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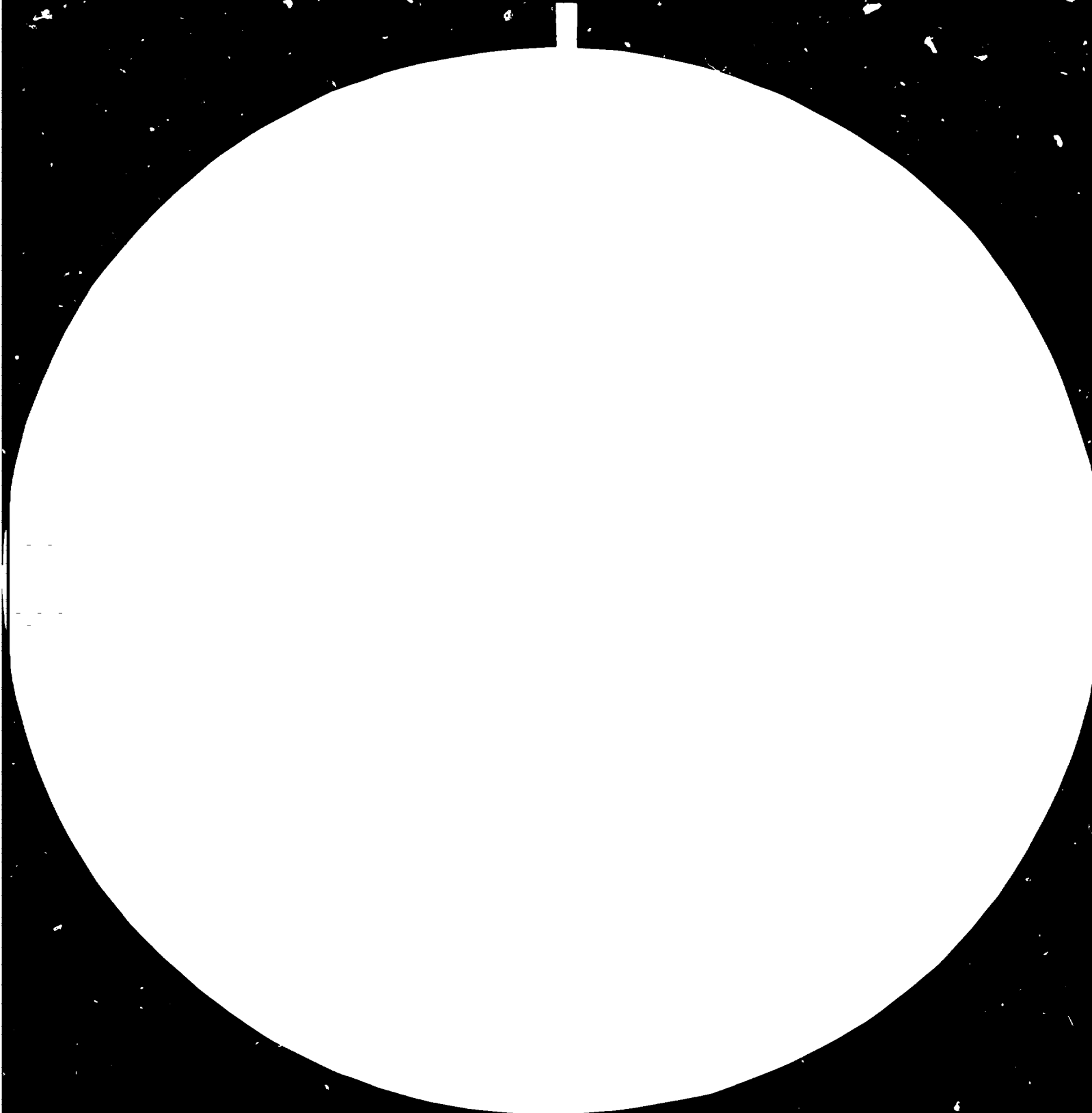
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Philippines.

INDUSTRIAL CHEMICALS FROM INDIGENOUS CARBOHYDRATE
RAW MATERIALS (SUCCO-BASED CHEMICALS).

ST/PHI/31/001

REPORT OF *
VISIT TO MANILA, THE PHILIPPINES
28 September - 2 October 1961

by

C.T. CALAM, Consultant, Technical Committee Member

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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The project is being funded by IFSTD, with UNIDO as the executive body, and with the National Scientific Development Board, Philippines Republic, supervising local activities. The object of the visit was to take part in the Technical Committee to define the work programmes of the participating scientists. Visits were made to the NSDB headquarters at Bicutá and to the University of the Philippines at Los Baños, to meet the workers involved. The other UN personnel involved were Mr. M. Maung (UNIDO, Vienna) and Mr. Cain (IFSTD, New York).

The object of the programme is to attempt to make use of sugar wastes and natural sources of sugar (e.g. Nipa sap) as a source of useful chemicals. These have been discussed in UNIDO documents and it is not necessary to deal with them in detail. It is hoped that, in this way, waste products can be converted into useful substances which can be used in the Philippines either to substitute for imported materials or to supply cattle foods etc. which are not available at present.

The various project headings, and the workers involved, may be summarized:-

<u>1. SCP Production</u>	<u>2. Dextran & Fructose</u>	<u>3. Organic substances</u>	<u>4. Organic acids</u>
a. Algae (Zafaralla, UP)	Borlaza (NIST)	a. Butanol-acetone (Padolina, UP)	(Citric acid)
b. Yeast (Del Rosario, UP)		b. Glycerol (Samaniego, UP)	(Palo, NIST)
c. Bacteria (Orillo, UP)		c. Ethanol (Del Rosario, UP)	
d. Fungi (Baril' & Fernandez, UP)		d. Acetic acid (Ramirez, UP)	

UP University of the Philippines at Los Baños.

NIST National Institute of Science and Technology, Bicutá.

It should be noted that the projects at the University are mainly supported by the BIOTECH programme of the Philippines government, though the present project gives valuable help, by providing apparatus and specialist consultations to be arranged through UNIDO.

It is surprising that lactic acid is not included, as it is extensively used in the food industry.

Some of the work has been in progress for several years (production of algae and yeast) and considerable progress has been made. In most other cases the work has hardly begun. Construction of a pilot-plant, for the exploitation of the results, is about to be begun at the University.

I. FIRST IMPRESSIONS

First impressions were mixed. The workers seem intelligent and capable of good scientific work, but it was difficult to form any impression as to the value of work done or how the various programmes were likely to work out.

No experimental data were presented, or only some vague figures. In general, literature studies and background information about the substance being sought were very weak.

Working conditions did not seem very good, laboratories were cramped and rather untidy, and temperature control seemed inadequate. In addition, most of the workers had other duties and it was not clear how much time could be given to the new research programmes.

Another serious question is that not much consideration has been given to the utility of the products being investigated. Some, e.g. SCP or alcohol, have been known for a long time and much discussed in the literature. It is therefore possible to predict the likely outcome of the programme and consider how such substances could be used in the Philippines economy. In particular, the means of application needs consideration. Thus the addition of yeast to cattle food is possible, provided the yeast is dried. For this, however, a cattle-food manufacturing industry is required. It is not known if this exists in the Philippines. Its absence in some countries, e.g. USSR, has been a bar to progress. Citric acid could probably be used quite readily, but its manufacture requires a high level of technology, and it is not known whether sufficiently skilled workers are available. The absence of such workers, and foremen, has led to great difficulties elsewhere.

Thus, this initial consideration of the programme raises a number of questions which need early attention if a successful outcome is to be achieved, and early consideration of them will help the workers in our programme to be successful.

It was felt that the approach of the workers was mainly academic, i.e. they were interested in given factors and their effect on product formation as an end in itself. In applied work it is necessary to go beyond this and consider production methods in terms of the likely use of the product and to know the minimum yields required for success, as well as appreciating how the product can be extracted and converted for practical use. This attitude will have to be built up in future.

Another feature was the lack of obvious leadership and the development of cooperative working. This lack may have been more apparent than real, but leadership is seen as an aid to the development of the workers and the encouragement of them to grow scientifically.

II. ON THE OTHER HAND

It should be pointed out that the programmes are at an early stage, and that some of them are new to the workers concerned. With care, the project should produce a cadre of experienced workers, capable of developing their earlier results into something of permanent use. This is essentially a process of self education. The fact that things are rather vague at present is no bar to obtaining clear results in due course. With help, they should be able to develop an applied outlook and discover the best way to exploit their results.

Probably, the development of an experienced team must be regarded as the main object of the programme. We cannot tell at present who the future leaders will be.

The supply of apparatus is important in building up conditions for the future and improving the standard of work. Contacts with consultants and visits abroad should also be of great value. It is not quite clear at present what the best arrangements for this will be.

The programmes and work plans have had to be put together very quickly. It is probable that the arrangements made are as good as can be expected, under the circumstances.

III. COMMENTS ON PRODUCTS

Certain comments seem desirable, to indicate the sort of enquiries that should be made to back up the work done and to avoid later disillusionment, also to help to develop the programmes.

SCP. SCP has obvious practical importance, but the question must be asked; suppose a quantity of SCP has been made, how should it be tested and what facilities would be needed? How much material would be needed and are there facilities in the Philippines to carry out such tests? Is there any legislation requiring consideration? Points like these need attention if the programme is to be worthwhile.

Dextran and fructose. We need to know how these products could be exploited, and to identify firms that might be interested in their use. In this way the best types of products could be sought.

Organic substances and organic acids. Butanol and acetone could probably be found uses, although the fixed ratio between butanol and acetone is a problem economically (you get too much butanol, which is now less required than in the great days of production by fermentation). To make commercial sense a large plant would be needed. Present plants in Egypt and South Africa both have a strategic significance. Are there firms in the Philippines likely to take up a process of this kind? Ought a mutation programme be started to find a strain with a more favourable solvent ratio?

The utility of glycerol is uncertain (is there an explosives industry in the Philippines?). The usual source is from soap manufacture (also based on natural products) or from synthesis. Ethanol is of interest; is it already made in the Philippines, and would contact with the other UNDP project be helpful?

Acetic acid is usually made chemically, but large amounts are made by fermentation in vinegar manufacture. Although the old trickling bed process is still used, the modern trend is the use of a highly aerated fermenter, specially designed and bought off the shelf. Examples are Frings "Acetator" or Yeoman Bros "Cavitator", described in text books. The Manila telephone directory shows two vinegar manufacturers in Manila, and Dr. Ramirez ought to be put in touch with these right away to see what they do. It may be that some acetic acid is made already. Some guidance may be available. Vinegar is sometimes made by diluting acetic acid and colouring it with caramel, but there is usually a legal requirement that it is made by fermentation.

The telephone directory also shows two yeast manufacturers in Manila, Fleishmann (obviously part of the American firm) and San Miguel Co. There must also be also cheese manufactures and distillers of spirits, and probably other fermentation-based factories. This suggests that there must be a number of people in the Philippines with a degree of fermentation expertise, and, additionally, some training facilities. These factories might be able to help train workers for the pilot plant. This subject will be further discussed below. Incidentally, brewers often sell dried yeast, and this might give a lead on SCP.

IV. SOME IMMEDIATE REQUIREMENTS

1) It is essential that the programmes produce useful results, and that the workers feel that they have achieved a success, even if, later, their work has to be abandoned. Only if they feel their efforts are worthwhile will they be able to develop to a higher level of work later on.

To do this, it is important for them to make a good start. They may need help over the literature survey, supply of cultures etc. If possible, some way of helping them over this should be devised, even before consultants are able to arrive. Time wasting re-discovery of old information must be avoided.

2) Money should be set aside for future purchases. When lists of requirements are compiled, important bits are often left out, and servicing may be needed. Unless some money is available for these things, it may not be possible to make the best use of the equipment.

3) Targets should be further clarified, if possible, in order that the workers may achieve success. If they are aiming too low, they may well feel disappointed in the end. Perhaps this is a matter for the review.

4) A start should be made, as soon as possible, to see how the information gained can be applied practically, so that possible applications can be identified and used. This may lead to advantageous changes in the research programmes, so as to meet practical requirements.

5) It would be valuable if progress reports could a summary page on the following lines. Standardisation, in this way would make understanding easier:-

Name

Assistants

Title of project

Field of investigation (3 lines)

Cultures used: Numbers tested

Media and test conditions

Summary of results (10 lines)

Description of Typical experiment, with results and time required (10 lines)

Difficulties encountered or needing solution

Conclusions (2 lines)

Future work (3 lines)

Comments

A fuller account could then be given in the worker's own words. The proposal is not intended to restrict the worker but to make it easier for advisers and to bring out difficulties they have to solve.

6) Attention needs to be given to safety aspects of SCP utilisation. No thought seems to have been given to this. The use of yeast as a food is well established, but algae and bacteria could present problems. WHO may have information, and there may be local regulations. Elsewhere, SCP projects have come to grief over this matter.

V. PHILIPPINE DIMENSION

Discussions by a UNIDO expert committee, in Vienna in 1969, brought out that with an applied process, in developing countries, it was usually the application of the result that was the most important, rather than solution of purely technical problems. There is little value in having a process unless a use for it can be found.

In the present case, a programme has been started to produce substances from sugar, to reduce requirements for imports to the Philippines. Some figures of imports have been given. The correctness of these is not known, but they do not suggest a large market. Therefore a first necessity is to find profitable outlets for products, and to establish processes to make them in a suitable form. This requires an understanding of the agricultural and industrial markets in the Philippines, so that suitable products can be chosen.

While the work plans specify that this shall be done by 1983, a much earlier survey is very desirable. It will be a great disappointment to these excellent young workers if the economic and practical aspect of their work is only brought out at the end of their work and shows that their products are useless. It would be better to discover this by mid-1982 when a recasting of the programme is possible, either to undertake new projects or to concentrate on the most profitable ones.

Another matter stressed at the Vienna meeting was the importance of trained workers in fermentation plants, at the process man - foreman level. It is known that a number of plants have been erected in developing countries which have failed for lack of suitable staff, able to debug the plant and operate it successfully. If pilot work is envisaged in 1983 and production work fairly soon after, something must be done to overcome this problem, as well as to familiarise the researchers with the problems that exist. It is felt that in some ways the approach is too academic and uninformed. An example of this is acetic acid production, where it is normal to use a specialised type of fermenter, and anyone entering the field should be aware of this. The worker concerned wished to see a plant in Egypt. That is reasonable, but there are vinegar plants in Manila and other nearer places, where a rapid consultation should be possible.

It is worthwhile considering the position in Manila in this respect. During the visit, it appeared that there was no fermentation work going on in Manila. Later reflection suggested that this was unlikely, and a quick reference, by telephone, to the Manila telephone directory in the Manchester Central Library, showed the presence there of two yeast plants and two vinegar manufacturers. There are almost certainly other fermentation processes going on in the production of cheese and beverages, including spirits, possibly also vaccines. It is known that another alcohol project is in being. If a few hours could be spent on enquiries, and if UNDP could use its influence, the project teams could probably get some advice and help on the spot and be able to plan more realistically.

Returning to the matter of acetic acid manufacture, Vogelbusch in Vienna are leading makers of fermentation equipment, and probably know all about them.

These suggestions do not remove the desirability of foreign visits and the use of consultants, but they could help the Philippino workers to be more alert to what is important and to enable them to ask the right questions. Some concern is felt about the future of their efforts. If the pilot plant is ready by 1983 it may not be in working order for some time, due to the need for training, and then there will be competition to get the use of it. They need all the help they can get.

Another point brought out at the Vienna meeting was that fermentation products are not necessarily cheaper than synthetic ones. The successful application of a fermentation process really depends on local conditions which vitally affect the situation (e.g. the Nipa sap-alcohol project in the islands), or on strategic considerations as with butanol-acetone in Egypt and South Africa. Other special cases is alcohol production from molasses in remote places (as in up-country Nigeria) where transshipment

of molasses is not worthwhile.

It has also been stressed that the reasons for adopting a certain fermentation process differ from place to place. The reasons for choosing ones in the Philippines will depend on local considerations which will have to be worked out on the spot, probably different from those in e.g. Brazil. It is therefore important that the local workers are able to think about their products in a Philippine context and find links between product and possible uses which are also realistic. In this the help of local people who know something of the fermentation industry could be helpful.

Two other points are: (1) it is essential in research to achieve a certain rate of progress, and workers in Manila should be encouraged to move forward at a rate that suits them, without waiting for foreign contacts to develop. Local contacts could be a help in this: (2) if the project is to succeed it must do so as a Philippine project, foreign contacts and advice being a help rather than the main driving force. Thus the development of local contacts, of all kinds, will be good, and some UNIDO or UNDP enquiries in this area should be valuable.

Finally, another possible Philippine problem may be mentioned. The requests made have been for apparatus, while there is probably also a shortage of books and journals. A journal like *Biotechnology Letters* costs £58 per year and is full of interesting articles (plus £3 airmail supplement). Vouchers for the UK Boston Spa Library might be useful. There are also standard textbooks like H.J. Pepler & D. Perlman's *Microbial technology*, vols 1 and 2 (*Microbial Processes: Fermentation Technology* (Academic Press 1979)), also A.H. Rose's *Economic Microbiology*, vol 1 Alcoholic beverages, vol 2 Primary products of metabolism, vol 3 Secondary metabolism, also Academic Press 1979, would be useful. The first 5 volumes of *Methods in Microbiology*, Academic Press 1969 onwards, are also useful.

VI. CONCLUSIONS

The proposals made for the work plans are probably the best that could be devised under the circumstances. However they do appear academic rather than applied in nature and possess a feeling of unreality.

The work is at such an early stage that we cannot judge likely progress: there is no need to be pessimistic. The projects are based on well known microbiological processes which are easy to get going, but need a lot of work to get them to give reliable, high yields. For this skilled development is needed. There are also great difficulties to be overcome when translating them into large-scale practice. In developing countries, for example, production of butanol-acetone was very difficult, and cases where citric acid production has failed altogether, are known. This has been due to lack of experience and of trained technicians.

The main objective must be to develop a few promising lines, also a team of scientists who can cope with the development problems likely to arise. Some of the projects may be difficult to start, and assistance should be provided for this.

The scheme is lacking in a Philippine dimension. This is apparent in several ways:-

- (a) It is essential that products under study are linked with an identifiable application (e.g. SCP - cattle food) and the requirements to forge the link understood and overcome. This can only be done in terms of Philippine conditions. It is essential that enquiries and discussions be started at once as to quantities needed, toxicity tests, organisations likely to be involved, how it would be used and other details, so that some sort of preliminary information is available by mid 1982. The viability of the idea, or what is necessary to make it

viable, can then be estimated. It is too late to start by then, but if a beginning is made, details can be filled in later.

(b) It is now known that there is some fermentation activity, commercially, in Manila, such as baker's yeast and vinegar production, as well as brewing and distilling. The last two may provide dried yeast. This situation should be investigated more fully, as it could (1) provide help and advice to the team, (2) provide training for technicians at plant level, and (3) give ideas about the practicability of the chosen projects. To bring a product into actual production is very hard work, and it demands special attitudes. Industrial contacts could help with this. It may be that there is a scientific society in Manila (chemical?) that could provide contacts.

(c) It is considered that the driving force for success will have to arise within the Philippines, and in relation to Philippines conditions, although foreign visits and visits by consultants will be a major help to the programme. It is essential to exploit local resources to the full, and there must be a good many in Manila.

The impression was received that there is not much local technical leadership. This could mean the workers are not getting the help they deserve.

The mid 1982 meeting should be used not only to review results, but also to consider the future. The presence of experts and consultants should be used to provide teaching and guidance to the group by lectures and seminars, as well as by individual discussions.

VII. RECOMMENDATIONS

1. The work plans laid down should be proceeded with.
2. UNIDO, or UNDP Manila, should investigate the local fermentation industry. Contacts should be made with a view to helping the project. Information from other UNDP projects should be brought in.
3. Even at this early stage, outlets for products should be sought, and the requirements for successful use established. Any toxicological requirements for SCP should be investigated.
4. The 1982 Summer visits of experts should be used to review the future and give general help by seminars and lectures as well as discussions.
5. A Philippine-centred approach must be generated. Local leadership and enquiry should be encouraged and improved.
6. A standard format to summarise work reports is proposed.
7. Some of the money should be held for "second thoughts", and some books and journals should be provided.



