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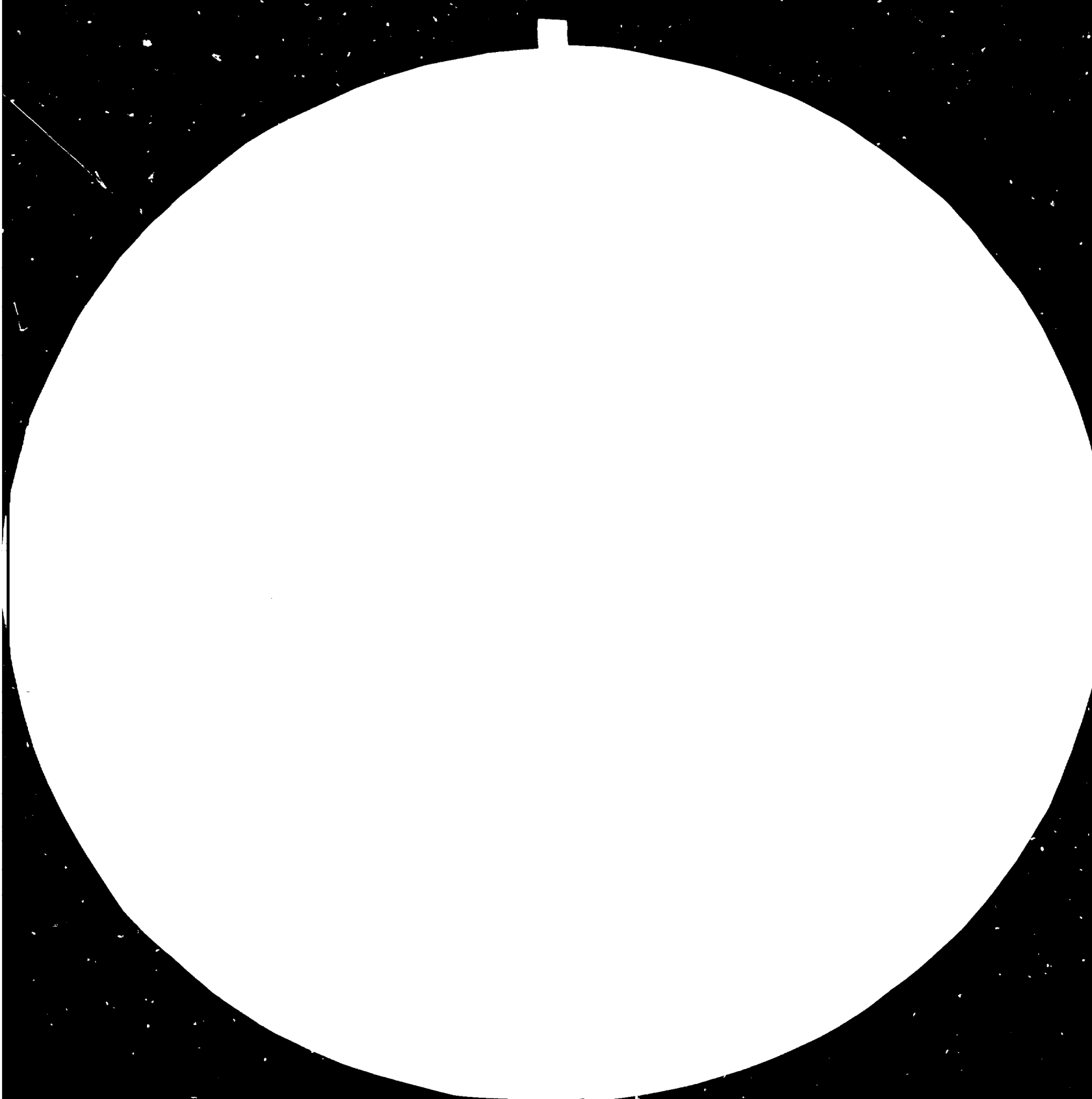

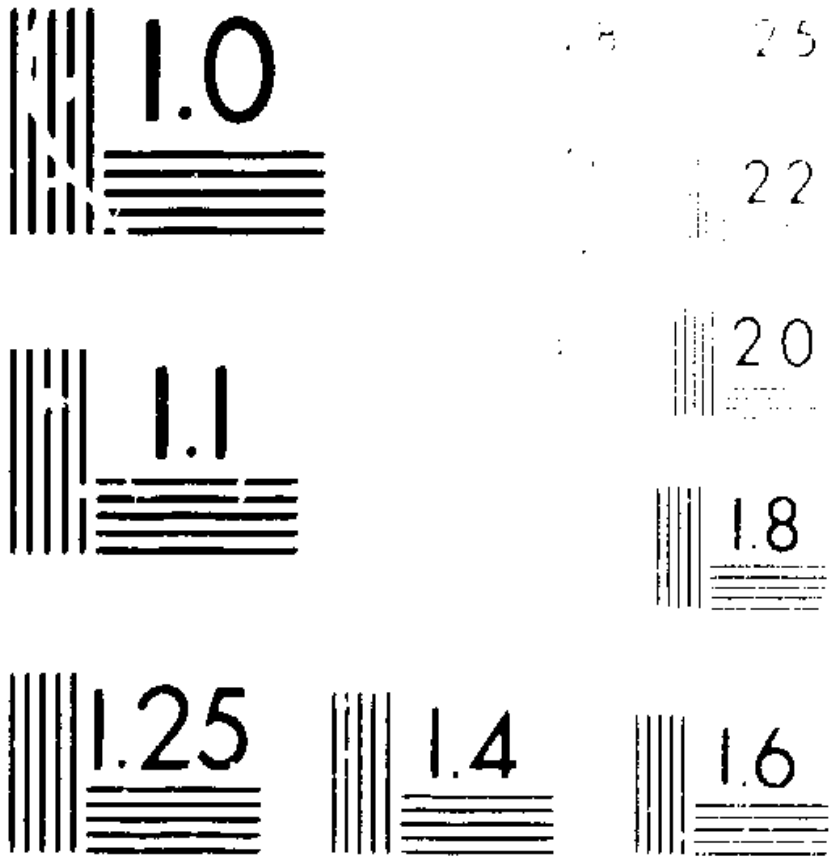
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PESTICIDE RESEARCH AND DEVELOPMENT CENTRE

SHENYANG

US/CPR/80/145

PEOPLE'S REPUBLIC OF CHINA

China.

Mission to the
Shenyang Institute of Chemical Industry
Pesticide Division
31 August - 16 September 1983

Final Report*

Prepared for the Government of People's Republic of China
by the United Nations Industrial Development Organization

Based on the work of K. Holly and D.J. de B. Lyon
Consultants on Pesticide

*This report has been reproduced without formal editing

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C O N T E N T S

1. Background

In July 1979 a UNIDO Mission visited China and subsequently recommended that assistance should be given to the pesticide industry. The Ministry of Chemical Industry (MCI) requested that this assistance should be directed at the Shenyang Research Institute of Chemical Industry, the Pesticides Division of which was to be designated the national centre for pesticides research and development. Other Divisions of the Institute covered dyestuffs and light-sensitive film. A second UNIDO Mission in July 1980 comprising UNIDO staff member K. Szabo, and UNIDO Consultants A.J. Davidson, A.B. Hadaway, and G.B. Pickering, recommended that priority should be given to strengthening the Toxicology Laboratory of the Pesticides Division, partly in anticipation of new legislation which would require full toxicological data on locally manufactured pesticides. Toxicology would be strengthened by the provision of new equipment, overseas training fellowships for local staff, and visits by consultants from industrialised countries to advise and train staff locally.

Funding was available from two sources, namely UNDP and UNIDF (Special Purpose contribution of the United Kingdom). For this reason two linked projects were initiated in 1980-81, both aimed primarily at modernising and strengthening the toxicology laboratory although other laboratories of the Pesticide Division were also to receive some assistance in training and equipment. One project, DP/CPR/80/008 was funded by UNDP (US $164,550) and the other US/CPR/80/143 was funded by the U.K. Government (US $717,700) with UNIDO as the executing agency for both projects.

In addition to this external funding the Chinese Government agreed to provide counterpart funding, mainly for staff and for a new toxicology laboratory and ancilliary services to be constructed on a green-field site outside Shenyang.

The projects were scheduled to be completed by December 1983 but a study tour of pesticide research institutions in Japan, Germany and U.K. by a senior staff of the Institute in 1981 resulted in major modifications being made to the design of the new laboratory (which necessitated the Chinese Government increasing the construction budget by a considerable amount) which is not now expected to be completed until June 1984. However,

the majority of the externally funded inputs will have been provided by the end of 1983.

2. Composition and objectives of the Mission

According to their job descriptions, the main duties of the two consultants were as follows:

For Mr. Lyon:

a) suggest a rationalized insecticides and acaricides programme;

b) assist in, and give advice on, the training of personnel in the insecticides laboratory;

c) recommend which type of equipment for biological tests and organic synthesis should be used in insecticides and acaricides development;

d) suggest ways and means of screening new insecticides and acaricides.

The job description for Mr. Holly substituted "Herbicides and plant growth regulators" for "insecticides and acaricides" in (a) and (c) above, and "herbicides" in (b) and (d).

The consultants' assignments were for two weeks in China, one week at home in the U.K. and one week at UNIDO, Vienna.

However, since the consultants' visit to China took place at the same time as a joint UNIDO/U.K. Government evaluation mission on the project US/CPR/80/145, they were requested to assist the evaluation mission comprising Mr. D. Whitecross, Principal, Overseas Development Administration (ODA) of the U.K. Government, and Mr. H. May, Deputy Director, Division of Industrial Operations, UNIDO.

In broad terms the objectives of the evaluation mission were to review the implementation of US/CPR/80/145 and the related DP/CPR/80/008 (which together comprise Phase I) and to consider proposals by the Chinese authorities for Phase II of the projects, to commence in 1984.

3. Achievement of Objectives and Itinerary

Thirteen working days were spent in China, of which only seven were spent at Shenyang, the remainder were in Beijing. Of the days at Shenyang one was spent on a visit to an underground lake near Benxi, a trip which incidentally gave a useful opportunity to see something of the agricultural features of Liaoning Province, half a day was devoted to a very useful visit to the Shenyang Agricultural College to see staff and facilities in the crop protection department and one full day was spent lecturing to staff of the Shenyang Research Institute (in English, with a translator). The time in the remaining four and a half days was divided about equally between gathering information and interviewing staff for the Phase I review and discussing plans for Phase II and assisting Chinese colleagues to prepare the initial draft project document (Itinerary: Annex I).

Since returning to the U.K. much time has been devoted to identifying locations for attachments under Phase II and to obtaining information on equipment requirements. Therefore, although the Consultants had a dual role, firstly to work with the ODA and UNIDO mission members in connection with Phase I and II of the projects, and secondly to advise the Chinese on detailed aspects of their insecticide, acaricide and herbicide programmes, in the event the greater part of the input had to be devoted to the Phase I review and preparations for Phase II. There was insufficient time while the Consultants were in Shenyang to establish the details of the objectives and content of the insecticide, acaricide and herbicide programmes which would have been necessary before any real contribution could be made to their development. A few general observations in this connection are made below, but it is hoped that the contribution by the Consultants to the design and implementation of Phase II will go some way to compensate for this inability to fulfill all the immediate objectives of the consultancy.

4. The Shenyang Research Institute of Chemical Industry

Shenyang Research Institute of Chemical Industry is already well founded, having started from small beginnings in 1949, established as a major institute in 1958 and now in 1983 employs c. 1000 personnel of which c. 350 are in the Pesticide Division. The seven departments into which the latter is divided cover chemical synthesis aimed at production of new insecticides, fungicides and herbicides, bioassay, formulation, toxicology and product quality control. Further support is available from a general technical

service division of the institute. The Institute is the technical information centre on pesticides for China. As the oldest pesticide research centre in China it seems to have established its own role and links with the other research, development and control bodies concerned with the many stages involved in the effective provision and utilisation of pesticides in the domains of agriculture and public health. These include the Institute for the Control of Agrochemicals and the Central and Provincial Plant Protection Stations under the Ministry of Agricultrue, Animal Husbandry and Fishery, and the corresponding Institutes of the Ministry of Public Health.

There is a functional system of inter-departmental committees with links to Shenyang Institute. Mr. Wang Daxiang (Vice President of the Shenyang Research Institute) is Chairman of the China Pesticide Science Society and is the China member of the International Standards Organisation Committee concerned with pesticide nomenclature. The Institute has direct contact with some international agrochemical companies based in Europe or North America.

The precise role and method of working of the Institute, particularly with regard to policy decisions on its programme and its linkages with manufacturers, and other ministries, was not easy to grasp. In Western terms it appears to combine the features of the research department of an agrochemical company with those of an industrial research association laboratory and a public sector laboratory. Pesticide manufacturing plants in China normally have only limited laboratory facilities of their own, presumably mainly relating to quality control, and rely on Shenyang to carry out the basic research that could lead to new compounds and the applied problem solving research, necessary to support local factories. The latter commission work of this type at Shenyang on a repayment basis, but the greater part of the programme appears to be self generated, in consultation with the Ministries of Chemical Industry, Agriculture and Public Health. So far only a few new compounds appear to have been discovered and much of the work has been directed at development of local manufacturing processes for known compounds, including development of formulations. The emphasis in effort and expertise is directed towards the chemical side of the programme, with biological and toxicological evaluation being relatively weak. However, as few new compounds have as yet been produced this imbalance is perhaps inevitable.

The research programe of a Western agrochemical company is much influenced by commercial and marketing considerations, the activities of competitors and the overall strategy of the company. These factors influene the decision-taking process at each stage of a pesticide's development as well as determining the resources which are devoted to the various stages from synthesis, screening, evaluation, toxicological and environmental studies, formulation, packaging and marketing. It is not at all clear how the Shenyang Institute takes decisions of this type or what criteria are brought to bear. It is possible that to date the throughput of compounds has not been large enough to necessitate very much attention being given to these matters but in the future, as the synthetic chemists increase their output, decision-taking processes will have to be reviewed and developed.

The national objective is to replace chlorinated hydrocarbon insecticides, mainly BHC, with environmentally less hazardous compounds. This will be achieved by increasing local manufacture of out-of-patent, commodity insecticides, mainly organophosphates and carbamates, local formulation and eventually active ingredient manufacture of in-patent pesticides, including the pyrethroids, through licensing arrangements with patent holders (mainly western multinationals) and eventual production of new compounds discovered and developed at Shenyang. Cotton and rice are the main targets for insecticides, although vegetables are also important. The introduction of integrated pest management (IPM) systems is a major objective of the Ministry of Agriculture in the hope that pesticide use can be reduced or at least rationalised.

In the West there can be a conflict between the realities of the pesticide market, where economics determine that insecticides must have a broad spectrum of activity particularly against cotton and rice pests, and the needs of IPM systems which call for pesticides with a narrow range of activity, which permits their use against selected targets, at the same time minimising the damage they do to beneficial species. It is to be hoped that, in the Chinese context, government control of pesticide management, from research through manufacture, marketing and use, might lead to the resolution of this conflict in favour of a rational approach to pesticide use.

Similar considerations apply to the development of herbicides where international agrochemical firms screen new molecules primarily for their relevance to use against major weed problems in a very few major world-wide

crops. More localised or specialised weed and crop problems receive scant attention initially and depend upon availability of products developed for the large markets.

5. Phase I (Strengthening the toxicology and pesticide synthesis departments)

i) Study tour

A six-member mission led by Mr. Wang Daxiang, visited 16 commercial and government research institutes in the UK, W. Germany and Japan between 12 January - 9 March 1981. This tour was clearly of great benefit to the Chinese when drawing up specifications and planning the new toxicology laboratory. Indeed, as a result of the tour the concept of the laboratory was substantially modified, necessitating a much larger budget from the government. These changes inevitably delayed construction of the laboratory.

It is not clear to what extent the information gained on the study tour influenced choice of equipment to be ordered; there is no evidence that the study tour was of any assistance to the Chinese when it came to the question of placing fellowships or selecting consultants. More might have been gained from the tour if there had been an opportunity for round-up meetings in each coutnry visited, and perhaps finally at UNIDO, to consolidate information obtained, identify gaps and initiate any follow-up activities necessary.

ii) Equipment

All the equipment ordered under Phase I with the exception of the mini-computer, had been delivered to Shenyang and where practical was either in use or under test. Some items, such as the Pye Unicam chromatograph were clearly much used and were stated by the Chinese Staff to be invaluable and use everyday. A list of spare parts and accessories for the equipment purchase was also approved during the visit. In contrast to many other countries in receipt of aid there is obviously considerable local capacity to maintain and repaire sophisticated scientific equipment and also to manufacture equipment based on overseas designs.

iii) Fellowships

There was provision for 10 overseas fellowships of 6 months each under the two projects. All except two (in toxicology to the UK) were taken up. Three problems arose in connection with the fellowships. The

first was language; few of the potential candidates spoke a foreign language to an adequate standard and most required extra tuition in China before they were able to pass tests arranged either by the British Council or the USA (two fellows in Germany needed an extra three months in that country to learn the language). The second problem was the age of the candidates. Most of the fellows appear to have graduated before the mid-1960's and were therefore in their late 30s or 40s. At this age learning a new language and coping with exposure to new cultural and technical experiences is much more difficult than it is for a younger person. The third problem was finding suitable placements for some of the fellows, and in this, there was insufficient interaction between the Chinese authorities and UNIDO in order to define the requirements and to match the placement possibilities with the training requirements. Outside consultants engaged for the projects also provided little help in this respect. The sort of training required for the fellows, with the emphasis on short-term attachments, practical work and the learning of new techniques is not easy to arrange. It requires a major commitment of staff resources by the host organisation which may feel that it does not get very much out of the exercise, except perhaps the goodwill and personal contact. Attachments of this kind are best in working laboratories either in the public or in the commercial sectors. Universities, where the emphasis is on formal courses, research degrees and individual research projects are less satisfactory.

It was not possible to meet all the fellows (two were still in Germany) but four(Mr. Wang Zuoming, Ms. Cao Eryun, Ms. Zheng Juaner, all at the Pesticide Research Center of Michigan State University, and Mr. Lu Ginggaeng, Japan, An-Pyo Centre) were interviewed in depth. English language comprehension and expression was still not very good with the first three fellows, even after the attachment. All had enjoyed the experience, had gained something from it, but had reservations about the suitability of Michigan for their needs and would have preferred to have spent more time in commercial laboratories. They made a series of brief one-day visits to one or two of the latter and one fellow spent a useful week at FMC.

The research projects on which they had been engaged at Michigan were not always closely matched to their needs. In one instance an

individual responsible for toxicology work had been engaged on a pesticide metabolism in plants project whereas he had been hoping for more involvement in animal research. This emphasises the need to arrange placements and projects many months in advance to provide plenty of opportunity to sortout any misunderstandings. It might have been more beneficial to arrange placements singly, rather than 3 in a group at the same time and place. Single placement would accelerate familiarity with the host language and encourage the establishment of a broader range of useful contacts which are usually feasible on a university campus.

Much more successful was the attachment to the An-Pyo Centre in Japan, for a number of reasons. the Fellow seen appeared to have a very positive outlook, his grasp of English was good which facilitated effective technical communication in Japan and, perhaps most important, his attachment followed a visit to China by a Consultant from the An-Pyo Centre (Dr. Kojima) and was in turn followed by another visit by another Consultant (Mr. Ape) with whom he had worked in Japan. In this way an invaluable inter-personal and inter-institutional relationship was established. The Fellow had only returned recently but was already imparting his experience to colleagues with enthusiasm and pursuing the implications for his own work and responsibilities at Shenyang. All these factors, affecting the success or otherwise of the fellowships, need to be borne in mind in Phase II.

iv) Consultancies

Not all the Consultancies which were available under the two projects were taken up and some of those which were, were of shorter duration than planned. Consequently, some funds available for Consultancies were transferred to equipment.

Shenyang appears to have received little help or guidance from UNIDO in identifying suitable Consultants and was forced to find people through personal contacts. The most useful inputs appear to have come from Japan, especially the two Consultants fromthe An-Pyo Centre, which led to a close relationship being established between the Centre and Shenyang (no report by Dr. Kojima has been seen however). Dr. Sato clearly made an invaluable contribution at the planning stage of the new toxicology laboratory, to the extent that the Chinese authorities invited him back a second time at their own expense (although this visit

could have been funded from the project). Dr. Dalton Wang's contribution appears to have been more of an academic nature, but was obviously appreciated by the Chinese scientists who are, to some extent, isolated from the mainstream of scientific thought in the West (although their literature resources are good and they appear to keep reasonably up-to-date). A cause for concern is that two consultant posts (originally intended to be filled by Drs. Hadaway and Pickering) were not filled. Both these gentlemen had retired from the public service and were unavailable and UNIDO was unable to identify replacements in time.

To have maximum impact consultants need to be carefully selected, well briefed on background and terms of reference and given adequate time before the assignment to prepare for it. They need to be at Shenyang for a sufficient period of time to allow for cultural and language adjustment, and to establish a working relationship with counterparts and to feel their way into the relevant work programmes of the Shenyang Institute. Where possible, some, at least, of the consultants should come from institutions where fellows have been, or are going, to be placed, to facilitate the development of personal and institutional relationships. Consultants' report should contain technical advice for the Chinese and an element of monitoring of project progress for UNIDO.

v) Buildings

The most important Chinese contribution to the project is the new toxicology laboratory complex being constructed at a "green field" site outside Shenyang. There is some slippage in the completion date, for the very good reason discussed above, but the laboratory is indicative of the Government's total commitment to the project. The only comment to be made regarding the laboratory is that building techniques and specifications appear old-fashioned by western standards and it should be possible to construct a more thermally-efficient building using modern insulation techniques. This should be borne in mind in planning the bioassay complex for Phase II. The building had not reached the stage of installation of the specialised laboratory services, nor were detailed plans seen. Hence it is not possible to comment on whether the problems foreseen by Mr. Sato in his visit report of October 1981 have been overcome.

vi) Future Plans

Future plans for the use of the toxicology facility were not discussed in detail. The general indication of tests to be conducted was in line with current practice in Europe or North America. It was noted by the consultants with approval that the Chinese requirements for toxicological information will follow FAO and WHO guidelines. Planned capacities for the toxicological programme did not appear over-ambitious.

6. Phase II (Strengthening the screening and biological evaluation department

a. Project objectives and general considerations

Like Phase I, Phase II will continue to have as its overall objective the strengthening of the Shenyang Institute. However, whereas the main emphasis in Phase I centered on the new toxicology laboratory the emphasis in Phase II will be on the establishment of a laboratory and related facilities for pesticide screening and evaluation. In addition, further inputs will be made, in the form of equipment and fellowships, to the pesticide synthesis and toxicology laboratories.

The declared intention is to screen new synthetic molecules for insecticidal, fungicidal, herbicidal and plant growth regulatory activity. Furthermore, there is the intention to enlarge a current interest in seeking biological active materials derived from the native plants of China.

Present facilities for pesticide screening and evaluation are inadequate, outdated and inappropriately located in the middle of Shenyang where atmospheric pollution is a problem. The knowledge and skills of the staff in this area of Shenyang's work appear to be more in need of updating than those in other departments. Therefore, there is every justification for the project proposals, in particular the proposal to establish new facilites at a "green field" site (adjacent to the new toxicology laboratory) outside Shenyang, and away from pollution problems.

For three reasons it is suggested that the new screening and evaluation facilities should not be overdesigned or overresourced initially, but should be built up and extended gradually over a period of years. It is appreciated that the opportunity presented by the likely availability of funding, both from within China and from outside, through the Phase II project, should not be missed, because it is unlikely to arise again. This means accepting the

fact that a large commitment will have to be made to buildings at the outset, but it also should be ensured that the buildings are designed to be as flexible as possible to allow for future, unpredictable, changes in use. The three reasons for this approach are as follows. Firstly the current output of new compounds from the pesticide synthesis laboratories is very small compared with that normal in an international agrochemical company. Forecasts indicate that this output will not increase dramatically in the immediate future (although the availability of new chemicals to test could usefully be increased if Shenyang were to strengthen its links with University research departments and China'a pharmaceutical industry). Therefore, a large screening and evaluation capacity will not be needed for some years. Secondly, although current priorities centre on replacing chlorinated hydrocarbon insecticides, it is impossible to predict where new leads for pesticides may arise or what type they will be. it is conceivable that a promising new group of herbicides, for example, will be discovered and as a result it will be worthwhile switching resources to herbicide evaluation. If the facilities are too rigidly dedicated to particular subject areas (fungicides, insecticides, herbicides, growth regulation) from the outset this flexibility will be lost. The third consideration concerns the relationship and respective roles of the Shenyang Institute and the Ministry of Agriculture in pesticide evaluation. In Western countries there is complete separation between the agrochemical industry, as inventors and producers of pesticides, and Ministries of Agriculture, responsible for checking efficacy and for registration and regulation of use. It is not clear to what extent this separation exists between the Shenyang Institute and the Ministry of Agriculture.

It was stated that major evaluation of new compounds in field experiments would be the responsibility of the Ministry of Agriculture, Animal Husbandry and Fishery. This would involve the Institute for the Control of Agrochemicals, the Central Institute of Plant Protection, the Provincial, Regional and Country Plant Protection Stations. These bodies would be concerned with the provision of information on efficacy and on problems associated with the usage of established pesticides, of new imported pesticides, and of new pesticides emanating from the Shenyang Institute. This information would be required both by the registration authority and by prospective users. There could well be competition for scarce resources to conduct all the necessary field experimentation. Hence the Shenyang Institute might need to adjust the boundary between the limited number of field experiments

accomplished by its present capability and those undertaken by other bodies. This might then require diversion of staff and resources to advanced field experiments.

Pesticide screening and evaluation generates a large quantity of data which needs to be analysed and stored in a retrievable form for future reference, both in relation to compounds developed subsequently and also for registration purposes. It is suggested that this data should be computerised from the start.

b. Project Inputs

i) Building design for pesticide screening and evaluation

The likely requirement may be summarised as follows:

- facilities for the production of target organisms (glasshouses, screenhouses and open pot standing areas for production of plant material (not only as targets but also as food for insect cultures) controlled environment rooms for culturing insects and pathogens. Preparation rooms and associated storage for plant growth media, insect diet, washing cages and containers, all completely separate from pesticide handling facilities to avoid contamination problems.

- facilities for the preparation of test compounds and formulations before application to target organisms, again separate both from areas where organisms are produced (see above) and where they are dosed and ehld afterwards, to avoid contamination.

- facilities for dosing target organisms (spray chambers, micro-applicators, potters towers, innoculation equipment, herbicide incorporation equipment) with ventilated working space to safeguard operators and prevent contamination of other working and organism production areas.

- facilities for holding dosed organisms for the duration of the test (glasshouses, controlled environment rooms, soil moisture adjustment equipment), to be separate from both pesticide handling areas and target production facilities to avoid contamination.

- facilities for assessing effects on target organisms, such as a weighing room equipped with modern recording digital balances.

- long-term ventilated storage facilities for samples of test materials.

- workshop, storage, and service areas (including shower rooms for staff handling pesticides).

- support facilities for small plot and large-scale field trials work (farm management services, transport, hand-held and tractor-mounted application equipment, building for handling plant material from field experiments).

- land for small plot trials close to the laboratory and access to sites where larger scale trials may be carried out.

- computer facilities for analysis, storage and retrieval of data.

Pesticide screening and subsequent evaluation and development requires regular production of standard target material, development of standard procedures for dosing, meticulous attention to avoidance of pesticide contamination of one part of the system to another, all aimed at ensuring that the results are repeatable and comparable.

The Shenyang climate, oscillating between extreme winter cold and summer heat presents special problems for buildng design and in rearing target organisms. Normally environment control of the type produced in small growth chambers is not required for this kind of work. Temperature, light, day length and humidity control within reasonable limits should be adequate. Over the next few years, when pesticide throughputs are not expected to be excessively numerous, it may be possible to rationalise use of resources by operating distinct summer and winter programmes, placing some cultures on a care and maintenance basis in seasons when it is difficult, for climatic reasons, to produce material in sufficient quantity and concentrating on other, more easily produced targets. For example, in winter it may be easier to concentrate screening on stored products and public health pests, which do not need difficult to produce green plant food, while in summer the screening could be switched to phytophagous insects. The disadvantage of this approach is that there is a long delay in obtaining complete results from the screen.

ii) Study Tour

The study tour in the UK and USA should include in its programme a selection of research stations of the main agrochemical companies operating internationally and public sector research stations engaged in detailed research on the utilisation of pesticides and their incorporation into pest management systems. Details and addresses of many appropriate research stations are given in Appendix II for these are also the establishments which might host fellowships. Particular attention should be paid to the organisation and management of total integrated programmes for screening and evaluation of novel pesticides and the handling and assessment of information therefrom. Likewise attention should be directed to facilities where the total equipment cannot be bought as a complete package "off the shelf" but may have to be individually designed and constructed from major components. This applies particularly to equipment for the control of environment and for the precise application of chemicals to target organisms.

The tour should also include a visit to the U.K. Building Research Establishment (and U.S. equivalents) to discuss problems of thermal insulation in extreme climates. Equipment manufacturers should also be visited.

Each stage of the tour should end with a round-up meeting to discuss the information obtained, identify gaps in this information and to initiate further action. The U.K. meeting could be organised by the Overseas Development Administration, ODA (UN Dept. A). A formal meeting at UNIDO should be held for debriefing members of the tour group. The U.K. tour should be arranged by the British Council on advice from Consultants and UNIDO

Consideration should also be given to whether the study tour provision should be split from one party of 6 persons to two parties (to a combined total of 6) with different timings and itineraries. One such party might then travel in the early part of the project period to concentrate on issues concerned with facility development, while the second and later one might be concerned more with equipment and programmes.

iii) Fellowships

a) General

The British Council acts on behalf of UNIDO in looking after Fellows from overseas countries on training attachments in the U.K.,

arranging travel, accomodation, local currency and itineraries. The Council will also advise on placements, but in doing so will itself seek advice from its own advisers (with pest research and control the Council frequently consults the Tropical Development and Research Institute). Under Phase II of the Project there is provision for six fellowships of six months each, to be taken up, as far as is practical, in the U.K. Two fellowships should be in the field of toxicology, while the remaining four should relate to pesticide screening and evaluation. A list of the various U.K. institutions which have indicated a willingness, in principle, to accept fellows is given in Appendix II, together with details concerning contact officers, acceptable duration of the attachment, costs and fields of activity, where it has been possible to ascertain these aspects. The institutions will obviously require much more information on the type of training required and the background and qualificattions of the individual fellows, before committing themselves to any specific training attachment.

There are several ways in which the various fellowships could be arranged, each with attendant advantages and disadvantages. Some of these options are set out in the following sections. Final decisions will have to be made in the light of discussions between officials of the Shenyang Institute, UNIDO, The British Council and the institutions concerned.

b) Fellowships options and objectives

i) Toxicology

Two fellowships in toxicology provided for under Phase I of the Project were not taken up because the candidates failed their English language tests. It was intended that these fellowships should be with UK institutions. It is recommended that two of the six Phase II fellowships should be in the toxicology field, and although the U.K. is the location of first choice, the possibility of sending one fellow, at least, to Japan, should not be ruled out. This point is made because, clearly, a very valuable relationship has been established under Phase I between the Shenyang Institute and the An-Pyo Centre in Japan and it may be considered worthwhile building on this through a further attachment in Phase II.

Under Phase II, the toxicology laboratory, constructed and equipped in Phase I, will be further strengthened through the provision of equipment for fish toxicity testing and for inhalation toxicity testing. As far as can be ascertained equipment for these purposes is not available "off-the-shelf" from U.K. suppliers; laboratories carrying out this type of work normally construct their own equipment using specialised components from a number of suppliers. It is suggested that the toxicology Fellowships should include in their objectives the task of deciding on which designs for inhalation and fish toxicity testing equipment will best meet the needs of the Shenyang Institute and identifying sources of supply of the various components which will have to be bought to make up this equipment. This task can be accomplished through visits to toxicology testing centres in the U.K. and discussions with relevant experts during the period of the fellowship. Leads to sources of information and equipment are given in Appendix III and these should be followed up by the Fellows.

Because the toxicology laboratory will be completed by the summer of 1984 it is suggested that the Toxicology Fellowships should be taken up as early as possible in 1984 to enable these equipment purchases to be made as quickly as possible.

ii) Pesticide screening and evaluation

Pesticide screening and biological evaluation are two distinct activities in a pesticide research laboratory. The objective of screening is to determine, from among a continuous throughput of candidate compounds, those which show signs of biocidal activity. Those which do are then put through successive stages of biological evaluation to determine activity against target pest organisms, at first on a small-scale in the laboratory or the glasshouse, then in small-plot field trials, and eventually in widespread large-scale field evaluation trials. A variety of skills and techniques are needed to manage and implement these processes which involve the production of biological target material (and host or food plants), application or dosing of this material with the compounds under test, and subsequent analysis, and storage, of the data generated. At the evaluation stage skills in designing and running field trials are also required. The main objective of the fellowship programme in pesticide screening and evaluation is to strengthen and update these skills in the Fellows involved.

There should be a secondary objective as well, concerning design, construction and installation of some of the equipment required for the laboratory to be built for screening and evaluation. As was the case with some of the toxicology equipment (see above) not all the equipment required for the laboratory can be bought "off-the-shelf". This particularly applies to environmental control equipment and pesticide application equipment, especially that needed for applying pesticides to targets in the laboratory, at the screening and preliminary evaluation stage. This type of equipment is normally custom-built by the laboratory to meet its own needs and it should be the responsibility of the Fellows to assist in determining the most appropriate designs, identifying sources of components and constructing the equipment when they return to Shenyang.

There are four Fellowships available under Phase II for pesticide screening and evaluation. It is suggested that one should be concerned principally with plant growth regulators while the other three should cover "conventional" insecticides, fungicides and herbicides. There are two main options for arranging the latter three fellowships, either by pesticide type or by screening and evaluation activity. Each has its advantages and disadvantages and the final decision should be based on discussions betweer Shenyang Institute staff and UNIDO.

Under the first option, which is the more straightforward, three Fellows, one each from the insecticide, fungicide and herbicide sections of the Shenyang Institute's bioassay laboratory would be attached to U.K. commercial and government institutions for training in all aspects of pesticides screening and evaluation in their particular field. In order that the Fellows should be able to start applying their new knowledge and skills as soon as possible after their return to China it is suggested that these Fellowships should not be taken up until 1985, near the completion date for the new laboratory complex. the advantage of this approach is that the Fellows will have been exposed, in the course of the fellowship, to all aspects of the screening and evaluation process. The disadvantages are that in any laboratory doing this type of work, the various operations need to be handled by different members of staff, partly to avoid cross-contamination problems. The need is usually for specialist staff with in-depth knowledge of a particular part of the work, for example insect rearing, pesticide

application, or data processing. A second disadvantage of this approach is that the timing might preclude the Fellows contributing usefully to the design and construction of the various facilities and equipment for the new laboratory. A further factor that needs to be taken into account is that under Phase I three Fellows received some training of this type at Michigan State University (although the training did not meet all its objectives (see above)) and in addition another staff member has recently received traing in this area at Ciba-Geigy in Switzerland (not funded by the project).

The second option would be to arrange the Fellowships according to the main activities of a screening and evaluation laboratory. Under this arrangement one Fellow's training would concentrate on organisation and management of the screening process plus analysis and handling of data generated. This Fellow should be a senior member of staff. The second Fellow would be trained in the production of target material (glasshouse culture of target weeds, host and food plants, insectary culture of target insects, and culture of plant pathogens). This Fellow would also be expected to familiarise himself with the environmental requirements of his organisms and with the equipment and facilities needed to achieve these requirements. He would then advise on the design, and purchasing of the necessary equipment and components and assist in its installation on his return to China. The third Fellow would specialise in techniques of pesticide application to target organisms, from the laboratory through to large-scale field trials, and would fulfil a similar role in relation to environmental control. If this option is adopted it is suggested that the Fellowships should be taken up as early as possible in the project period to enable these Fellows to contribute to the design and equipping of the screening and evaluation laboratory.

c) Summary of Fellowships Options

i) Toxicology (two fellowships x 6 months each 1984)

a) Fellowship to U.K. (or to Japan)) One Fellow to take special
b) Fellowship to U.K.) responsibility for fish
) toxicity testing equipment,
the other for inhalation
toxicity equipment.

ii) Pesticide Screening and evaluation (4 Fellowhips x 6 months each)

First Option

a) Fellowship in Plant Growth Regulation 1985

b) Fellowship in Insecticide Screening and Evaluation, 1985

c) Fellowship in Fungicide Screening and Evaluation, 1985.

d) Fellowship in Herbicide Screening and Evaluation, 1985.

Second Option

a) Fellowship in Plant Growth Regulation 1985

b) Fellowship in Organisation and Management of Pesticide Screening and Evaluation and Data Processing (Senior Staff Member)

c) Fellowship in Production of Biological Target Organisms. (The Fellow to take special responsibility for environmental control equipment).

d) Fellowship in Application of Pesticides (the Fellow to take special responsibility for pesticide application equipment).

iv) Consultancies

Where practical consultants should be drawn from institutions receiving Fellow on attachments. This should facilitate the development of inter-personal and inter-institutional linkages. If this is accepted then the pattern of consultancy topics would conform to the discussion in the Section on Fellowships above. Consideration should be given to retaining the services of one or more consultants for the duration of the project to advise on fellowship placements, recruitment and briefing of other consultants, monitoring project progress and assisting with identification of equipment requirements and sources and design of facilities. Consultants should be thoroughly briefed and given realistic terms of reference, should be given adequate time before visiting China to prepare for their consultancy and should have long enough in Shenyang to acclimatise and establish relationships with their counterparts. Consultants should be expected to report adequately on their work and to carry out a project monitoring role as well. Emphasis in selecting consultants should be placed on those who can contribute practically to the immediate problems of staff development and creation of research and development facilities rather than academically orientated people.

v) Equipment

Sources of equipment and indications of prices are given in Appendix III or in the folders of equipment literature despatched separately to the Shenyang Institute. The Shenyang staff will have to give precise specifications for the items they require before final costs can be obtained. Equipment

for fish toxicity testing, inhalation toxicity testing, environmental control and pesticide application cannot be bought off the shelf. It will need to be fabricated, mainly in China, from parts obtained from the UK and elsewhere as well as locally. Part of the job of those on the study tour as well as those on fellowships will be to obtain the information necessary to enable the required components to be ordered and the equipment made up in China.

7. Programme for the screening and evaluation of new compounds

Present procedures for screening for insecticidal, fungicidal and herbicidal activity were described to the UNIDO consultants briefly but only a small amount of experimental activity was actually witnessed. Hence detailed consideration of the many complex issues which will be involved in scaling up and modernising the approaches as the new proposed facility comes into use must await the specialist expert visits to be financed by the Phase II project, together with the outcome of the study tour and fellowships which are also included.

However, it may be useful to list areas to which attention should be directed:

1. Selection of organisms for a primary screen to maximise chance of detection of any form of biological activity.
2. Comfirmation of activity and the routes by which it is achieved.
3. Targetting of later screening stages to determine applicability to major Chinese agricultural and public health problems.
4. Detection and measurement of properties of active compounds which may have relevance to undesirable activity on non-target organisms, or which may influence reliability of performance.
5. The recording, storage and retrieval of experimental data, and the development of a bank of information on structure-activity relationships.
6. The preparation of summaries of information on active compounds for the use of those concerned with later stages of the R & D process.
7. The development of full R & D programmes and time scales covering the total sequence from initial synthesis of compounds for test to full scale practical utilisation of active compounds which are discovered. This should include not only the activities within the Shenyang Institute but also those of other bodies whose efforts have to be integrated into the total process.

8. Acknowledgements

The UNIDO consultants acknowledge with gratitude the assistance and hospitality extended to them by all those whom they met in China, in particular Mr. Wen Anging and his colleagues of the Foreign Affairs Department of the Ministry of Chemical Industry, Mr. Wang Daxiang and his colleagues of the Shenyang Research Institute and Mr. Zhan Bingjian and his colleagues of the Ministry of Foreign Economic Relations and Trade.

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Brighton, pp. 881-893.

Appendix I

Itinerary in China of Dr K Holly and D J de B Lyon

Wednesday 31 August	1020 depart Heathrow Flight BA003 for Beijing
Thursday 1 September	1415 arrive Beijing. Met by Messrs Wang Kaidi and Wang Genrong of Ministry of Chemical Industry (MCI) and taken to Yanjing Hotel. Joined by Dr Herbert May (UNIDO) and Mr D Whitecross (CDA).
Friday 2 September	0930-1215 Discussions at UNDP office with Mr Alan Doss (Deputy Resident Representative), Mr Albertus Sissingh (Senior Industrial Development Field Adviser), and Mme Li Qiming (Senior Programme Officer).
	1430-1600 Meeting at MCI with Mr Wen Anqing (Chief, Scientific & Technical Cooperation Division), Mr Zhang Bingjian (Division Chief, Department of International Relations, Ministry of Foreign Economic Relations and Trade) and colleagues.
Saturday 3 September	0915-1130 Meeting at Ministry of Foreign Economic Relations and Trade with 1) Ministry of Agriculture officials (Mr Chou Ji Tan, Deputy Head of Plant Protection Division and Mme Li Bing, Institute for Control of Agrochemicals) 2) Ministry of Public Health officials (Dr Fu Shing, Division of Occupational Hygiene).
	1200-1400 Banquet hosted by Mr Yang Guangqi, Vice Minister, MCI.
	1500-1730 Tour of Imperial Palace Museum.
Sunday 4 September	0800-1700 Visit Great Wall of China at Juyongguan Pass and the Ming Tombs.
	2000-2100 Meeting with Messrs May and Whitecross.
Monday 5 September	0900-1200 Reading background papers in Hotel and meeting with Messrs May and Whitecross.
	1600 depart Hotel for Beijing airport and Shenyang.
	2330 arrive Shenyang with Messrs Wang Kaidi, Wen Anqing, Zhang Bingjian, Albertus Sissingh, H May and D Whitecross. Met by Messrs Daxiang Wang (Vice President, Shenyang Research Institute of Chemical Industry), Chuanyi Hong (Vice Chief Engineer) and colleagues, and members of Shenyang Municipal Scientific & Technical Committee.
	0030 Arrive at Liaoning Hotel, Shenyang.
Tuesday 6 September	0900-1200 Tour of Shenyang Research Institute of Chemical Industry with Mr Daxiang Wang and colleagues. Inspection of equipment provided under Phase 1.
	1430-1630 Visit construction site of new Toxicology Laboratory (Mr Zeng Minhang, Chief Engineer, China National Chemical Construction Corporation).
	1730-1800 Meeting with Dr May at Hotel.
	1800-2000 Reception and Banquet given by Deputy Mayor of Shenyang.

Wednesday 7 September	0830-1200; 1400-1630 Meetings in hotel with Mr Daxiang Wang, Wen Anquing, Zhang Bingjian and colleagues to review project 1745-1830 Meeting with Messrs May, Whitecross and Sissingh.
Thursday 8 September	Messrs May and Whitecross depart for Harbin and the Daqing oilfields. 0630-1730 By road to Benxi to visit underground lake. Observation of agricultural activities during journey.
Friday 9 September	0830-1015 Meeting in Hotel with Messrs Daxiang Wang, Chuanyi Fong and Piede Shen (Director of Chief Engineer's office). 1015-1200 Tour of Bioassay Department of Shenyang Research Institute (Mr Hu Sheng and Mue Wang Qui - joint Departmental Heads). 1415-1530 Meeting with Pesticide Synthesis chemists and Head of Formulation Department at Shenyang Research Institute. 1530-1630 Tour Shenyang Research Institute Library.
Saturday 10 September	0830-1215 Meeting at Hotel with Mr Daxiang Wang and colleagues to discuss project proposals. 1400-2200 Lecture preparation.
Sunday 11 September	0830-1200 Lectures on insecticides (Lyon) 1400-1700 Lectures on herbicides (Holly) at the Shenyang Research Institute. 1830-2200 Theatre - modern play in Chinese.
Monday 12 September	0845-1200 Visit Shenyang Agricultural College to meet Professors Huang Fen (Head of Plant Protection), Chang Ching (Entomology), Wu Yousan (Plant Pathology), Li Cheng (Chemical Plant Protection). 1430-1645 Interviews with holders of Project Phase I overseas fellowships in Hotel (Messrs Lin Zheng(potential holder), Wang Zuoming, Mme Cao Eryun, Mme Zheng Juaner, Mr Lu Gingqni.
Tuesday 13 September	0550 depart Shenyang for airport and Beijing 0830 arrive Beijing and return to Yanjing Hotel. 1430-1645 Meeting with D Whitecross at Beijing Hotel. 1730-2000 Banquet at Peking Duck restaurant hosted by Minister for Foreign Economic Relations and Trade. (Messrs Lyon, May and Sissingh).
Wednesday 14 September	0900-1230 Final meeting with Chinese counterparts including Wang Daxiang and Hong Chuanyi at Ministry of Foreign Economic Relations and Trade. 1500-1700 Visit Beijing Hotel and Friendship Store. Mr Whitecross left for London.
Thursday 15 September	0900-1100 Discussion on report between Lyon and Holly. 1400 Depart Hotel for Beijing Airport. 1655 Depart Beijing Flight BA020 for London via Hongkong, Bombay and Rome.
Friday 16 September	0845 arrive London Heathrow.

Appendix II

Fellowships and Consultancies

(Notes on U.K. Organisations which could provide assistance)

1. British Council

UN Unit
Fellows and Scholars Department
10 Spring Gardens
London SW1A 2BN
(Tel. 01-930-8466)

(Contact: Mr. Roger Saunders, Ext. 2191)

The British Council have confirmed that they act on behalf of UNIDO in placing overseas fellows on training courses or attachments in the U.K. They handle the fellow's travel and accomodation arrangements, provide local currency, itinerary and advise on placements (although in the pest control field they would normally seek outside advice, usually from TDRI).

2. Laboratory of the Government Chemist

(Department of Trade and Industry)
Cornwall House
Stamford Street
London SE1 9NQ
(Tel. 01-928-7900)

Agricultural Materials Analysis Information Service.
(Contact: Drs. Hoodless and C. Woollan, Ext. 672 and 587 respectively)
Would be prepared to advise Chinese Visitors on choice of equipment for pesticide analaysis and to indicate suitable British suppliers.

Training, Information and Publicity

(Contact: Dr. Tarrant, Ext. 646 and Mr. A. Smith, Ext. 665)
Could take overseas fellows on training attachments but would have to charge full overheaded cost, unless the trainee was in the laboratory long enough to contribute to the work programme in which case the cost could be much less. The main work of the laboratory concerns the routine analysis of chemicals, including pesticides.

3. Huntingdon Research Institute

Huntingdon
Cambridgeshire PE18 6ES
(Tel. 0480-890431)

(Contact: Mr. David Ogborne, Training Officer and Dr. Ralph Haywood, Head of the Medical and Scientific Division).

Huntingdon is a commercial research organisation specialising in the field of biological safety evaluation. In agrochemicals it has the capacity for all stages of toxicological evaluation, various efficacy studies (laboratory and field), residue determination and assessment of environmental impact. Training attachments for overseas fellows is a possibility and an initial request, specifying what is required in the way of training should be addressed to the Director. As the laboratory is a commercial concern, charges would almost certainly be made for any training provided.

4. Medical Research Council

Toxicology Unit
Woodmansterne Road
Carshalton
Surrey SM5 4EP
(Tel. 01-043-8000)

(Contact: Dr. T. Connors, Director and Dr. Aldridge, Deputy Director, Ext. 317).

The unit is the principal public sector toxicology laboratory in the U.K. which includes pesticides in its remit. It is a WHO Collaborating Laboratory in the Pesticide Evaluation Scheme for vector control. In principle this laboratory would be able to accomodate overseas fellows on training attachments in toxicological testing techniques. Bench fees would probably be charged at rates to be negotiated.

5. Building Research Establishment

Overseas Unit
Garston
Watford WD2 7JR
(Tel. 092-73-74040)

(contact: Dr. R.F. Stevens, Head of Overseas Division).

The BRES can provide advice on design and specifications for laboratory buildings located in areas of extreme climatic conditions where the need is to create a controlled internal environment when external temperatures may fluctuate from -20°C to 40°C in the course of the year.

6. Rothamsted Experimental Station

Harpenden,
Herts. AL5 2JQ
(Tel. 05827-63133)

(Contact: Dr. Trevor Lewis, Deputy Director)

Rothamsted (Insecticides and Fungicides Department) would, in principle, be prepared to accept overseas fellows on training attachments. Bench fees at approximately £685 per year would be charged.

7. East Malling Research Station

Maidstone
Kent ME19 6BJ
(Tel. 0732-843833)

(Contacts: Dr. I.J. Graham-Bryce, Director and Dr. T.R. Swinburne, Head of Crop Protection Division).

In principle, East Malling would be prepared to accept overseas fellows for training. Details would need to be discussed with the Head of the Crop Protection Divison. Acaricides are of major interest to East Malling which concentrates on research on all types of fruit. Bench fees would be charged at a rate of £980 p.a. plus VAT on a pro rata basis depending on duration of the attachment.

8. F B C

Chesterford Park Research Station
Saffron Walden
Essex CB10 1XL
(Tel. 0799-30123)

(Contact: Mr. Tom O'Leary, Visitors)

FBC (formerly Fisons Pest Control, now part of Scherings) has a tradition of training overseas scientists (currently two scientists from India are attached to the formulations department) and in principle would be prepared to accept Chinese fellows. However, the recent change of ownership places a degree of uncertainty on future policy and capacity to accept trainees.

9. Shell International Chemical Company Ltd.

Shell Centre
London SE1 7PG
(Tel. 01-934-5567)

(Contact: Mr. M.R. Jeffrey)

Shell have indicated that they would be very willing to accept overseas trainees at their agrochemicals research station at Sittingbourne (Shell Research Ltd.), in Kent. Like the Chesterford Park Station all aspects of pesticide R & D are covered here, including screening new compounds, development research and toxicological and environmental impact research.

10. ICI Plant Protection Division

Fernhurst
Haslemere
Surrey GU27 3JE
(Tel. 0428-4061)

(Contact: Dr. E.G. Schumacher, North Pacific Area Manager)

ICI have indicated that they would be unable to accept long-term attachments from overseas fellows but would welcome visitors on a very short-term basis (1-2 days) at their Jealott's Hill Research Station (similar to Sittingbourne and Chesterford Park) (and could involve fellows on a longer term basis in their field trials programme).

11. Wellcome Research Laboratories

Berkhamstead Hill
Berkhamstead
Herts HP4 2QE
(Tel. 044-275681)

(Contact: Dr. J. Wickham, Head of Entomology)

Wellcome are particularly concerned with the development of public health pesticides. They are prepared to accept overseas fellows for short periods of training (duration about one week) and can supply technical literature on the evaluation methods they employ. Wellcome is a commercial organisation and might wish to make some sort of charge for training.

12. Commonwealth Mycological Institute

Ferry Lane
Kew
Richmond
Surrey TW9 3AF
(Tel. 01-940-4086/7)

Contact: Dr. J.M. Waller, ODA. Liaison Officer).

CMI would be prepared to accept overseas fellows for training. Areas of relevance would be culture and preservation of fungi. CMI does a limited amount of fungicide evaluation mainly of paints etc. for mould resistance. Bench fees would probably be required.

13. Tolworth Laboratory

(Ministry of Agriculture: Agricultural Science Service)
Hook Rise South
Tolworth - Surrey
(Tel. 01-337-6611)

(Contact: Dr. J.H. Greaves or Mr. E. Wright)

Tolworth screens rodenticides and is able to train overseas fellows in the techniques involved, providing staff and other resources are available.

14. Tropical Research and Development Institute

London Road
Slough
Bucks
(Tel. 0753-34626)

(Contact: Mr. D. Calverley)

TDRI Slough can provide training in techniques for testing insecticides against pests of stored products. Full overhead costs liable to be charged.

15. Tropical Research and Development Institute

Porton Down
Salisbury
Wilts SP4 OJQ
(Tel. 0980-610211)

(Contact: Mr. D.J. de B. Lyon, Ext. 643)

TDRI Porton Down can provide training in techniques for testing insecticides against public health pests and vectors, in particular mosquitoes and flies. Full overheaded costs liable to be charged.

16. Long Ashton Research Station

Bristol.

(Contacts: Dr. Brent, Head of Plant Protection and Dr. Treharne, Head of Physiology)

Long Ashton is particularly willing to provide training in Plant Growth Regulators.

17. May and Baker

M. & B. Research Station
Ongar
Essex

(Contact: Dr. Cole, Deputy Director)

May and Baker would be willing to provide training in pesticide screening (particularly insecticides)and evaluation.

18. Weed Research Organisation

(Agricultural Research Council)
Begbroke Hill
Yarnton
Oxford OX5 1PF
(Tel. 08675-3761)

(Contact: Dr. K. Holly, Head of Weed Science Department)

WRO is prepared to consider training attachments where they can readily be assimilated with the research programme, for herbicide evaluation.

19. Imperial College

Silwood Park
Near Ascot
Berks

(Contacts: Dr. G.A. Matthews, Dr. Price).

Imperial College run a 10-week Pesticide Management Course between May-July, mainly for overseas students. The course places considerable emphasis on the field application of pesticides.

20. Dr. Q.A. Geering (Consultant)

Q-Ag. Consultancy
(Tel. 022-026-2387)

Dr. Geering was, until he retired recently, Head of the Zoology Department at FBC (see above) at Chesterford Park Research Station, responsible for screening and evaluating insecticides and acaricides.

Scientific equipment

Appendix III

(Notes on specifications and sources of supply)

General

The inventory required for a modern research facility can broadly be divided into two categories. Those instruments which may be purchased from the shelf and whose performance and suitability can be appraised from the manufacturer's specification and those which have to be designed and fabricated from parts supplied by various companies. In the case of the latter, financial considerations are not enough, specialist advice should be sought on what would be required for a specific application.

1. Instruments should be compatible with the mains voltage and frequency used in China and suitable for the environmental conditions pertaining there. This is particularly important in view of the sophisticated electronics employed these days.

2. Modern analytical instruments are interfaced with other modules and often linked to computers so versatility in design is a major consideration.

3. The suppliers are in a position to provide advice and servicing, giving some idea on how long "spares" would be available, as rapid progression in instrument design results in obsolescence in a very short time.

The following headings summarise the information obtained so far, indicating if possible where further guidance can be obtained. All companies contacted are willing to provide demonstrations or further explanation of their products. Catalogues and price lists are attached.

1. High Vacuum Distillation Device

High vacuum distillation is a generic term covering a variety of techniques at reduced pressure. The type of equipment required depends on the precise nature of the problem but in a general chemical laboratory it might be supposed that the requirement would be simply distillation at reduced pressure; e.g. Lowering the boiling point and therefore facilitating the separation of mixtures of compounds below the temperature at which they decompose or undergo other chemical alteration.

This requirement could be met by a "High Vacuum" pump a "Vacustat" and a Pirani gauge mounted on a trolley.
Suitable suppliers:-

Edwards High Vacuum International
Manor Royal
Crawley, West Sussex
STD (0293) 28844.

This company is internationally renowned with overseas agencies, and provides a technical advice service and product training.

An alternative is:- Javac (UK) Ltd
3 Waverly Lane
Farnham, Surrey GU9 8BB
Tel: (0252) 721539

2. Ultra-violet and Infra-red spectrophotometers

There is a good selection of equipment supplied by 'Phillips', a multi-national involved in the manufacture of a wide variety of analytical instruments, and 'Cecil' a wholly British company specializing in U/V-Vis spectrophotometry.

Two types of instruments should be considered, single or double beam, the latter might be preferred if 'scanning' was a requirement. Otherwise recent inovations in design suggest there is not much difference in performance.

Inevitably there is a wide range of accessories, spares and consumables which must be included in any package.

The Philips SP3 series of Infrared spectrophotometer with an appropriate data processor system seem to be in the right sort of price bracket.

Further information from:-

Cecil Instruments Ltd.
Milton Industrial Estate
Cambridge CB4 4AZ
Tel: 0223 66821

Pye Unicam Ltd., (Philips)
York St.
Cambridge CB1 2PX
Tel: 0223 358866

Fish Toxicity Unit

Such a unit would have to be constructed to a specification related to the toxicological investigation requirement. This could range from simple toxicity tests with a variety of fresh-water or marine fish to a detailed aquatic eco-system investigation. Consideration would have to be given to such factors as flowrate, temperature pH aeration.

Further information from: Dr Peter Matthiessen, (Tropical Development and Research Institute, College House, Wrights Lane, London W8 5SJ) and:-

Huntingdon Research Centre
Huntingdon
Cambridgeshire PE18 6ES
Tel: (0480) 890431

This commercial organisation offers fish toxicity testing facilities.

Inhalation Toxicity Experimental Equipment

The requirements for this specialized equipment depend on the scale and nature of the experiments.

Some information is available from large chemical companies such as Shell, ICI, or from Huntingdon. Normally equipment would be hand built to specification. This could be achieved with materials supplied by:

Corning Ltd.
Stone, Staffs ST15 0BG
Tel: (0785) 817211

In consultation with their engineers it is possible to construct a 'drain pipe' apparatus. This consists of a tube with suitable inlet ports for animals to sample a homogeneous dynamic atmosphere controlled for humidity and temperature.

Such equipment has been constructed by:-

Dr. Tony Riley
British Industrial Biological Research Institute
Woodmanstone Rd
Carshalton, Surrey
Tel: 01-643-4411.

The contact at Corning is Mr. Bailey who provided advice and equipment for Dr. Riley.

Environment Control Equipment
Haraeus-Vötsch and Fisens manufacture equipment for biological research but they are highly specialized and expensive. Further advice can be obtained from:-

Weed Research Organization
Begbroke Hill
Yarnton
Oxford OX5 1PF
Tel. 08675-3761
Contact: Dr. J.C. Caseley

Application Equipment
Laboratory scale application of pesticides to a variety of surfaces with a 9 cm maximum diameter can be accomplished using a Potter Tower. Small modifications can be made to this apparatus to apply aqueous or oil formulations. This equipment is marketed by:-

Burkard Manufacturing Co. Ltd.,
Woodcock Hill Industrial Estate
Rickmansworth, Herts,WD3 1PJ
Tel: Rickmansworth 73134/5

This company also markets microdispensing equipment suitable for applying ul volumes of pesticides to plants and large insects.

There appears to be no manufacturers of controlled large scale application equipment for laboratory use. This is usually custom built with regard to volume application rate, formulation, drop size spectrum, etc. Information and possibly drawings could be obtainable from the Rothamsted, Glass House Crops, ICI Jealott's Hill, and Shell Sittingbourne research stations.