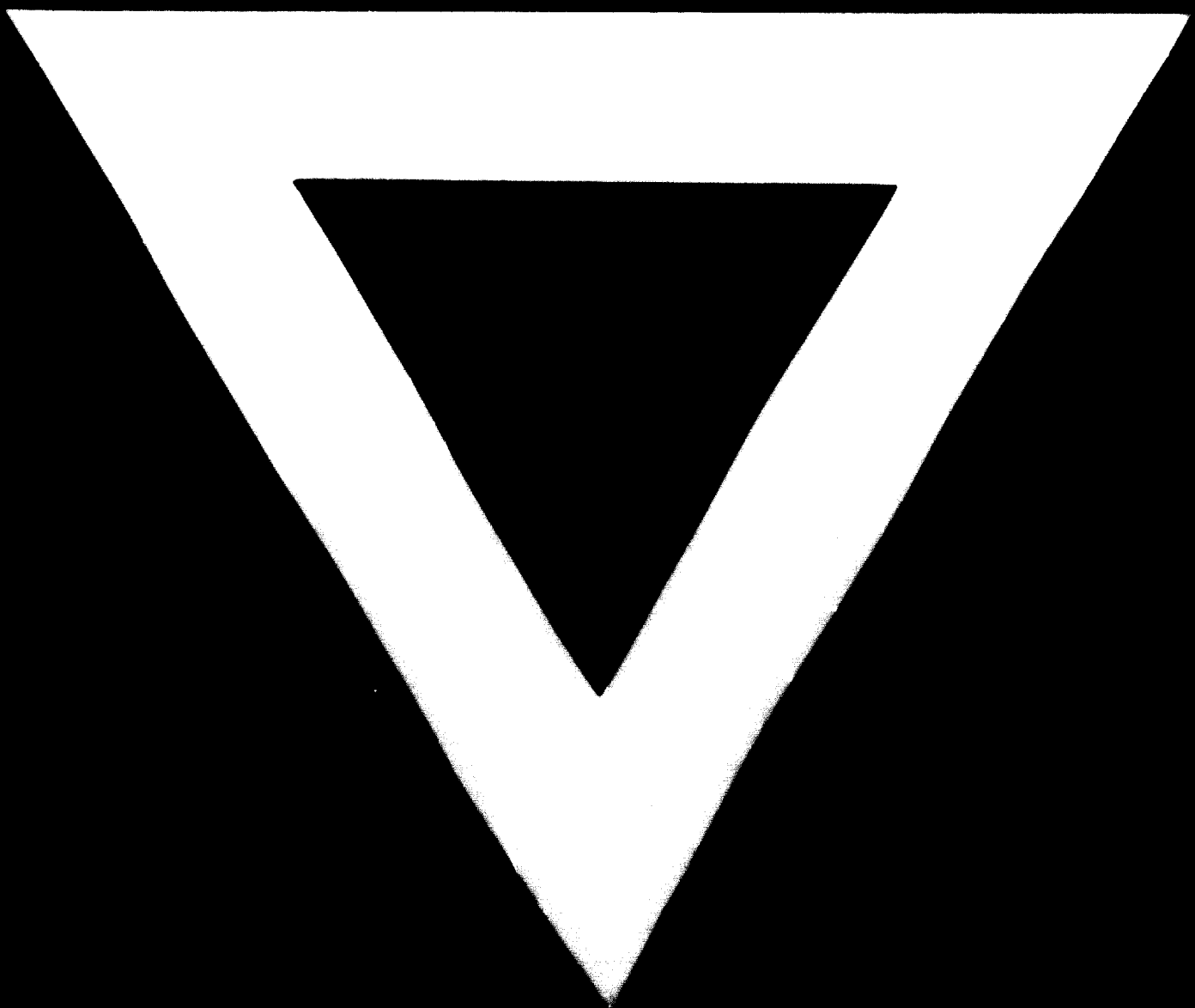
Name and address of research institute (1)	*Name and designation of head of the institute* (2)	*Source of funds* (3)	*Industries served* (4)	*Research programme, project and/or functions* (5)	*Publications on results, reports, etc.* (6)
Chinese Petroleum Corporation (CPC), Taipei, Taiwan	Mr. Jerome S. N. Hu, President	Govt. budget	Petroleum industry		
Geological Survey of Taiwan, Taipei, Taiwan	Mr. Ching-Chang Pi, Director	- do -	Mining	Geological research and mapping, mineral survey; ground water & engineering research.	Bulletin of the Geological Survey of Taiwan, maps and papers.
High Voltage Research Institute, Taiwan Power Co., Taipei, Taiwan	Mr. Yong Pao Chen, Director	- do -	Electric power industry	1. Applied research on electric power industry. 2. Study on high voltage phenomena. 3. Study of technical applications on electronic computers in electric power industry.	Technical Reports.
Institute of Chemistry, Academia Sinica, Nankang Taipei, Taiwan	Prof. N. S. Woo, Director	Govt. and grants from enterprises	Chemical industries	1. Microbiological chemistry, such as enzymes of mucor, nucleic acids of bacteria, classification of fungi. 2. Organic chemistry, such as functional groups of benzene. 3. Analytical chemistry, such as methods for determination of germanium, arsenic and transition elements, and radiation chemistry of metal complexes.	Bulletin of Institute of Chemistry.
Metal Industries Development Centre, Kaohsiung, Taiwan	Mr. S. C. Chi, Managing Director	United Nations Special Fund & Govt. Contribution	Metal industries	The Centre introduces various training courses; renders consultation services as well as applied research; and with the facilities of its workshop it develops prototype products and manufactures tools, jigs and fixtures.	Metal Industries Bulletin (bi-monthly) 1. Reports on the steel industry of Taiwan. 2. Reports on the iron foundries of Taiwan.
National Bureau of Standards (weights and measurements), Ministry of Economic Affairs, Tainan, Taiwan	Mr. S. T. Hsiang, Director	Govt. budget	Standard weights and measurements		

* Compiled by the Industries Division, Economic Commission for Asia and the Far East.

Name and address of research institute (1)	Name and designation of Head of the institute (2)	Source of funds (3)	Industries served (4)	Research programmes planned and executed (5)	Publications, reports etc. (6)
Refinery Laboratory, Kaohsiung Refinery, CPC, Kaohsiung, Taiwan	Mr. S. F. Tung, Vice-President General Manager	- do -	Petroleum refining & petroleum-chemical industries	The Laboratory is devoting part of its man-power and facilities to the applied research in relation to petroleum refining and treating process, utilization of refinery hydrocarbons as raw materials for manufacture of petrochemicals.	
Research Division, Chia Yee Solvent Works, CPC, Chiayi, Taiwan	Mr. Pen-Chich Ko, Manager	- do -	Fermentation and petrochemical industries	1. Study on petroleum fermentation. 2. Partial oxidation of hydrocarbons. 3. Study on the preparation of petro-chemical intermediates. 4. Polymerization of petroleum products.	Technical Reports & Patent Rights.
Research Laboratory, Taiwan Tobacco & Wine Monopoly Bureau, Taipei, Taiwan	Mr. N. S. Wei, Director	- do -	Tobacco & Wine	Applied research on tobacco processing, wine making and raw materials concerned.	
Taiwan Agricultural Research Institute, Taipei, Taiwan	Dr. S. S. Hsu, Director	- do -	Manufacturing of agricultural machines and processing of agricultural products.	1. Improvement and studies on power tiller used for paddy fields. 2. Improvement and studies on processing machines of fibre crops in Taiwan Fibre Crops Branch Experiment Station. 3. Experiments on processing and manufacturing of fruits and vegetables in Fengshan Tropical Horticultural Branch Experiment Station. 4. Experiment on tea manufacturing in Yuchin Tea Branch Experiment Station and Pinchin Tea Branch Experiment Station, etc.	1. Annual Report. 2. Journal of Taiwan Agricultural Research.
Taiwan Alkali Co., Kaohsiung, Taiwan	Mr. C. Chang, President	- do -	Alkali & chlorine products	Utilization of chlorine to make insecticides, herbicides, chlorinated wax, chlorinated rubber, solvent of chlorinated organic compounds.	

Name and address of research institute (1)	Name and designation of head of the institute (2)	Source of funds (3)	Industries served (4)	Research programme, project and/or functions (5)	Publications on results, reports etc. (6)
Taiwan Aluminum Corp., Kaohsiung, Taiwan	Dr. C. H. Sun, President	- do -	Aluminum industry	Applied research on aluminum metallurgy, aluminum fabricating and aluminum surface finishing technique.	Technical Reports.
Taiwan Fisheries Research Institute, Keelung, Taiwan	Dr. H. T. Teng, Director	- do -	Fish preservation, marine food and fodder processing industries	Experiments and study on the preservation and utilization of fish and marine products.	Bulletin of Taiwan Fisheries Research Institute
Taiwan Forestry Research Institute Botanical Garden, Taipei, Taiwan	Mr. Lin Wei-Fang, Director	- do -	Pulp and paper, plastics, wood, and plywood	Experiments on wood lamination, veneer and plywood, modified wood, wood preservation pulp and paper.	Technical papers.
Taiwan Petroleum Exploration Div., CPC, Miaoli, Taiwan	Mr. T. M. Wu, Vice-President and Manager	- do -	Petroleum exploration and production	1. Geological and geophysical studies on petroleum exploration. 2. Drilling, production and reservoir engineering studies.	1. Petroleum Geology of Taiwan. 2. Drilling and Production Engineering.
Taiwan Provincial Bureau of Commodity Inspection and Quarantine, Taipei, Taiwan	Mr. Cheng Fu-Juh, Director	- do -	All industries	The Bureau with ten laboratories (Food Chemistry, Inorganic Analytical Chemistry, Organic Analytical Chemistry, Fibre, Drug, Mechanical, Electrical, Materials Testing, Pathology & Entomology and Micro-Biological) in Taipei and six stations throughout Taiwan has the responsibility of: 1. Inspection of import and export commodities and the activities of plants and animals quarantine; 2. Testing of industrial materials and products.	Journal of "Inspection", monthly.
Taiwan Provincial Sea Products Research Institute, Taiwan		- do -	Canning & food processing industries	Experiments and study on the processing and utilization of sea products; handling of the finished goods, designing fish driers; processing of fish sausages, etc.	
Taiwan Sugar Experimental Station, (TSC), Taiwan	Dr. K. C. Liu, Director	- do -	Sugar mills sugar-cane farms, etc.	Research programmes of projects for process of sugar manufacturing, molasses utilization, improvement of sugar-cane culture, studies on soils and fertilizers, control of diseases and pests, etc.	Report of Taiwan Sugar Experiment Station Nos. 1 to 38, and other publications.

Name and address of research institute (1)	*Name and designation of head of the institute (2)*	*Source of funds (3)*	*Industries served (4)*	*Research programmes, projects and activities (5)*	*Publications, research reports, etc. (6)*
Union Industrial Research Institute, Ministry of Economic Affairs, Hsinchu, Taiwan	Dr. Hong-Chien Yuan, Director	- do -	All industries	The Institute operates ten research laboratories (Organic Chemistry, Inorganic Chemistry, Agricultural Chemistry, Radioisotope, Petro-Chemistry, Metallurgy, Ceramics, Engineering Materials, Industrial Instrument, Chemical Processing Development) for studying industrial problems especially manufacturing and utilization of by-products.	Technical Reports
Private Sector					
China Fermentation Industrial Co., Ltd., Taipei, Taiwan	Mr. H. L. Tan, Chairman of the Board of Directors	Private	Fermentation and food industries	Glutamic acid fermentation and monosodium glutamate manufacturing	
China Glass Industrial Research Institute, Chatung, Hsinchu, Taiwan	Mr. S. W. Chen, Chairman of the Board of Directors	- do -	Glass industry	The Institute conducts related industrial consultation, development, research, general laboratory service, and technical information and library service.	
Institute of Electronic Research, Chiaotung University, Hsinchu, Taiwan	Dr. H. M. Li	- do -	Research on electronic development		
Pioneer Chemical Corporation	Mr. P. S. Lim, Chairman of the Board of Directors	- do -	Chemical industry	Coke, coal-tar, naphthalene, anthracene, creosote oil, industrial gas, benzine, phenol ammonium, sulphate.	
Research Division, Wei-Chuan Foods Corporation, San-Chung, Taipei, Taiwan	Mr. J. C. Yuh, Head, Mr. C. C. Tung, Deputy Head	- do -	Fermentation and food industries	The Division conducts applied & fundamental research in the manufacturing of monosodium glutamate, soy sauce, dairy products, aspartic acid, baby food and other food items.	
Research Laboratory of Sintong Chemical Industrial Co., Ltd., Taoyuan, Taiwan	Mr. Wu Chin-Chang, Acting Head of Research Laboratory	- do -	Pharmaceuticals	1. Synthesis of vitamin C. 2. Synthesis of Aluminum Salt of Aspirin. 3. Synthesis of Neophylline-M.	Seminar Report.
Taiwan Cement Corp., Taipei, Taiwan	Mr. C. F. Koo, President	- do -	Cement industry	Cement and ceramic manufacturing	
Tsin-Tsin Weisu Co., Taipei, Taiwan	Dr. C. T. Chen, Director	- do -	Food industry	1. Research on fermentation & recovery techniques in monosodium glutamate manufacturing process. 2. Research on bio-chemistry for application in other food industry.	Japanese Journal of Fermentation Technology.



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