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PHILIPPINES

Technical report: Medicinal Plants and Essential Oils in the Context of an Integrated Pharmaceutical Industry in the Philippines*

Prepared for the Government of the Philippines
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Prgramme

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* This document has not been edited.

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Summary

The present report sets out the situation regarding medicinal and aromatic plants in the Philippines, as understood by the author from a 1-month visit to the country in July/August 1988. It is intended as an input into the "Master Plan" for an integrated indigenous pharmaceutical industry at present being prepared by UNIDO at the request of the Philippine Department of Health.

A National Integrated Research Program on Medicinal Plants (NIRPROMP) has been running for 10 years and is currently being looked after by the Philippine Council for Health Research and Development (PCHRD) which comes under the Department of Science and Technology (DOST). The plants selected on the basis of herbolarios (traditional healers) reports are aimed at the low-income sections of the population (mainly in the rural areas) for treating the most commonly occurring conditions and symptoms:

Respiratory conditions (cough, asthma)
Gastro-intestinal tract (diarrhoea, colic)
Intestinal parasites
Skin conditions (fungal diseases, scabies)
Cardio-vascular conditions (diuretics)

Following a lengthy pharmacological protocol, dosage forms (tablets, decoctions) have been developed for two of the priority plants, lagundi (Vitex negundo L.) and tsaang gubat (Ehretia microphylla Lam.) and are being (to be) produced in four production units situated in various parts of the country; only one unit is so far in production. The planning behind the locations and capacities of these units is not clear. It is intended to commercialize the necessarily low-profit operation. The population is also being encouraged to grow the plants and to use them for making remedies as and when required. In various parts of the country, doctors are including medicinal plants as one of the available options in treating patients.

The two main shortcomings of the project are that: (a) so far the active principles remain largely unknown, with consequent problems of standardization and quality assurance, and (b) the mechanism(s) of action, long-term effects, teratogenicity, etc. still require study. (Phyto)chemical investigations are hampered in some laboratories by a lack of equipment (chromatographic, spectroscopic) for undertaking the isolation and structure elucidation of the active principles. There is, however, some collaboration with overseas laboratories. More refined methodologies for the pharmacological examination and bioassay of the active principles need to be acquired.

Projects for the extraction of locally grown cinchona bark and for the production of agar-agar have been put forward.

The Philippines imports almost all its requirements of essential oils - to the value of very approximately $20 million annually - even although most of the plants from which they are obtained are already in the country. While the Department of Science and Technology, through its Industrial Development Technology Institute (ITDI), has been

carrying out some research and development work and there are some signs of entrepreneurial initiative, much still remains to be done if a viable essential-oil industry is to be developed in the country. There is the capacity for making the requisite equipment in the country and suitable designs are appended to this report.

As a result of the present study, the following recommendations are being made:

Medicinal plants

(a) Immediate attention should be given to:

  (i) The isolation, characterization, and structure elucidation of the active principles occurring in the priority plants;
  (ii) More detailed pharmacology (mechanism(s) of action, chronic toxicity, teratogenicity, etc.) of both the dosage forms and the isolated active principles;
  (iii) The evaluation, standardization, and development of assay methods for the active principles in the plant materials and dosage forms.

(b) A full range of testing facilities for herbal products should be available in government establishments in order to be able to carry out independent quality assurance.
(c) Further clinical trials of the dosage forms should be carried out in order to allay doubts among members of the medical profession and others regarding their efficacy and safety.
(d) A training programme should be initiated as soon as possible by Government and the Universities. It should be oriented towards natural-products chemistry and pharmacology (including advanced biological testing and bioassay methods) and should be carried out both at home and abroad.
(e) The range of equipment in most of the laboratories currently undertaking (phyto)chemical studies should be extended.
(f) The planning behind the location and estimated capacity of the regional production units should be clarified, and also the question of the availability of spares for repairing imported equipment in the event of a breakdown.
(g) Continuity of (Government) financing for the activities of the NIRPROMP project needs to be ensured.
(h) Consideration should be given to the possibility of setting up a Philippines Center for Medicinal and Aromatic Plants Research (PCMAPR), with its own budget, to concentrate and carry out the full range of research and development required for the on-going NIRPROMP project and for establishing an indigenous essential-oil industry. It has to be contingent on a trained cadre of research workers in the range of disciplines covered (agronomy, (phyto)chemistry, pharmacology, pharmacy) and could only be set up after completion of the training programme proposed above (under (d)).
(i) The proposed project for the extraction of quinine from bark derived from the Mindanao cinchona plantation, along with the development and production of suitable dosage forms, deserves full support and should be accepted.

(j) The development of agar-agar production on a commercial scale should be investigated.

Essential oils

(a) Government through the ITDI should pursue the initial research and development of essential oils with all the vigour at its command. The project should have a minimum duration of 5 years.
(b) For the required research and development work, it is desirable to have a permanent installation. This could form part of the pilot-plant facilities that would have to be located at the (suggested) Philippines Center for Medicinal and Aromatic Plants Research (PCMAPR).
(c) In order to stimulate the development of the industry, a number of mobile or permanent units for the large-scale distillation of essential oils should be placed in different parts of the country, e.g. Central Luzon, Bohol, Mindanao. They should be made available under advantageous financial conditions.
(d) More detailed statistical information relating to essential-oil imports should be gathered, so that trends and changes in the oils being used in the country can be discerned.

Contents

ACRONYMS

ARI	Acute Respiratory Infections
BFAD	Bureau of Food and Drugs
CLSU	Central Luzon State University
DOH	Department of Health
DOST	Department of Science and Technology
ITDI	Industrial Technology Development Institute
NIRPROMP	National Integrated Research Program on Medicinal Plants
NIST	National Institute of Science and Technology (now ITDI)
NSTA	National Science and Technology Authority (now DOST)
NSTL	National Standards and Testing Laboratory
PCARRD	Philippine Council for Agriculture and Resources Research and Development
PCHRD	Philippine Council for Health Research and Development
PIPAC	Philippine Institute of Pure and Applied Chemistry
POPCOM	Population Commission
UP	University of the Philippines
UPCM	University of the Philippines College of Medicine
UPCP	University of the Philippines College of Pharmacy
UPLB	University of the Philippines at Los Baños
USP	United States Pharmacopoeia
UST	University of Santo Tomas

1. INTRODUCTION

The Philippines through its Department of Health (DOH) has asked UNIDO to prepare a "Master Plan" for the development of an integrated pharmaceutical industry in the country. To this end, UNIDO has brought together a group of international consultants, and the present report is the input of the consultant on medicinal and aromatic plants.

Plants continue to be a major source of medicinal agents throughout the world, and UNIDO has been playing an important part in promoting the utilization of medicinal and aromatic plants for the production of pharmaceuticals in African and Asian countries (1). To assess the situation in the Philippines, besides examining relevant literature, extensive discussions were held with members of appropriate Government departments and other organizations, with commercial firms and individuals, and with staff members of departments and institutes in several universities. These discussions took place principally in Metro Manila, but also in Regions 3, 4, 6, 7, 11, and 12 (map: Annex I). The list of contacts made is given in Annex II. The period of time available to the consultant, about 1 month, was not enough to carry out a complete investigation; in particular, agricultural and commercial aspects have not been as thoroughly studied as is desirable. However, in spite of this, it is considered that sufficient information has been gathered to enable an adequate assessment of the situation to be made.

The report falls naturally into two parts - the first dealing with medicinal plants and the second with essential oils.

2. MEDICINAL PLANTS

2.1. Policies

Government policies regarding medicinal plants are set out in an undated document entitled: Proposed Policies Relative to the National Integrated Research Program on Philippine Medicinal Plants (NIRPROMP) (2). The envisaged programme was started in 1977/78 by the then National Science and Technology Authority (NSTA), now the Department of Science and Technology (DOST), who recognized the potential use of herbal medicine in the country. The programme was later placed under its health sector arm - the Philippine Council for Health Research and Development (PCHRD).

The stated overall policy was that:

"Indigenous medicinal plants shall be optimally utilized to promote and maintain the health of the Filipino people."

The means by which that objective was to be attained were given as follows:

"1. The speedy generation of scientific knowledge on the medicinal potentials of indigenous plants;

2. The immediate application of knowledge for the treatment of diseases common in the country and provide substitutes for imported drugs; and

3. The implementation of complete scientific studies on plants having great medicinal potentials for commercial and possibly export purposes."

The guidelines included the setting up of a Technical Committee "to continuously assess and direct the activities of the project". The required research and development was divided into two Missions:

Mission I concerned all activities that would result in the use of medicinal plants as fast as possible:

"a. Research activities shall include all efforts to provide scientific proof of plant efficacy, technology for the propagation and cultural management of plants for national distribution and the preparation of quality galenical pharmaceutical dosage forms for use.

b. Implementation activities shall include all educational efforts to bring all pertinent knowledge to the people to cultivate the plants in the barangays for direct use by the sick or to distribute the galenical dosage forms with proper instructions for use mainly in the rural areas."

Mission II included only selected plants from Mission I of great potential therapeutic value. The studies - phytochemical, pharmacological, toxicological, microbiological, immunological, and clinical - were to culminate in the purification and identification of the active principle(s); determination of the effectiveness and safety for the treatment of human diseases; the pharmaceutical development, production, and commercialization of such pure active drugs.

The thinking behind the project was that cheaper but efficacious herbal medicines should be developed for the less well-off sections of the population, mainly those in the rural areas, who are unable to afford the cost of Western-type medicines and that their rational utilization in primary health care should be promoted. It was envisaged that ultimately the products would be commercialized, either by Government or by private organizations that would be at least 60%

Filipino-owned.

A second, likewise undated, document, Framework Plan of the Research and Development Program for Herbal Medicine (3), brings the story up to about 1984. The current (1988) situation is presented in a third undated document entitled Status of Research and Development DOST/PCHRD Integrated Research Program on Herbal Plants (4), in which the achievements of the programme so far are set out (see Annex III). In spite of the considerable length of time that has elapsed and the problems that have beset the programme, due largely to underfunding and lack of resources, as well as to certain changes of emphasis stemming from changes in the membership of the Technical Committee, it has to be credited with some very solid gains.

The necessary research and development work has been carried out mainly as follows:

Agricultural:

University of the Philippines at Los Baños (UPLB)

Central Luzon State University (CLSU)

Medical (Toxicology, Basic and Clinical Pharmacology):

University of the Philippines College of Medicine (UPCM)

(Departments of Pharmacology and Biochemistry)

Pharmaceutical:

University of the Philippines College of Pharmacy (UPCP)

Chemical (Phytochemical):

Philippine Institute of Pure and Applied Chemistry (PIPAC)

University of the Philippines (UP)

University of Santo Tomas (UST)

Production:

Philippine Council for Health Research and Development (PCHRD)

There are also links with the Department of Health, Department of Agriculture, and the Department of Education, Culture, and Sports.

2.2. Selection of the plants to be investigated

Since the project was chiefly aimed at providing remedies for the primary health care programme, enquiries were initiated among herbolarios (traditional healers) throughout the country regarding their use of medicinal plants. The potentially useful information (uses, plant parts, doses, preparations) thus acquired was set out in a series of unpublished reports (5); cf. 2.3, below. By correlating this information with the most commonly occurring diseases and symptoms (pain, fever, etc.), attention was focussed on five main areas:

Respiratory conditions (cough, asthma)

Gastro-intestinal tract (diarrhoea, colic)

Intestinal parasites

Skin conditions (fungal diseases, scabies)

Cardio-vascular conditions (diuretics).

Based on a lengthy pharmacological screening protocol (Annex IV), the leaves of four plants were selected for priority research and development:

Vitex negundo L.	Lagundi	- Cough, asthma, bronchitis
Mentha cordifolia Opiz	Yerba buena	- Analgesic after dental extractions, haemarrhoidectomy, minor surgery, etc.
Ehretia microphylla Lam.	Tsaang gubat	- Colic, diarrhoea
Blumea balsamifera (L.) DC.	Sambong	- Diuretic

A further five are still being studied:

Leucaena leucocephala (Lam.) De Wit	Ipil-ipil	- Anthelmintic (seeds)
Quisqualis indica L.	Niyog niyogan	- Anthelmintic (nuts)
Cassia alata L.	Akapulko	- Antifungal (leaves)
Garcinia mangostana L.	Mangosteen	- Antidiarrhoeal (fruit pericarp and endocarp)
Psidium guajava L.	Bayabas	- Antidiarrhoeal (leaves)

2.3. Documentation of Philippine medicinal plants

Medicinal Plants of the Philippines by Eduardo Quisumbing, first published in 1951, is the best-known modern compilation; it was based on field work as well as on a study of the pertinent literature (6).

Within the last 10 years numerous publications dealing with Philippine medicinal plants, mostly from a practical point of view, have appeared in English (7-17); some have been translated into other languages such as Tagalog, Cebuano, and Ilonggo. Several of these works (7-9) have been prepared as outputs of the NIRPROMP project and have been written for the lay public by people associated with the project. They give information on commonly occurring medicinal plants and on how to prepare household remedies from them for treating common ailments.

The extensive survey of medicinal plants and their use by more than 1100 herbolarios (traditional healers) throughout the country, carried out by Prof. Quintana and her team at the start of the NIRPROMP project (5), is set out in five annual reports (1978-1982) totalling almost 1900 pages. About 1700 plants were identified. It is very unsatisfactory that the bulk of the information they contain remains inaccessible, as no funds have been available to edit and publish them and thus make them more widely known.

2.4. Research and Development

2.4.1. Identification

Only three of the seven NIRPROMP priority plants occur throughout the country; the other four are limited to certain regions. There is no quantitative information on their occurrence in the wild but the plants are mostly fairly readily cultivated in those parts of the country where they do not grow naturally. The plants are well-known and easily recognized, so that their (taxonomic) identification poses few problems. Staff in University Departments of Biology and Botany as well as Colleges of Pharmacy are usually able to carry out the necessary verifications. To identify less well-known and rare medicinal plants, specimens have to be sent to the National Herbarium in Manila (= Botany Division of the National Museum) or to the herbarium of the UPLB College of Forestry. The number of full-time taxonomists is limited.

2.4.2. Ethnobotany/Ethnomedicine

The Population Commission (POPCOM) is funding an integrated research project on indigenous medicinal plants for fertility regulation. The work is being done at the UPLB Institute of Biological Sciences and ITDI and is within WHO guidelines. It includes plant identification and documentation, biological and chemical screening, toxicity testing, etc.

Other activities at the Institute of Biological Sciences include popular undergraduate and postgraduate courses on economic botany, the major parts of which concern medicinal plants. There are also courses dealing with the preparation of simplified pharmaceutical formulations, i.e. kitchen methods for making syrups, hand-made pills, ointments, lozenges, etc. Another project deals with medicinal plants

in animal health.

CLSU has a Department of Veterinary Medicine and a programme is being started up to identify medicinal plants suitable for use as veterinary drugs; this includes insecticidal effects.

2.4.3. Agriculture

Studies relating to the cultivation of the priority plants are most advanced for lagundi and yerba buena. The Philippine Council for Agriculture and Resources Research and Development (PCARRD) has a list of 25 projects, most of which are reported to be either extended or on-going. It has not been possible to investigate these further and it seems that some of them, relating to the diseases and pests of medicinal plants, as well as to certain aspects of their (optimal) cultivation, harvesting, and storage, have had to be deferred owing to lack of funding.

The only on-going projects at the UPLB College of Agriculture are the maintenance of the medicinal-plant gene bank and production farm. The collection, identification, and propagation of plants with pesticidal activity is also being pursued.

The Central Luzon State University (CLSU) at Muñoz, Nueva Ecija (Region 3), joined the NIRPROMP project in 1981 to further the development of the agricultural management of medicinal plants and to supply raw materials for processing. Five of the priority plants, but mainly lagundi, have been grown on a 4 hectare site and planting material has been supplied to the people through certain government departments; they have no processing facilities of their own. The cost of production of the air-dried leaves, after garbling, is ₱60/kg. (A point to note is that transport costs are high - ₱1000 to transport 30-50 kg of plant material from CLSU to Manila.) At the moment (August, 1988), the PCHRD

has run out of funds and the CLSU has stopped supplying material. There is, however, a little funding available from the PCARRD Rural Women's Project to provide planting material for use in the villages. A community-based health programme is just being started and training and demonstrations in using home-made galenicals are being organized (18).

2.4.4. Pharmacology

The pharmacological protocol by which the priority plants have been selected is outlined in Annex IV. This work, which has involved pre-clinical (animal, laboratory) and clinical (human) studies, has been the primary aim of Mission I of the NIRPROMP project, and has mostly been carried out at the UP College of Medicine (UPCM). While admirable in itself, the work raises questions that worry not only the writer but also some of the doctors with whom the project has been discussed. Essentially, these concern the mechanism(s) of action* and long-term effects of the preparations, as well as their possible teratogenicity (which has not so far been investigated), but above all the fact that so far little or no work has been done to find out what the active principles are in the plants being so widely recommended and used. This is a serious deficiency that appears to have arisen as a result of the emphasis at the beginning of project of getting the medicines to the people and asking questions afterwards. It has taken about 10 years to reach the stage where suitable dosage forms have been developed for the first few plants selected, and this has meant that

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* It has been mentioned to the writer that the anti-diarrhoeal effect of tsaang-gubat may come about through a reduction in intestinal motility. This is contrary to current WHO recommendations. The matter needs further study.

the investigation of the active principles has had low priority. But without an adequate knowledge of the active principle(s), it is difficult, if not impossible, to obtain a proper idea of the efficacy and long-term effects of such drugs. Moreover, it becomes difficult to standardize the final products, and hence to ensure that there are no untoward effects. It is a situation that must be remedied as quickly as possible.

Nevertheless, there is evidence from clinical trials that lagundi tablets are indeed an effective antitussive (19,20).

Some pharmacology is also being done abroad, e.g. in Japan.

2.4.5. Chemistry

As indicated above, relatively little has been done about investigating the active principles of the medicinal plants selected for development. Facilities for doing so are limited, also in the sense that such work needs to go hand in hand with biological testing and the facilities for doing that are likewise restricted.

At present, the most advanced (phyto)chemical work is being done mainly at the Philippine Institute of Pure and Applied Chemistry (PIPAC), an independent research institute founded in 1973 and situated on the campus of the Ateneo de Manila University, Quezon City. The PCHRD is one of the funding agencies for this work. The 4 people concerned work in well-equipped laboratories and in collaboration with overseas departments (Japan, UK) carry out detailed structural studies on isolated plant constituents. Among the plants being studied are lagundi and sambong; several active constituents have been obtained from lagundi and identified. The bioassay techniques available, at the UPCM, require a considerable amount of isolated product; more advanced

methods using less material are urgently needed.

Research into medicinal plants is also being carried out in the University of Santo Tomas (UST) Research Center for the Natural Sciences, Manila. Although not as well equipped as the PIPAC, it has the advantage of closer collaboration with pharmacologists, clinicians, and others who are faculty members of the university. While there are facilities for a range of biological tests (it provides a service on behalf of UNESCO for South-East Asia), there is a need to extend the range of tests, e.g. to cover anti-tubercular activity, and to develop more refined methodologies. An ointment, based on the seeds of pepita del Tonkin (Ipomoea muricata (L.) Jacq. - Convolvulaceae), has been produced; it is said to have effective analgesic, anti-inflammatory, and anti-tubercular properties (21).

Some natural-products chemistry is being done in the UPLB Department of Chemistry. However, the number of people involved and the facilities available are rather limited.

The Department of Chemistry, De La Salle University, Manila, is also interested in natural products, but mainly in those from marine sources, and its work does not fall within the orbit of the present enquiry.

All the laboratories mentioned above collaborate with, or depend on, to a greater or lesser extent overseas laboratories, not only in structure elucidation studies but also in some cases biological testing and assaying.

None of the other university chemistry, pharmacy, and biology departments visited, in Manila or elsewhere, are in a position to undertake anything more than relatively simple phytochemical screening.

The main impression is that there is a general shortage of trained people and of equipment for isolating plant constituents and

carrying out their structure elucidation and identification. Facilities for biological testing also need to be strengthened and extended.

2.4.6. Pharmacy

The UP College of Pharmacy (UPCP) has been mainly responsible for the development of the processing and dosage formulation. It likewise has a phytochemical research programme which also encompasses plants not included in the NIRPROMP project, e.g. those used as pharmaceutical aids and containing polysaccharides or pigments. The UPCP is equipped primarily as a teaching college and its facilities are modest. However, it forms part of a consortium with De La Salle University and Ateneo de Manila University in which post-graduate (M.Sc. and Ph.D.) lectures and laboratory equipment are shared. There are some facilities for simple biological testing, but mostly that is undertaken by the UPCM.

An Institute of Social and Biomedical Research, embracing medicine, dentistry, subjects allied to medicine, etc., is in course of being set up, with the aim of obtaining high-technology equipment that can be shared.

2.4.7. Cinchona (Region 10)

It did not prove possible to visit the 1854-hectare cinchona plantation on the southern slopes of Mt. Katanglad, Bukidnon, in Central Mindanao. The Philippine Cinchona Reafforestation Project is administered by the Bureau of Forest Development, Department of Environment and Natural Resources. There are indicated to be ca. 2 1/2 million trees belonging to seven different species, as follows:

Cinchona Species	Trees 1-5 years old*	Trees 6 and more years old
C.ledgeriana	272,386	383,875
C.succirubra	141,594	311,775
C.calisaya	89,780	85,550
C.kartamanah	206,389	190,400
C.officinalis	59,361	138,000
C.hybrida	96,474	152,100
C.tjinjiroena	166,153	235,150
Total	1,032,137	1,496,850

Grand total: 2,528,987 trees

* The data in this table are taken from the project proposal discussed below. The original table has "1-15 yrs. old". It is presumed that this is a typing error. Harvesting of cinchona bark normally starts when the trees are 7 years old.

According to information the writer was able to glean in Davao, bark has been exported to the value of about $45,000, but it is not known what weight of bark this represents. At present, there is no processing plant for alkaloid extraction.

The UPCP Department of Industrial Pharmacy has put forward a project proposal for the isolation of quinine, and the formulation of successful and good quality dosage forms, to be followed by pilot-plant scale production of the dosage forms (22). This project should be encouraged. Since there is now resistance to synthetic antimalarials in the country, the exploitation of locally produced quinine (or a mixture of cinchona alkaloids) is an attractive possibility. As pointed out in

the proposal, it could be the start of a truly indigenous pharmaceutical industry and it could also mean a saving of foreign currency. The proposed budget, at ₱1.27 million is on the low side and should be increased to ₱1.75-2.00 million to allow for additional equipment and inflation. Adequate pilot-plant facilities for the project are probably not available.

2.4.8. Agar-agar production

The production of agar-agar from the local seaweed Gracilaria verrucosa has been investigated by the DOST/ITDI (23). The product, so far obtained only on a small scale, appears to be satisfactory for microbiological, food, and pharmaceutical application. Again, it is a question of developing potentially viable production from this initial study.

2.5. Production of medicinal-plant dosage forms

The setting up of production facilities in different parts of the country started 4 years and is being assisted by a World Bank loan.

2.5.1. Bicutan (Metro Manila)

As part of the NIRPROMP project, a pilot plant for the production of dosage forms from philippine medicinal plants has been erected at Bicutan, Metro Manila. It is a DOST/PCHRD/UPCP plant with a capacity of about 10,000 tablets/day. Some equipment, e.g. the mixer and drying oven (4 kg capacity), is of local construction. 4 Materials are being processed:

lagundi, yerba buena, tsaang-gubat, and sambong.

There are limited quality assurance facilities, with the bioassays being done at the UPCM and other assays at the UPCP. It was not

possible to see the data sheets. The excipients are checked to USP standard. In October 1987, the cost of production, including packaging, was ₱0.37/tablet. Cf. 2.5.2, below.

2.5.2. Davao (Region 11)

Based on the experience gained with the Bicutan pilot plant, the DOST/PCHRD set up a plant at Davao as a research installation in 1982. The raw materials come from a 9 hectare plantation at the foot of the mountains in South Cotabato. Two products have been made - lagundi and tsaang-gubat tablets - and have been supplied to rural health units. A mangosteen tablet has also been formulated and is awaiting clinical trial.

The plant has now been able to make 10,000-15,000 tablets/-day, with the unit cost ₱0.07/tablet (packaged ₱0.11/tablet), compared with a shop price of ₱1.50/tablet for Biogesic. Production ceased in the early part of 1987, because of departmental reorganization and refurbishment of the buildings. Stocks have now (July 1988) run out. It is hoped to resume production in September with partly new personnel.

Current plans are to produce 1.5 million tablets/year, but it appears that the target has not been definitely established. This will supply half the island of Mindanao. However, production is limited by the locally made stainless-steel drying oven which has a capacity of only 6 kg and no forced draught/circulation. After being air-dried, the milled material is oven-dried to 10% moisture content. This requires at least 5 hours; the tabletting process, on the other hand, takes less than 1 hour. The capacity of both the drying house and the drying oven will have to be increased.

Only limited quality assurance facilities are available. Bioassay of the powder before tabletting used to be carried out by the UPCM, but it is intended now to set up their own bioassay procedures and animal house.

2.5.3. Cotabato (Region 12)

The construction of a larger up-to-date production facility in the grounds of the Regional Hospital has been almost completed and it is hoped to start production in October. Lagundi and tsaang-gubat will be the initial materials processed. The facility comprises a garbling area, air-drying house, drying and milling equipment, tabletting machine (1200 tablets/minute),* quality-assurance and other laboratories, animal house, bioassay building, offices. Besides the director, the staff comprise:

1 agriculturist, 6 pharmacists (production, quality assurance), 2 doctors (bioassay work), 1 animal breeder, 1 veterinarian, 1 medical technician

Most are university graduates and are (or will be) specially trained. No money is available for engaging further technicians. Cultivation of the raw materials is done under contract; 5-6 hectares is reckoned to be sufficient, but, as elsewhere, the local people are being urged to plant their own supplies of the priority medicinal plants.

In 1987 about 3.5 million tablets were dispensed in Regions 9, 11, and 12 - about 3 1/2 days' estimated output of the new plant. The intention of the DCH and DOST with regard to the new production facility is not yet clear.

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* The situation regarding spares for the equipment from overseas is unclear, since the ordering was done centrally. This could have serious repercussions in the event of a breakdown.

2.5.4. Tacloban (Region 8) and Tuguegarao (Region 2)

Production facilities are also being set up in Tacloban on the island of Leyte and in Tuguegarao in north-east Luzon. These were not visited and it is understood that, while the buildings to house them have been constructed, there have been problems with the power supplies and equipment. They are not yet operational. It is understood that the Tacloban facility will be supplied from a 15-hectare farm.

2.6. Quality Assurance

A major problem associated with the herbal products is their quality assurance. None of the laboratories attached to the production units has the full range of facilities required, with the exception of the new set-up at Cotabato. The National Standards and Testing Laboratory (NSTL), which comes under the Industrial Technology Development Institute (ITDI) of the DOST, and the Bureau of Food and Drugs (BFAD) (not visited), which should monitor the herbal products, only have facilities for determining standard parameters like ash values, extractive values, etc. Published standards for the herbal products are not yet available - the writer was not able to see any data sheets - so that until they are established it is impossible for outsiders to determine whether the products meet appropriate criteria. Neither laboratory has facilities for bioassays, mutagenicity tests, etc., which at the moment have to be done by the UPCM. This situation must not be allowed to continue and must be corrected as soon as possible.

At the DOST laboratories in the regions, e.g. in Cebu, proper facilities for the independent testing of herbal products are not available.

2.7. Commercialization

2.7.1. Philippine Herbal Group Inc., Metro Manila

Market studies with lagundi and tsaang-gubat tablets, as anti-tussive and antidiarrhoeal, respectively, among health workers and users in the provinces surrounding Manila, are reported to have established their acceptability.

It is intended that the Company take over the Bicutan processing plant later this year or next year; they will pay a royalty and a technology transfer fee. As indicated above, they are already marketing the products. From the nature of the preparations being made and the fact that they are intended primarily for less well-off members of the community, profit margins are having to be kept small. The principal contacts through whom the company is operating are the midwives.

The company also aims to carry out post-marketing clinical trials and to look at the possibility of developing herbal teas (for decoctions) and syrups, particularly for paediatric use.

2.7.2. Sisters of the Rural Missions, Bacolod

In Bacolod, the Sisters of the Rural Missions have been making herbal products for the last 7 years and, besides doctors, both government and non-government agencies have been involved. They have 1 hectare of garden and use air-dried fresh leaves to produce 15 kinds of capsules containing ground and sieved material, as well as poultices, ointments, oils, etc. The operation is organized by a Sister pharmacist. The Sisters have connections with the Medical Mission Sisters in Manila who test all their products, which are sold at about one-fifth of the price of products having similar effects available in local pharmacies. But the people, especially the mothers, are also

being encouraged to grow the plants themselves, as a self-reliance project; pamphlets in Ilonggo have been produced, giving the vernacular and scientific names, together with details of how to identify the plant and prepare the herbal medicine. The Sisters have 57 centres in the rural areas of Negros Occidental and they treat several thousand patients a year.

The bottles are sometimes labelled with indications that would no longer be accepted elsewhere in a product that, as it were, is sold over the counter.

2.8. Involvement of the medical profession

As will be evident from what follows below, many members of the medical profession include the use of medicinal herbs as one of their options in treating patients. UPCM participants in the NIRPROMP project toured the country twice during 1982-1985 in order to make known the results of the project to both government and non-government organizations. Of the ca. 3000 people thus contacted, 40% were doctors. There are doubtless other parts of the country where the medical profession makes use of medicinal plants. However, only those programmes that were visited are discussed in the following paragraphs; see 2.5.2 and 2.5.3.

2.8.1. Bay, Laguna (Region 4)

The botica (pharmacy) of the hospital has a small herb garden which forms part of the Comprehensive Community Health Program. Patients are taught how to plant the herbs and make decoctions, and if they do not have the plants themselves they are given planting material. Medical interns and students of pharmacy and the health and allied professions (nurses, physictherapists, occupational therapists, nutritionists, etc.) spend 4-6 weeks at the hospital as part of their

community work in primary health care. Among other things, they are given a handout with information on about 20 commonly used herbal preparations.

2.8.2. Bacolod (Region 6)

In this region, there is a number of strong groups, both government (DOH) and non-government, who are actively promoting herbal medicine; the city authorities are also interested in the programme. It involves both urban and rural areas, with the barangay (primary) health workers using various preparations including syrups; again, it is the mothers who are encouraged to use herbal medicine and the emphasis is on self-reliance. A programme aimed at setting up community-based herbal gardens as a livelihood project is about to get underway. A series of seminars for barangay health workers is held in which they learn about the identification and preparation (by simple household means) of local medicinal plants, making use of an Ilonggo translation of the Guidebook on the Proper Use of Medicinal Plants (9). In the session attended by the writer the enthusiasm and interest of the participants was evident.

2.8.3. Cebu (Region 7)

Active use of the herbal preparations that have been developed is being promoted by members of the medical profession in Cebu. From discussions with the Deans of two of the medical schools, it became clear that they are aware of the need for indigenous medicines. Students encounter them in their pharmacology course and are encouraged to collect information from their local village or town; this information has not yet been collated. As part of one of the community

out-reach programmes, a herbal garden has been set up and the people in the area are taught how to prepare the medicines, based on the above-mentioned Guidebook. The medical schools carry out very limited research into medicinal plants, mainly because of the lack of funds; they would like to expand the work.

2.8.4. Bohol (Region 7)

Herbal preparations are also an integral part of the medication used in the Acute Respiratory Infections (ARI) Project on Bohol, begun in 1983 and part funded by the Australian Development Assistance Bureau (ADAB); WHO supplies the (expensive) cotrimoxazole required in the moderate, severe, and complicated cases. Some 200,000 people on the island are involved. The project is aimed primarily at the ca. 15% who are 0-4-year old children, 85% of whom will have 4-6 mild episodes of ARI/year (25). The barangay (primary) health workers are taught how to make and use the herbal preparations recommended in the treatment of mild to moderate cases that they diagnose by means of a management tree (26); and they in turn teach the households under their care how to prepare the medicines. The project has been extended to 1991 and is expected to go nationwide.

2.8.5. Davao (Region 11)

The Davao Medical School Foundation is concerned with primary health care, and the use of medicinal plants is integrated into the undergraduate course in much the same way as in the Cebu medical schools. A Center for Education, Research and Development in Health has been set up very recently (1986/87) and is offering a 2-year post-graduate course in community medicine. It is also hoped to develop research in the area.

3. ESSENTIAL OILS

It has to be said at the outset that because of the lack of time the enquiries by the writer in this area have not been as extensive as desirable. Nevertheless, it is probable that the picture would not greatly change as a result of further investigation.

Almost the entire requirement of essential oils in the Philippines is met by imports. During the period 1982/85 the annual amount varied between 2000 and 4000 tonnes and was valued at $20-25 million (Annex V), representing a considerable expenditure of foreign currency. Yet, many of the plants from which the imported materials are obtained are already in the country but so far have been little exploited. There is no doubt that development of an indigenous essential-oil industry would lead to considerable economic and commercial advantages.

3.1. Essential-oil imports

The import data relating to essential oils are of limited value in determining the nature of the oils imported since the individual oils and their derivatives are not listed separately; more detailed statistics ought to be gathered, so as to be aware in the future of changing patterns and trends in the oils being imported. Be that as it may, it is evident that currently peppermint and spearmint oils other than for the manufacture of medicine are by far the largest category in amount and value. The various citrus oils together are the second most important group.

The principal importers during the period January to June 1984 are listed in Annex V. The names of the companies are a sufficient indication of the use to which the essential oils and/or their derivatives are put: cigarettes, soft drinks, cosmetics, toiletries,

and confectionery.

While some of the multi-national companies may be tied to (overseas) in-company sourcing of their essential-oil requirements, others, such as the Philippine Refining Company, would be willing to source their oils in the Philippine domestic market provided the quality were acceptable.

3.2. Essential-oil exports

According to statistics provided by the National Economic and Development Authority (NEDA) (29), exports of essential oils during the period 1982-1986 rose from about $2 million to nearly $7 million. There is no information on which oils are being exported; the writer did not acquire any data on this aspect.

3.3. Research and Development

That there has been some interest on the part of the DOST (former NSTA) is evident from the Seminar/Workshop on Essential Oils, Spices and Pigments sponsored by them and held in Manila in 1982 (27). The workshop group identified certain gaps in the research and development in this area: technology transfer; in the short term, crop production and processing; and in the long term, industrial production, utilization, marketing, and manpower development. Three plants were considered to have top priority, viz citronella, Japanese mint, and lemongrass, while a series of other plants was earmarked for research into their development potential. Possible funding and implementing agencies were also identified. Proposals for a number of research projects were put forward, but it appears that since then there has been only sporadic activity in the field.

Studies on the small-scale production of ilang-ilang (Cananga odorata) oil have been undertaken; up to the end of World War I the Philippines was the main producer of this oil. The oils from Citrus medica (limon real) and Citrus mitis (calamansi; see 3.3.1) have also been examined by chromatography. Some examination has been made of the oils from the leaves of Cymbopogon citratus (lemongrass), Cymbopogon winterianus (citronella; see below), and Eucalyptus tereticornis. These, along with the oils from Mentha piperata and other Mentha species (peppermint (see below), spearmint, Japanese mint, etc.), are the ones that should be considered for further development as they are likely to prove the most attractive commercially (28).

More recently, a research and development project proposal has been put forward by the DOST/ITDI Technology Transfer Section, Rural Technology and Information Division (30). According to the preamble, currently the Bureau of Plant Industry is propagating ilang-ilang, lemongrass, citronella, and peppermint in Leyte, North Cotabato, and Davao; the areas planted are no more than a few hectares (but cf. 3.4.2). There is also a plantation of ilang-ilang in Batangas. This means that supplies of planting material are available, but it is not clear to the writer what steps have been taken to ensure that high-yielding strains are being used. Some of the yields mentioned are extremely high and are presumably derived from experimental distillations under ideal conditions in the laboratory; such yields are unlikely to be attained during large-scale production.

3.3.1. Oriental Mindoro (Region 4) - Calamansi oil

According to the Bureau of Agricultural Statistics (31) the area planted to calamansi throughout the Philippines during the period 1980-1985 was fairly constant at about 10,000 hectares, producing about

45,000 tonnes of the fruit annually.

Figures given to the writer during a visit to Oriental Mindoro indicate that this province has about one-third of the area planted to calamansi in Region 4: ca. 7000 hectares, with an annual production of ca. 18,000 tonnes. The area under calamansi is expected to grow to 15,000-20,000 hectares within the next 10 years.

Calamansi is a very widely used fruit and the peel, pulp, juice, and seeds can all be made to yield useful products. In the present context it is the peel that is important. Apart from its use in making marmalade and as a source of carotenoids, pectin, and ascorbic acid, it contains an essential oil that can be employed as a flavouring in many kinds of food, as a perfume, and as a perfuming ingredient in soaps and other detergents, air fresheners, cosmetics, etc.

The DOST/ITDI, together with the Provincial Government of Oriental Mindoro, maintains a Demonstration and Training Center for Citrus-based Products at Merit, Victoria. As its name implies, its primary function is the dissemination of information through extension work; it does not do any agronomy and the basic research comes from the UPLB College of Agriculture. Only demonstration equipment is available at the centre; for example, the capacity of the hydro-steam distillation unit is a mere 3 kg of peel. The Center is chiefly concerned with calamansi.

3.3.2. Central Luzon State University (Region 3)

Among the essential-oil plants being grown on the university farm are citronella, eucalyptus, and ilang-ilang. So far, distillations have been done only on a laboratory scale or using the DOST/ITDI portable 3-kg unit.

3.3.3. Cotabato, Mindanao (Region 12)

Both lemongrass and eucalyptus are growing in the region, but there are no facilities for distilling the oil. In the hills in the Cotabato area, and rather isolated from the mainstream of Philippine society, there is a group of about 5000 low-income farmers, with between them about 3500 hectares, who could be persuaded to grow crops of essential-oil plants. This could only be done if there was ready access to (portable) distillation equipment.

3.3.4. Other

In 1982 a multi-author thesis was submitted to the Faculty of the College of Business and Economics, De La Salle University, entitled A feasibility study on the commercial production of natural peppermint oil in the Philippines (32). It discussed in some detail the various activities that would be involved in setting up a company wishing to undertake the commercial production of the oil from locally grown material. The marketing aspect of their work was based partly on enquiries among firms, both local and mutli-national, making use of the oil. Although the study dealt with what was essentially a hypothetical situation, the conclusion reached by the authors was that the project was indeed feasible and that peppermint oil of good quality could be produced locally at a substantially cheaper price than imported oil. Whether current prices are such that this is still the case needs to be investigated, but it is a lead clearly worth following up.

3.4. Local essential-oil production

3.4.1. Samar/Leyte (Region 8)

It is said that a few years ago on Samar/Leyte farmers had a number of small stills (ca. 30 kg capacity) for distilling essential

oils. The writer has no further information.

3.4.2. Bohol (Region 7)

In the eastern part of the island, the Alicia Cooperative Milling and Marketing Inc. has a citronella oil project which has been set up with some technical support from the DOST/ITDI but which is still very much in the development phase. The Cooperative has 43 hectares planted to citronella, about half of which is at present furnishing material for distillation.

The Chairman of the Board is an enterprising local businessman who has had a direct-fired water/steam distillation unit (capacity ca. 300 kg) fabricated in Cebu to a design furnished by the DOST/ITDI. Currently, the best conditions for distilling the oil are being determined and the original design has been modified to increase efficiency. The average yield of oil so far obtained, 0.8%, is somewhat on the low side. No quality control of the oil has yet been undertaken, but this will be done in the coming months with the help of the DOST/ITDI. Some agronomic development work is also being done. The oil is distilled on a cooperative basis.

An important aspect of this project is the encouragement being given to local farmers to grow citronella, and at the price offered by the Cooperative for delivery to the nearest barangay road it represents a considerable increase in their earnings. At the same time, it decreases their vulnerability by adding a further crop from which they can derive income. Annex VI reproduces part of a letter from the Chairman of the Cooperative. Additional distillation units will be required if the expected increase in the amount of citronella grown is realized. The initiative shown by the people involved in this project

deserves to be fully supported and projects of this kind are worth considering for other parts of the country. The oil, of as yet undetermined quality, is sold to small manufacturers in Manila for use in shampoos, soaps, mosquito repellents, aerosols, etc.

3.4.3. Mindanao (Region 10)

One joint-venture company, Filipinas KAO Inc., at present has a research and development project at Cagayan de Oro. The main emphasis is on coconuts and coconut oil, but within the last two years research to obtain high-yielding essential-oil plants has been started with the aim of satisfying in-house demand (for use in cosmetics, etc.). The technology is being transferred from Japan and is under Japanese supervision; the pilot-plant distillation unit has a capacity of 1 tonne. The company has its own plantation, but is also involving local farmers who are inter-cropping with citronella, patchouli, vetiver, mint, ginger, etc.

3.4.4. Other

Himmel Industries Inc., a sister company of the Fortune Tobacco Corporation, is reported as being capable of supplying 2000 lbs of peppermint oil/month (30). The writer has no further information and the statement needs to be checked.

3.5. Quality assurance

The National Standards and Testing Laboratory (NSTA), Bicutan, which comes under the DOST/ITDI, deals with samples mostly from commercial firms (exporters) and other private clients, but also receives samples from the Customs and Audit Office. It does not have the full range of equipment necessary for testing essential oils.

The Bureau of Product Standards deals with samples from the inspectorate; and if it cannot carry out the work itself, the sample is sent to a Government-accredited commercial laboratory. The Bureau was not visited.

4. General conclusions

It is not easy to see how medicinal plants and essential oils can fit into a project embracing an indigenous pharmaceutical industry. In view of the social context in which indigenous medicinal plants and their preparations are being developed, they must be looked upon as a low-profit area and will therefore have little attraction for most commercial firms. The main connection that essential oils have in the pharmaceutical industry is as flavouring agents - a use which extends far beyond the pharmaceutical industry as such. Because of the economic and commercial potential of essential oils, they (and medicinal plants) could, if necessary, form a project in their own right which could have a very good chance of success. This, however, would depend entirely on the dedication of the person leading the project - the choice of this person would be crucial and would have to reflect the importance and commitment attached by Government to the project. Without such a commitment, the project might in the long run be unsuccessful.

Government research and development work - even if promising - appears to excite little interest in the commercial sector, in spite of Government's desire to transfer technology wherever possible. This may be partly due to insufficient development work because of the lack of scaling-up (pilot-plant) facilities.

4.1. Medicinal plants

The NIRPROMP project has now reached the stage where tablets of the first two priority plants, lagundi and tsaang-gubat, have been made available to the public, i.e. the project has begun to attain its stated objective. But it has taken 10 years to do so, which is far longer than it should have, and there are still many questions to be answered:

4.1.1. Agriculture

Although a medicinal-plants gene bank has been set up at UPLB, with materials from all over the country, it is not clear what rôle it has played in the selection of the plants that have been used during the subsequent pharmacological and pharmaceutical research and development. Has production been optimized on the basis of agricultural yield (biomass) rather than activity?

Agricultural studies have to be carried out in conjunction with phytochemical studies on the active principles, in order to be able to maximize activity and yield. Since the active principles are not yet fully known, this has not so far been possible. Such studies are also necessary so that the consequences of growing the plants in different parts of the country under different ecological conditions can be determined.

4.1.2. Pharmacology

There are still several important aspects of the pharmacology of the priority plants that have to be established, viz the mechanism(s) of action, the long-term effects, teratogenicity, etc. It must be borne in mind that centuries-long use of a herbal remedy is no guarantee that it is harmless. The warning by Schoental (33) that one should "be aware

of the hazards of plants which do not show immediate toxic effects but which act insidiously and can cause chronic dis... and eventualy death after a long latent period even with a single dose" is very relevant.

It is therefore extremely important and urgent that the active principles be studied in detail - not only their chemical constitution but also their pharmacological effects and mechanism(s) of action. If the active principles are not known, it is difficult to standardize the products and to devise satisfactory quality assurance measures. Only when the active ingredients have been identified is it possible to set up adequate evaluation, standardization, and quality assurance procedures.

4.1.3. (Phyto)chemistry

It follows from what has been said in the two previous sections that the most important lacuna so far in the NIRPROMP project is the lack of knowledge concerning the nature of the active principle(s) in the products currently being made available to the public. The utmost priority must now be given to the necessary chemical investigations which will lead to their isolation and structure elucidation or identification. This will enable progress to be made in the agricultural and pharmacological aspects that still require study.

4.1.4. Dosage forms

Due attention should be given to the development of paediatric dosage forms, especially for the 0-4 years-old age group of children who are too young to be able to take tablets.

When progress has been made in the study of the active principles, it will be possible to examine the question of bioavailability

which has so far not received any attention but which nevertheless is important in connection with the efficacy of the products being made.

4.2. Essential oils

The indigenous production of essential oils is likely to be of considerable economic benefit to the country. So far, there are few signs that local entrepreneurs or local branches of multi-nationals are interested in exploiting material available in the Philippines.

In these circumstances, it is clearly up to Government to remedy the situation. The ITDI has so far been able to carry out very limited development work, due partly to the fact that it lacks distillation equipment for carrying out scaling-up operations. There is also a lack of equipment in the regions. Usually, essential oils have to be distilled from fairly fresh plant materials, if the products are to be of good quality, and this often means that the distillation unit has to go to the plant material rather than the other way round. There are many designs for both permanent and mobile distillation units. A reference on essential oils that should prove especially useful is the UNIDO Practical Manual on the Essential Oil Industry (34). Annex VIII shows some designs from this reference that have proved successful and that afford good quality oils; in general, units with a separate steam generator yield better quality products. Suitable units could be fabricated locally for as little as $10,000 or less, depending on the design and the material used (mild steel, galvanized iron, stainless steel).

Having made these points, the current situation is such that it will not be easy to carry out the required work, but the following points may be helpful in determining what course of action to take.

Training programme

At present, because of the nature of the activities required for the NIRPROMP project, the work is being carried out in a multitude of different government, university, and non-government departments and institutes, with sometimes a lack of co-ordination and occasionally duplication of effort. Because many of the scientists involved in the project have other calls on their time, progress has tended to be slow. In order to increase the available cadre, priority should be given to intensifying postgraduate training in the relevant sciences. Currently, there appears to be no government or university programme for sending people overseas for advanced training.

Equipment

With certain exceptions, equipment in government and university laboratories has not kept up with the general advances that have been made in the last 20-30 years. But where modern instruments are indeed available, often they are under-utilized or out of use because they have broken down and cannot be serviced. Some laboratories where natural-products research is being carried out do not have the basic range of equipment, e.g. for chromatography, spectroscopy, etc., that should be present in such a laboratory. Inevitably, this has hampered progress in the phytochemical examination of the priority plants, although to some extent it has been overcome by collaboration with overseas laboratories. However, that is not an ideal solution and steps should be taken to upgrade equipment in those institutions where phytochemical studies are being done. At the same time, it will be essential to train people in the maintenance and repair of equipment.

Center for medicinal and aromatic plants research

As indicated above, the activities of the NIRPROMP project are spread over many different department and institutes - a situation that has disadvantages. It is therefore perhaps worthwhile considering setting up a centre in which the various activities can be more effectively co-ordinated and concentrated. It would be essential, however, to give the centre its own budget, so as to assure continuity of funding. This would avoid the stop-go financing that has been a problem during the NIRPROMP project and responsible, in part at least, for its slow development. However, it would only be possible to set up such a centre when a cadre of trained people becomes available, e.g. from the training programme envisaged above, and would have to be looked upon as a medium-term objective.

The cost of the centre would depend on whether an existing building could be utilized or whether a new one would have to be built. The space required would be about 750+ sq. m. and would house several laboratories (chemical, analytical, pharmacological, pharmaceutical, etc.), pilot plant, solvent store, animal house, offices, etc.; 16+ scientific staff would be required. Equipping such a centre for research as well as development (pilot plant) would probably cost $1-1.2 million; the annual running costs would amount to $0.3-0.5 million.

5. Recommendations

5.1. Medicinal plants

(a) The most urgent matters requiring attention are the Mission II objectives of the NIRPROMP project:

(i) The isolation, characterization, and structure elucidation of the active principles occurring in the priority plants;

(ii) More detailed pharmacology (mechanism(s) of action,

chronic toxicity, teratogenicity, etc.) of both the dosage forms and the isolated active principles;

(iii) The evaluation, standardization, and development of assay methods for the active principles in the plant materials and dosage forms.

(b) A full range of testing facilities for herbal products is required in government establishments (ITDI, BFAD), in order to be able to carry out independent quality assurance.

(c) Further clinical trials of the dosage forms are required in order to allay doubts among members of the medical profession and others regarding their efficacy and safety.

(d) A training programme should be initiated as soon as possible by Government and the Universities. It should be oriented towards natural-products chemistry and pharmacology (incl. advanced biological testing and bioassay methods) and should be carried out both at home and abroad.

(e) The range of equipment in most of the laboratories currently undertaking (phyto)chemical studies needs to be extended, so that adequate investigations can be accomplished.

(f) The planning behind the location and estimated capacity of the regional production units requires clarification, as does also the question of the availability of spares for repairing imported equipment in the event of a breakdown.

g) Continuity of (Government) financing for the activities of the NIRPROMP project needs to be ensured so as to avoid the long delays in its realization that have been a feature so far.

(h) Consideration should be given to the possibility of setting up a Philippines Center for Medicinal and Aromatic Plants Research

(PCMAPR) with its own budget to concentrate and carry out the full range of research and development required for the on-going NIRPROMP project and for establishing an indigenous essential-oil industry. It would necessarily be contingent on having a trained cadre of research workers in the range of disciplines covered (agronomy, (phyto)chemistry, pharmacology, pharmacy), i.e. it could only be set up after completion of the training programme proposed above (under (d)).

(i) The proposed project for the extraction of quinine from bark derived from the Mindanao cinchona plantation, along with the development and production of suitable dosage forms, deserves full support and should be accepted.

(j) The development of agar-agar production on a commercial scale should be investigated.

5.2. Essential oils

(a) Government through the ITDI should pursue the initial research and development of essential oils with all the vigour at its command. The outline project proposal (Annex VII) should form the basis of a fully worked-out project with a minimum duration of 5 years.

(b) For the required research and development work it is desirable to have a permanent installation. This could form part of the pilot-plant facilities to be located at the (suggested) Philippines Center for Medicinal and Aromatic Plants Research (PCMAPR).

(c) In order to stimulate the development of the industry, a number of mobile or permanent units for the large-scale distillation of essential oils should be located in different parts of the

country, e.g. Central Luzon, Bohol, Mindanao. They should be made available under advantageous financial conditions.

(d) More detailed statistical information relating to essential-oil imports should be gathered and made available so as to be able to discern changes and trends in the oils being used in the country.

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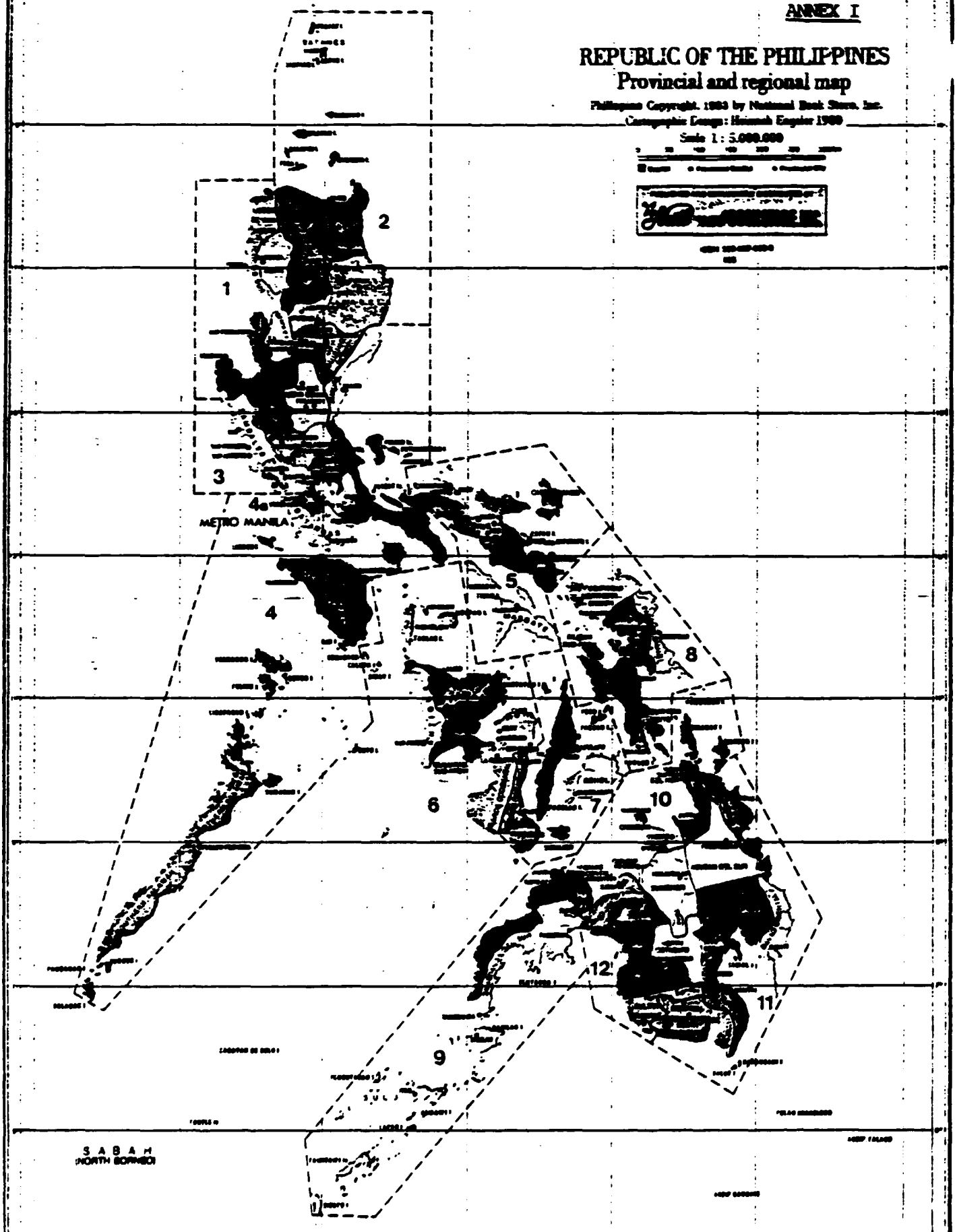
ANNEX I

REPUBLIC OF THE PHILIPPINES
Provincial and regional map

Cartographic Design: Heinrich Engler 1980

Scale 1 : 5,000,000



ANNEX II

PEOPLE AND ORGANIZATIONS CONTACTED

Metro Manila (Region IVa)

Department of Health (DOH)

Mediodora C. Saniel: Director, Research Institute for Tropical Medicine (RITM)

Nelia Salazar: Department of Health, RITM

Department of Science and Technology (DOST)

Q. L. Kintanar: Executive Director, Philippine Council for Health Research and Development (PCHRD)

Teresita C. Atienza: Senior Science Research Specialist, Human Resource and Institution Development Program, PCHRD

B. Cabrera: Consultant, PCHRD

Joselita P. Manalo: Senior Research Specialist, PCHRD UPCP Pilot Plant for the Production of Dosage Forms from Philippine Medicinal Plants

R. C. Lirag, Jr.: Director, Industrial Technology Development Institute (ITDI)

A. D. R. Gopez: Deputy Director, ITDI

Felicidad E. Anzaldo: Head, Technology Transfer Section, Rural Technology and Information Division, ITDI

Annabelle M. Vuelban: Rural Technical and Information Division, ITDI

A. C. Pacotro: Rural Technical and Information Division, ITDI

Violeta P. Arida: Chief, Chemicals and Mineral Division, ITDI

Board of Investments

Glory Lleander-Chanco: Director, Chemical Industries Department

National Museum

R. del Rosario: Assistant Director

University of the Philippines (UP)

E. Domingo: Chancellor

E. V. Valdez: College of Medicine, Department of Pharmacology

Nelia P. Cortes-Maramba: College of Medicine, Department of Pharmacology

Judith G. Balboa: College of Medicine, Department of Biochemistry

Magdalena Cantoria: Dean, College of Pharmacy, and her staff

University of Santo Tomas

Beatrice Q. Guevara: Senior Researcher, Research Center for the Natural Sciences

Rosalinda C. Solevilla: College of Pharmacy; Senior Researcher, Research Center for the Natural Sciences

De La Salle University

L. G. Paca: College of Engineering

G. Genaro: Department of Chemistry

Consclacion G. Ragasa: Department of Chemistry

Milagros Relon: Department of Biology

Philippine Institute of Pure and Applied Chemistry (PIPAC) (Ateneo de Manila University)

F. M. Dayrit: Research Coordinator

Philippine Herbal Group Inc.

W. G. Friend: General Manager

Pilipinas Kao Inc.

E. B. Sy: Marketing and Sales Manager, Chemical Division

G. S. Cortez: Corporate Staff, Government Relations Representative

Muñoz, Nueva Ecija (Region 3)

Central Luzon State University

R. E. Undan: Director of Research

Fermina T. Rivera: Vice-President Research

Nemita de la Cruz: Research Assistant (Project Leader)

College, San Pablo City, and Bay, Laguna (Region 4)

University of the Philippines (UP) at Los Baños

W. G. Padolina: Institute of Chemistry; Director, National Institutes of Biotechnology and Applied Microbiology (BIOTECH)

Ludivina S. de Padua: Institute of Biological Sciences, College of Arts and Sciences

J. V. Pancho: Institute of Biological Sciences, College of Arts and Sciences

Ernesta G. Quintana: Department of Horticulture, College of Agriculture

Encarnacion Q. Saracs: Pharmacist, UP Comprehensive Community Health Program (CCHP), Bay

Maria C. A. Echavez: UP CCHP, Bay

Department of Science and Technology

Lydia C. Tamsinin: Regional Director, San Pablo City

C. Yaco

Calapan and **Victoria**, Oriental Mindoro (Region 4)

B. L. Marasigan: Provincial Administrator

Demonstration and Training Center for Citrus-based Products, Merit (DOST/ITDI/PGOM = Provincial Government Oriental Mindoro)

Bacolod City, Negros Occidental (Region 6)

A. M. Gauzon: Dr. Pablo O. Torre Memorial Hospital (Riverside Medical Center)

A. R. Remoto: Chief of Hospital, Corazon Locsin Montelibano Regional Hospital

Luisa B. Efren: Assistant Provincial Health Officer, Provincial Health Office

R. B. Cuevas: Assistant Provincial Health Officer, Institute of Philippine Health Organizations

Joretta A. Moreno: City Health Office

Remedios L. Ortaliz: Bulig Community Health Programme

Miriam B. Montelibano

Lydia H. Arrayo: City Health Educator

Sister Mary Elia Escrupulo: Sisters of the Rural Missions

Alicia, **Ubay**, and **Tagbilaran**, Bohol (Region 7)

J. L. Dungog: Chairman of the Board, Alicia Cooperative Milling and Marketing Inc., Napo, Alicia

Department of Agriculture

R. Reyes: Official-in-Charge, Bohol Experiment Station, Gabi, Ubay

Department of Health

Lilia Pague: Field Operations Officer, Acute Respiratory Infections, Bohol Project, Provincial Health Office, Tagbilaran

Cebu City, Cebu (Region 7)

Department of Science and Technology

Araceli G. Almase: Regional Director, Regional Office no. 7

University of San Carlos

Leticia G. Cabrera: Dean, College of Pharmacy

Remedios Sol: College of Pharmacy

Jocelyn R. Locaylocay: Department of Chemistry

Cebu Institute of Medicine

Josephina Poblete: Dean

Cebu Doctors' College of Medicine (CDCM)

E. B. Gruet: Dean

Aurora M. Vibar: Coordinator CDCM-CDH Council on Health Research and Development

Erlinda R. Abellona: Chairperson, Department of Pharmacology

Davao City, Davao del Sur (Region 11)

Department of Health

Marietta C. Fuentes: Assistant Regional Director

Asuncion A. Paraan: Medical Researcher, Davao Herbal Processing Plant

Myrna A. Manzo: Pharmacist, Davao Herbal Processing Plant

W. P. Principe: Pharmacist, Davao Herbal Processing Plant

R. Malo: Agriculturist, Davao Herbal Processing Plant

Ateneo de Davac University

W. C. Vicente: Director, Centre for Education, Research and Development in Health, Davao Medical School Foundation

Trinidad C. de la Paz: Director, Institute of Primary Health Care, Davao Medical School Foundation

Perfeccion Loy: Department of Chemistry

Emelia Podador: Department of Chemistry

Mila Viacrusis

Immaculate Conception College

Adelina Royo: Dean, College of Pharmacy

Cotabato, Maguindanac (Region 12)

Cotabato Regional Hospital

E. T. de la Fuente: Head; also Head of Herbal Production Plant

ANNEX III

ACHIEVEMENTS OF THE NATIONAL INTEGRATED RESEARCH PROGRAM ON MEDICINAL PLANTS (NIRPOROMP), AS OF 1988

RESULTS OF VARIOUS STUDIES ON THE 4 PRIORITY PLANTS

PLANTS						
Local Name	Scientific Name	Parts Used	LD_{50}	Formulation	Dose	Indication
1. Lagundi	Vitex negundo L. (Fam.Verbenaceae)	leaves	103.0 g/kg	Tablet 300 mg	Adults-1 tablet every 4-6 hrs. Children (7-12yrs) 1/2 tablet every 4-6 hrs	Relief of cough due to common colds, flu and pharyngitis
2. Tsaang-gubat	Carmona retusa (Vahl) Masam (Fam. Boraginaceae)	leaves	63.1 g/kg	tablet 250 mg	Adults - 2 tablets initially then 1 tablet every 4 hrs	For symptomatic relief of non-specific diarrhoea and colic secondary to gastro-intestinal disorders
3. Sambong	Blumea balsamifera L. (Fam. Compositeae)	leaves	62.65 g/kg	tablet 250 mg	Adults - 1-2tablets every 6 hrs	For urinary tract pain and burning sensation, to increase urinary output secondary to fluid retention
4. Yerba buena	Mentha cordifolia opiz (Fam. Lobiateae)	leaves	60.26 g/kg	tablet 250 mg	Adults - 1-2tablets every 4-6 hrs	Symptomatic relief of pain, aches and discomfort such as headache, toothache, muscle pain, dysmenorrhoea and post-operative pain secondary to minor surgery

ANNEX III

PLANTS UNDER STUDY

PLANTS						
Local Name	Scientific Name	Parts Used	LD_{50}	Formulation	Dose	Indication
1. Mangosteen	Garcinia mangostana L.	fruit/ pericarp/ endocarp	fairly safe	tablet 250 mg	Adults - 2 tablets initially then a tablet 4 x a day	antidiarrhoeal
2. Ipil-ipil	Leucaena leucocephala L.	ground dried seeds	164.4 g/kg	suspension 4 g/30 ml	single dose	anthelminthic
3. Niyog-niyogan	Quisqualis indica L.	dried nuts	220.7 g/kg	chewable tablet 500 mg	single dose	anthelminthic
4. Bayabas	Psidium guajava L.	leaves	85.11 g/kg	10 % decoction,	100-150 mg/kg	antidiarrhoeal
5. Akapulko	Cassia alata L.	leaves	49.87 g/kg	10 % decoction, 5, 10,15% ointment	150-200 mg/kg pro renata	antifungal

ANNEX III

FORMULATION OF PEDIATRIC DOSAGE FORMS UNDERGOING DEVELOPMENT AND PRODUCTION

	PLANTS	FORMULATION	INDICATION
1.	Lagundi	tablet 175 mg/ml	cough
		syrup 150 mg/ml	cough
2.	Sambong	tablet 125 mg	diuretic
3.	Yerba-buena	tablet 125 mg	antipyretic

NEW PLANTS APPROVED FOR STUDY (1988)

Local Name	Scientific Name	Parts Used	Formulation	Indication
1. Ampalaya	Momordica charantia L.	young leaves		antidiabetic
2. Bawang	Allium sativum L.	cloves	capsule	antihypertensive
3. Ulasimang Bato	Peperomia pellucida L.	leaves		anti-rheumatoid arthritis, antiinflammatory
4. Cinchona	Cinchona officinale L.	bark		antimalarial

ANNEX IV

PHARMACOLOGY PROTOCOL FOR SELECTING THE PRIORITY MEDICINAL PLANTS

Agreement of 60% of the herbolarios questioned throughout the country as to the use(s), plant part (mainly leaves), preparation, dose for the conditions (symptoms) selected to be treated first yielded about 100 plants. The list was then narrowed down to about 12 and ultimately to 4 for priority investigation.

Initial pharmacological studies on the preparations as used by the herbolarios included determination of the acute LD_{50}, ED_{50}, in-vitro screening on smooth-muscle preparations (uterus, GIT, foetal heart), in-vivo monitoring of heart rate and respiration (cat, mouse, rat, pigeon), behaviour (motor activity: spontaneous, +ve or -ve reinforcement).

Mutagenicity and clastogenicity testing (Ames test, i.e. before metabolic activation; REC assay, for direct DNA damaging capacity; host-mediated assay, i.e. after metabolic activation; micronucleus test, for chromosome breakage) was also carried out.

If either the LD_{50} was very low or any of the mutagenicity tests were +ve, the plant concerned was immediately rejected.

The efficiency of the preparation was confirmed on pharmacological models and by comparison with known effective synthetic drugs.

If the margin of safety: acute LD_{50}/ED_{50}, was at least 20, then it was considered that the preparation could safely be treated as an over-the-counter (OTC) drug.

An initial clinical screening was carried out on 18 patients (6 per dose) at 3 dosage levels:

Highest dose, not exceeding the herbolaric dose

Intermediate dose (= 1/5th of the dose giving adverse effects in animals)

Lowest dose (= 1/10th of the dose giving adverse effects in animals)

The patients signed an informed consent form; their baseline parameters (blood, urine, vital signs, etc.) were determined and they were kept under observation in hospital for a minimum of 8 hours. If there was 90% efficiency, then the UP College of Pharmacy was asked to make up the material as tablets or in tea-bags (for use as a decoction). 35-45 Patients were given an effective dose and if 75-80% efficacy was realized then a double-blind placebo study was undertaken.

Finally, the herbal preparation went to the primary health care workers.

Standardization of the material used for production purposes is limited to determination of the acute LD_{50} and bioassay of the particular activity for which the material is being used. The LD_{50} of the prepared tablets is also determined.

ANNEX V

Quantity and Value of Philippine Imports of Essential Oils (1982 - 1985)

ESSENTIAL OILS	1982		1983		1984		1985	
	QUANTITY*	FOB VALUE**	QUANTITY	FOB VALUE	QUANTITY	FOB VALUE	QUANTITY	FOB VALUE
Lime and lemon oils for the manufacture of medicine	131	7,981	5,778	259,339	4,602	35,427	750	10,902
Lime and lemon oils other than for the manufacture of medicine	56,317	3,135,434	48,815	2,802,350	46,720	2,398,872	24,760	1,487,923
Citrus oil excluding lime and lemon oils for the manufacture of medicine	49	2,144	227	10,804	460	18,739	89	4,439
Citrus oil excluding lime and lemon oils other than for the manufacture of medicine	14,126	71,111	15,887	83,905	21,995	170,060	13,395	112,913
Peppermint and spearmint oils for the manufacture of medicine	-	-	-	-	13,930	126,990	4,938	49,069
Peppermint & spearmint oils other than for the manufacture of medicine	-	-	-	-	257,896	4,119,420	274,363	5,201,478
Eucalyptus oil	-	-	-	-	10,683	57,944	8,694	42,796
Ilang-ilang oil	213	5,077	300	7,639	211	4,952	-	-

* in net kilograms
** in U.S. Dollars

ESSENTIAL OILS	1982		1983		1984		1985	
	QUANTITY*	FOB VALUE**	QUANTITY	FOB VALUE	QUANTITY	FOB VALUE	QUANTITY	FOB VALUE
Other essential oils excluding oils used for the manufacture of medicine	8,575	124,408	10,963	182,635	32,875	174,472	7,623	132,556
Other essential oils excluding oils used other than for the manufacture of medicine	93,435	629,794	118,650	738,579	306,207	2,031,048	131,359	1,256,841
Terpenic by-products of the deterpenation of essential oils	6,087	13,850	4,876	10,797	2,732	8,535	1,430	3,677
Mixtures of essential oils resinoids or synthetic aromatics	219,619	1,308,726	390,035	2,317,672	119,283	1,451,346	173,625	2,297,324
Synthetic perfume & flavor materials and concentrates enfleurage grease and mixtures of alcohol and essential oils for use in perfumery	7,052	239,346	17,406	450,269	4,333	138,255	5,105	186,652
Synthetic flavor materials and concentrates enfleurage greases and mixtures of alcohol & essential oils used in the pharmaceutical and food industries	1,551,517	10,976,307	2,324,955	12,528,661	3,128,051	13,199,946	1,703,837	9,060,756
TOTAL FOR ESSENTIAL OILS, FLAVOR AND PERFUME MATERIALS	2,273,715	21,649,397	3,294,839	25,902,306	3,950,075	23,937,194	2,350,325	19,851,741

* in net kilograms
** in U.S. Dollars

SOURCE: National Census and Statistics Office, Manila, Philippines

QUANTITY AND VALUE OF PHILIPPINE IMPORTS OF ESSENTIAL OILS (1986/87).

Essential oil	1986		1987	
	Quantity*	FOB Value**	Quantity	FOB Value
Anise oil, USP or NP for the manufacture of medicine	136	1,660	70	657
Lime and lemon oils for the manufacture of medicine	561	15,341	2,358	26,536
Lime and lemon oils other than for the manufacture of medicine	-	-	23,757	973,525
Citrus oils (excl. line and lemon oils) for the manufacture of medicine	374	3,407	863	7,865
Citrus oils (excl. lime and lemon oils) other than for the manufacture of medicine	-	-	26,651	143,830
Peppermint and spearmint oils for the manufacture of medicine	4,478	55,392	3,300	52,472
Other essential oils for the manufacture of medicine	5,938	151,872	12,036	245,075
Other essential oils (excl. oils for the manufacture of medicine)	-	-	342,076	2,484,112
Synthetic flavor materials and concentrates, enfleurage greases, and mixtures of alcohol and essential oils, usedmin pharmaceutical, food, etc. industries	2,516,118	10,617,304	2,733,425	12,729,850

Reference: Central Bank Statistics

* in kilograms ** in U.S. dollars

PRINCIPAL IMPORTERS OF ESSENTIAL OILS AND THEIR DERIVATIVES

(JANUARY-JUNE, 1984).

	Value
Fortune Tobacco Corporation	$1,856,484
Pepsi Cola Far East Trade Development Co.	1,310,328
Procter and Gamble PMC	600,676
International Flavors and Fragrances (Phils.) Inc.	247,686
Seven-Up (Phils.) Inc.	178,487
Coca Cola Export Corporation	144,847
Colgate-Palmolive (Phils.) Inc.	131,595
Wrigley (Phils.) Inc.	115,538

ANNEX VI

EXTRACTS FROM A LETTER BY THE CHAIRMAN OF ALICIA COOPERATIVE MILLING & MARKETING INC. (ACMAMI), BOHOL

27 July 1988

. . . at Ubay and Alicia, Bohol, more than 65% of the arable land is uncultivated, idle lands that could be utilized for productive purposes. The farmers . . . are aware of their very low living conditions, but the government cannot provide all the solutions. The reasons for such very poor economic conditions are:

a) Lack of local market for the present cash crops (rice, corn, camote, cassava, banana, and mango);

b) The barangay roads (the farm to market roads) are very badly maintained, if there are any;

c) The farmers' means of transportation from the farm to their very limited market is only through carabao sled or carabao caromata;

d) It is very obvious that once the farmers can produce more than what is needed for the local market or for their [own] consumption, the price of such crops will go down very low so that it cannot pay back the cost of production;

e) If there are crop surpluses, the farmers have no way of storing it for future use or to hold it in anticipation of price increases because they do not have the storage facilities, nor the chemicals to kill the insects, prevent molds or hold the deterioration of such produce within a very short period of time.

. . .

. . . citronella grass planted in the ACMAMI cooperative showed very good growth, yielding 7,000 to 9,000 kilos of fresh leaves per 120 days cycle. You have seen the ACMAMI distillation equipment, and checked the oil yield at an average of 0.8% computed on the fresh leaves. ACMAMI will be willing to enter into a marketing contract with the farmers to buy the fresh citronella leaves at ₱0.50 per kilo, delivered by the farmers to the nearest available barangay road or the farmers may choose to have the citronella leaves processed in the cooperative distillation units, the transportation and processing cost being shouldered by the cooperative. The farmers will be paid at the price of ₱85.00 per kilo of whatever oil is produced. At the price of ₱0.50 per kilo of fresh leaves or ₱85.00 per kilo of citronella oil, the farmers yearly earnings will increase to over ₱10,000.00 per year per hectare. Comparing this income with the income they have from rice (90% dependent on rainfed irrigation), corn, camote, cassava, etc. which yields only between ₱3,000.00 to ₱6,000.00 per year per hectare. In addition to the above income comparison, the farmers will not be so dependent on the monthly rainfall (which is very irregular), and will no longer sustain extensive damage due to storm, typhoon, or drought with citronella plantation.

. . .

What we need . . . is funding for the initial cultivation and culture of the citronella grass at the rate of ₱8,000.00 per hectare, and the funding of distillation equipment at the cost of ₱50,000.00 per set of distillation equipment to service 38 hectares of citronella plantation. A farmer's family (consisting of 5 to 7 members) can easily farm between 2 to 3 hectares of citronella grass plantation. Therefore, in adjacent barangays with 75 farmer families, each cultivating/-

culturing two hectares of citronella grass or a total of 150 hectares will need about 4 distillation units, each unit having a loading capacity of 500 kilos of air dried citronella leaves. The initial investment for the 150 hectares plantation is ₱1,200,000 and the 4 distillation units is ₱200,000, or the total investment will amount to ₱1,400,000, employing 75 farmer families, giving each of the 75 farmer families an annual income of ₱43,968, computed as follows:

a) From the sale of fresh citronella leaves of 1,200,000 kilos per 120 days cycle, or 3,600,000 kilos per year at ₱0.50 per kilo is . . . . . ₱1,800,000

b) From the income of citronella oil distillation, out of 3,600,000 kilos of fresh citronella leaves or 2,800,000 kilos of air dried leaves (20% loss of weight) or 23,040 kilos of citronella oil at ₱65.00 per kilo is 1,497,600

Total income per year . . . . . ₱3,297,600

c) Therefore, giving the 75 farmer families an annual income of ₱43,968 per family.

If the total cost of citronella oil production is ₱150 per kilo (cost of fresh leaves at ₱0.50 per kilo plus processing cost of ₱65.00 per kilo of oil), it is possible to enter and compete in the export market at the price of USA $7.50 per kilo FOB Cebu.

. . .

ANNEX VII

DOST/ITDI OUTLINE PROJECT PROPOSAL FOR THE PRODUCTION OF ESSENTIAL OILS IN THE PHILIPPINES.

The project is to consist of two phases and will have a minimum duration of 5 years.

PHASE I Development Stage (years 1 and 2)

a) Agronomic studies. This will be concerned with all aspects of the cultivation of the plant raw material, including the selection of high-yielding strains, the determination of the optimum conditions of growth, yield, etc.

The University of the Philippines at Los Baños (UPLB) and the Central Luzon State University (CLSU) will both be involved in this work.

b) Procurement of the facilities needed for the laboratory- and small-scale distillation, as well as characterization and quality assurance, of essential oils.

These facilities should be placed with either the DOST/ITDI or the (suggested) Philippine Center for Medicinal and Aromatic Plants Research (PCMAPR).

c) Technical training of personnel from the DOST/ITDI and from the identified regional project sites (see below), to be carried out at the DOST/ITDI in Manila.

d) Procurement of the facilities required for the characterization and quality assurance of essential oils at the DOST/ITDI, Manila, and at certain of the DOST regional laboratories, e.g. Cebu, Tacloban (?).

PHASE II Pilot-plant Stage (years 3-5)

a) Optimization of processing (distillation) parameters and of equipment design.

b) Local fabrication of 4 or more distillation units having a capacity of at least 200 kg, to be installed at project sites tentatively identified as follows:

Region III: CLSU, Muñoz, Nueva Ecija - **Mint** oil
Region IV: Demonstration Center, Merit, Victoria, Oriental Mindoro - **Citrus** oil
Palawan - **Ilang-ilang** and **Patchouli** oil
Region XII: Cotabato - **Lemongrass** and **Eucalyptus** oil

c) Establishment of standards

d) Analysis of market acceptability

e) Production and Evaluation of the essential oils produced.

DCST/ITDI

ANNEX VIII

DIAGRAMS OF DISTILLATION EQUIPMENT FOR ESSENTIAL OILS

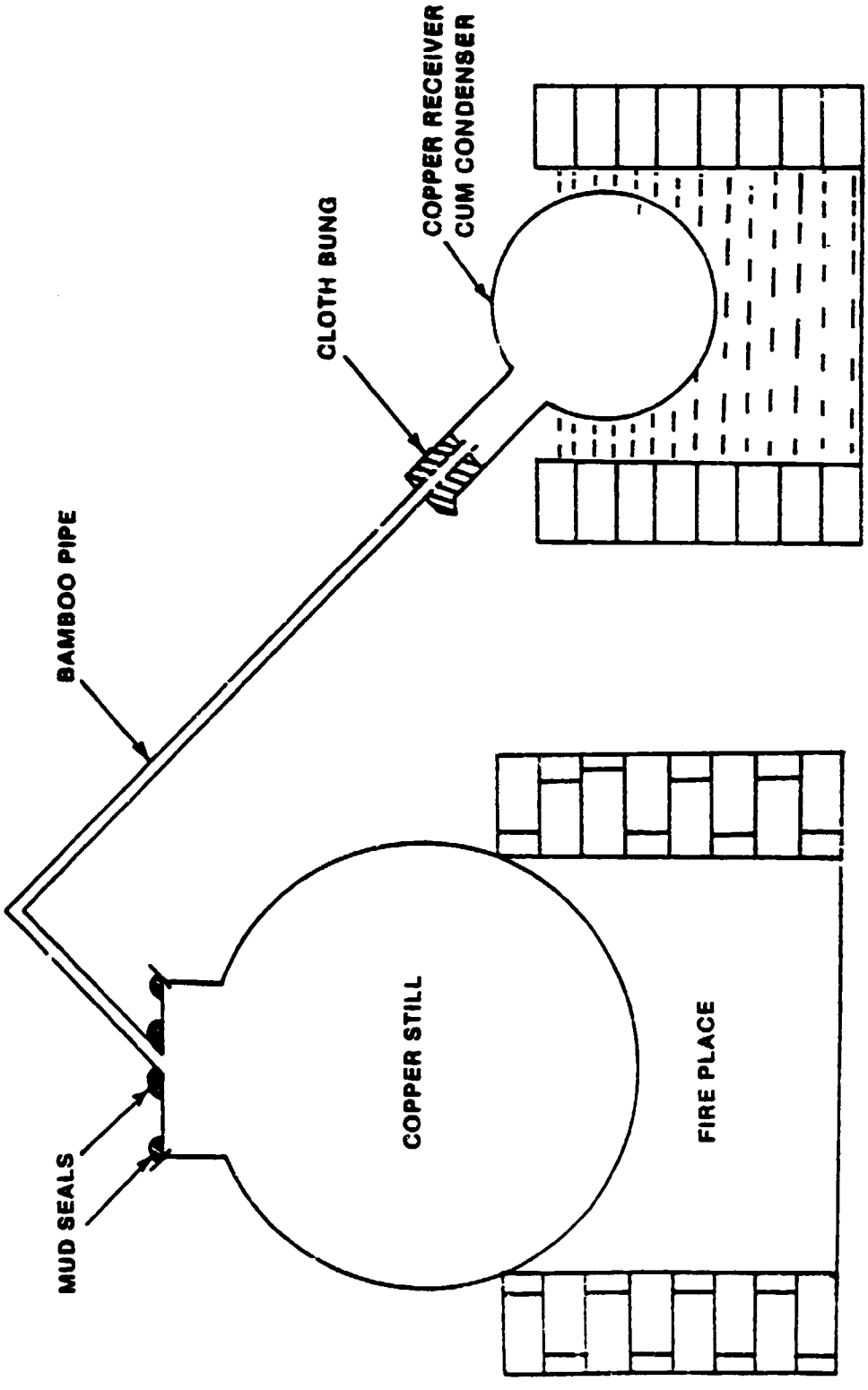


FIG. 1 COUNTRY STILL FOR HYDRO – DISTILLATION

WATER DISTILLATION

Water or Hydro distillation differs from steam distillation mainly in that the plant material is almost entirely covered with water in the still which is placed on a furnace. Water is made to boil and the essential oil is carried over to condenser with the steam which is formed. Hydrodistillation is the simplest and the oldest process known to man for obtaining essential oils, from plants. A water distillation still which is in use in India to this day is shown in Figure 1. Still is most commonly made from copper. Another vessel with a long neck is placed in a water tank or a natural pond to serve as condenser. A bamboo pipe is used as the vapour connection and mud is used to seal the various joints.

Water distillation suffers from some serious drawbacks.

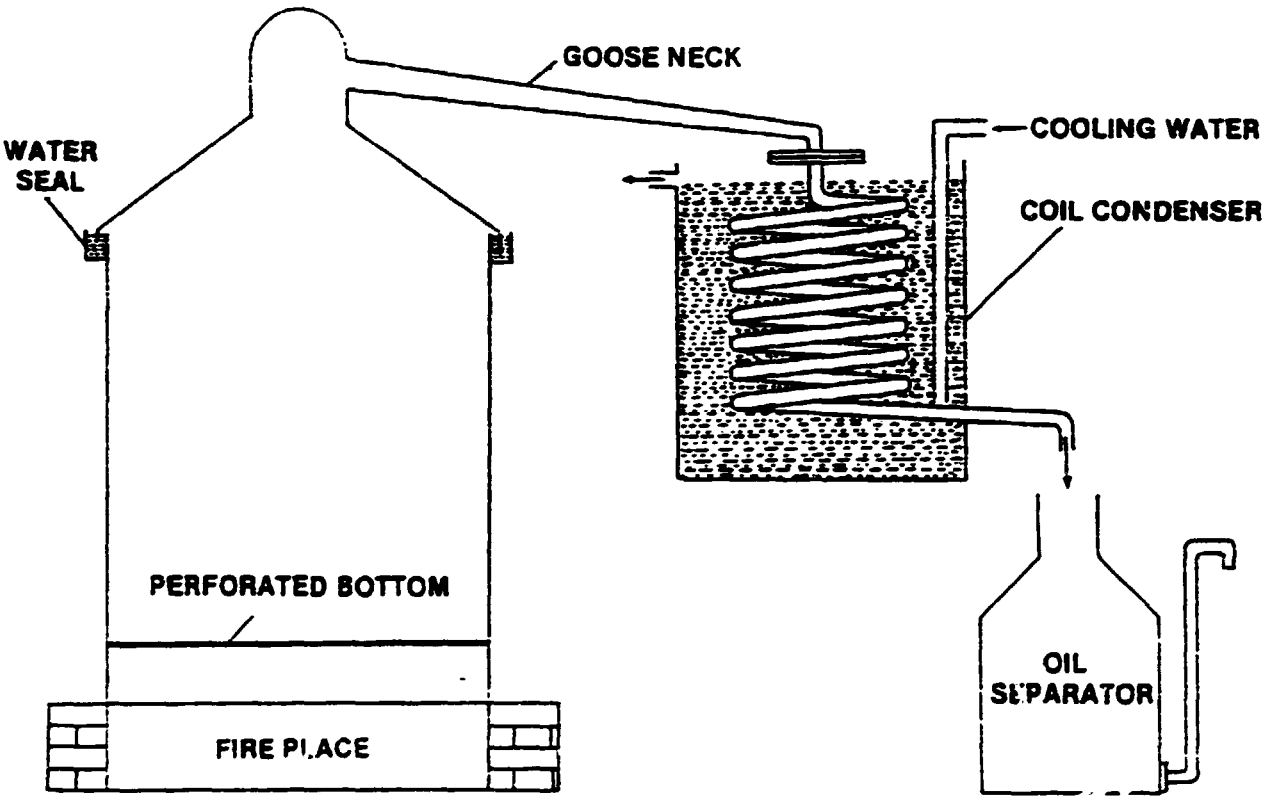


FIG. 2 FIELD DISTILLATION STILL

(a) As the plant material near the botton walls of still comes in direct contact with the fire from furnace, there is the likelihood of its getting charred and thus imparting an objectionable odour to essential oil.

(b) Prolonged action of hot water can cause hydrolysis of some constituents of the essential oil such as esters.

(c) The process is slow and distillation times are much longer compared to steam distillation. Inspite of these drawbacks water distillation is not without its advantages in certain application. Rose flowers are invariably water distilled to obtain otto of rose because if steam is blown through a layer of roses they agglutinate and form an impenetrable mass. Some of the drawbacks of water distillation can be removed if a perforated grid is introduced in the still to support the plant material as shown in Figure 2. Direct contact of plant material with hot furnace bottom is thus avoided. When the water level is kept below the grid, the essential oil is distilled by the rising steam from the boiling water.

or aluminium depending upon the corrosive nature of the essential oil. Reasonably well – equipped workshop would be required to fabricate these units. Reference (2) gives additional information on various aspects of steam distillation.

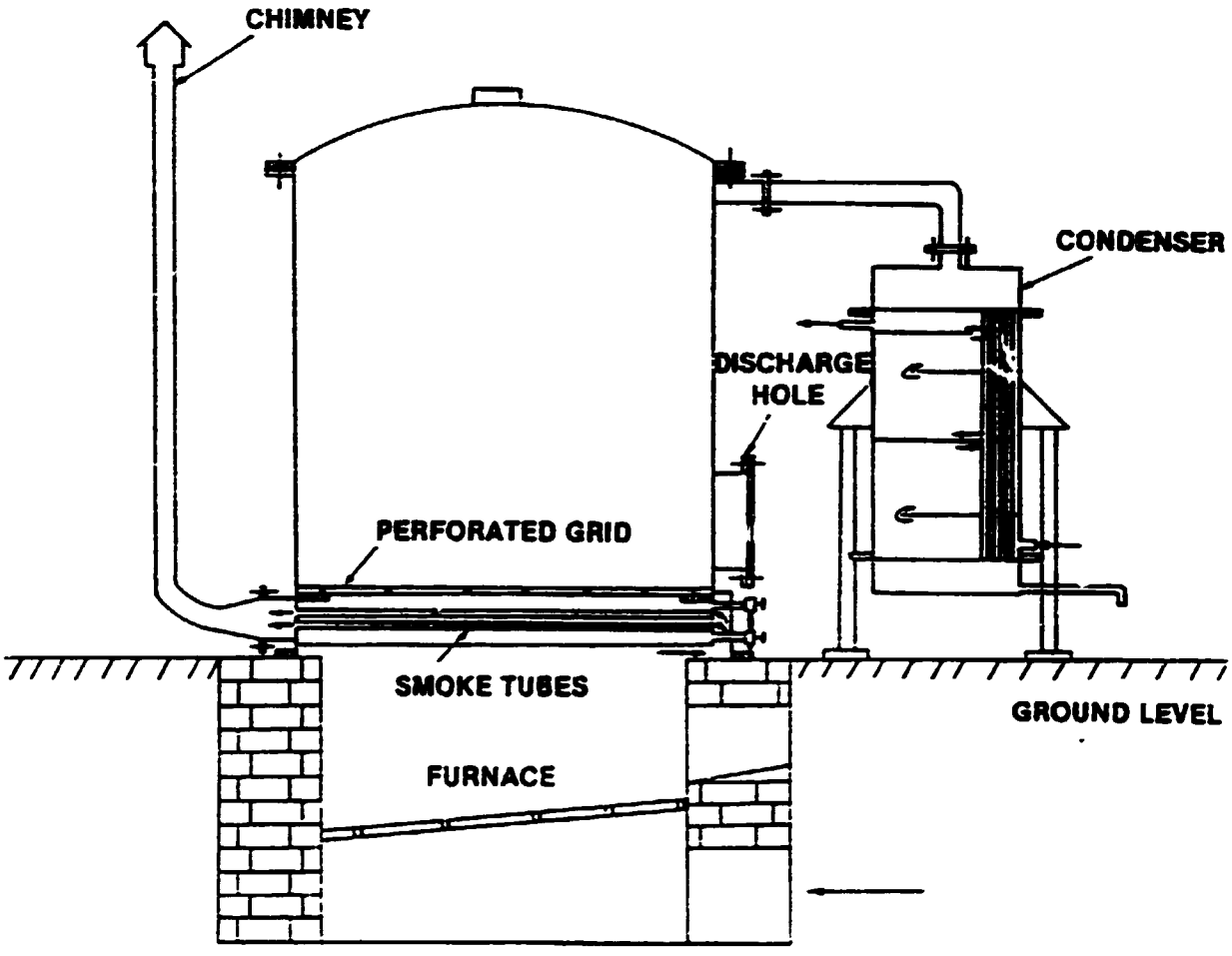


FIG. 3 IMPROVED FIELD DISTILLATION UNIT

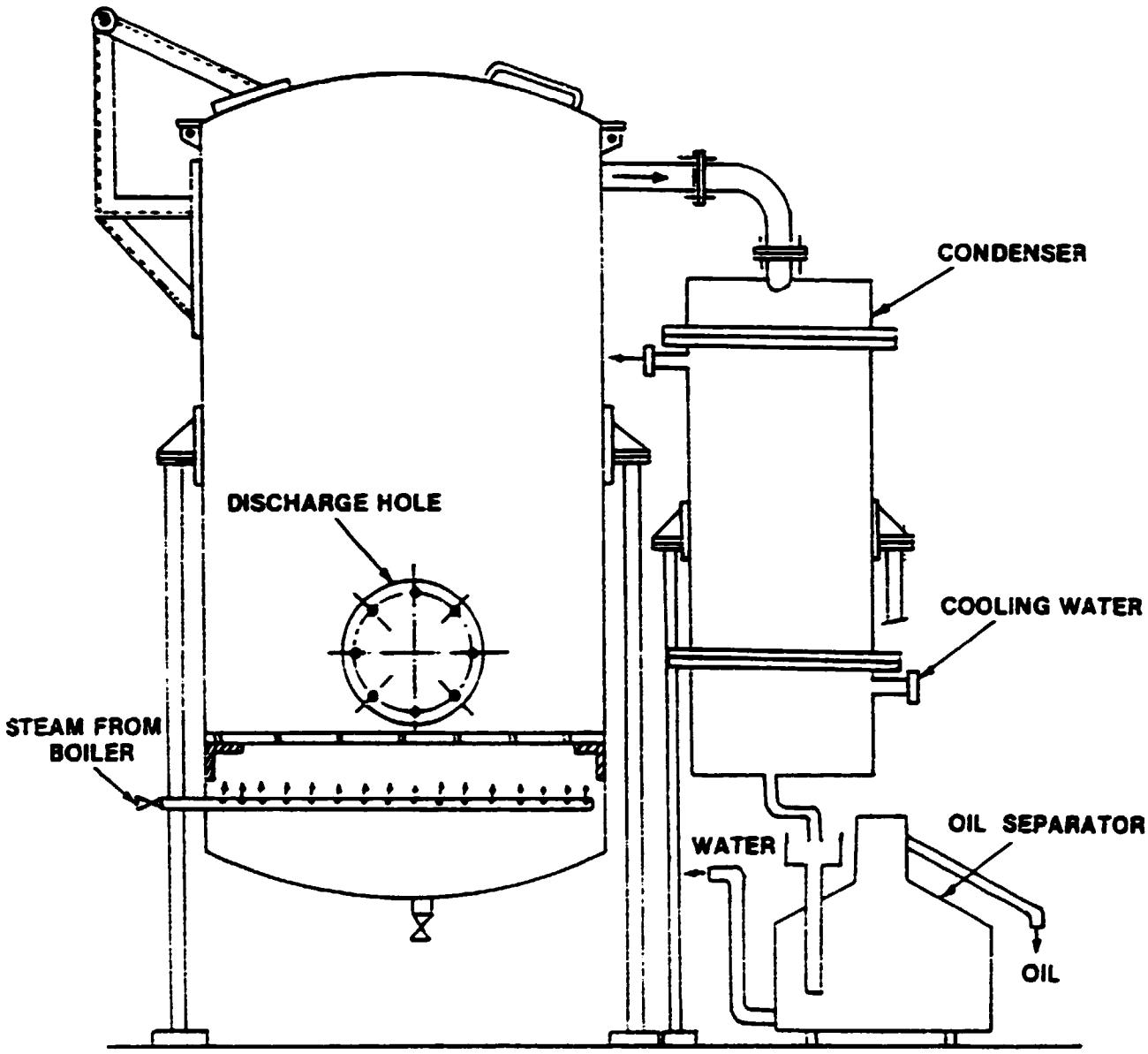


FIG.4 MODERN DISTILLATION STILL

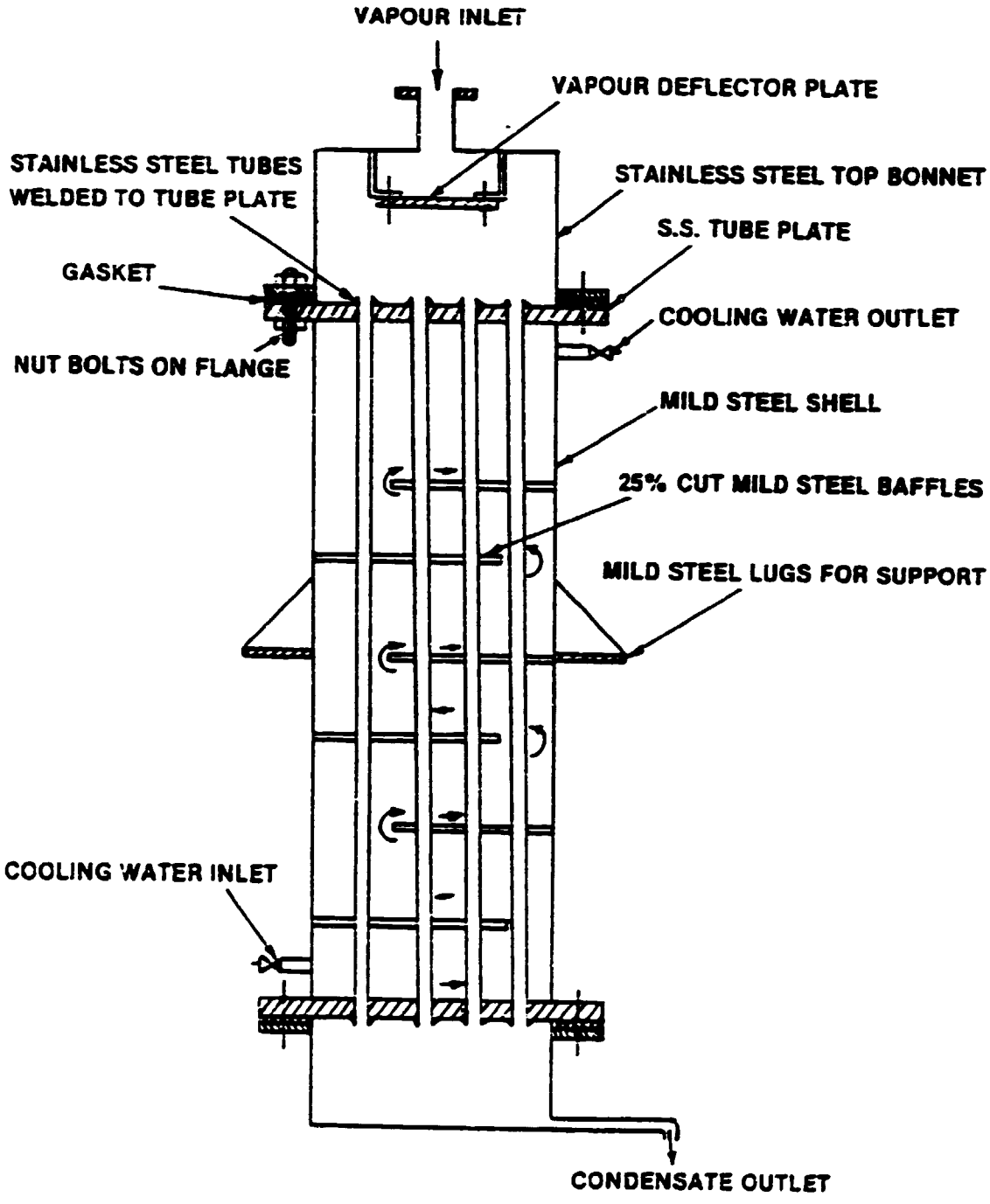


FIG. 5 CONSTRUCTION DETAIL OF CONDENSER

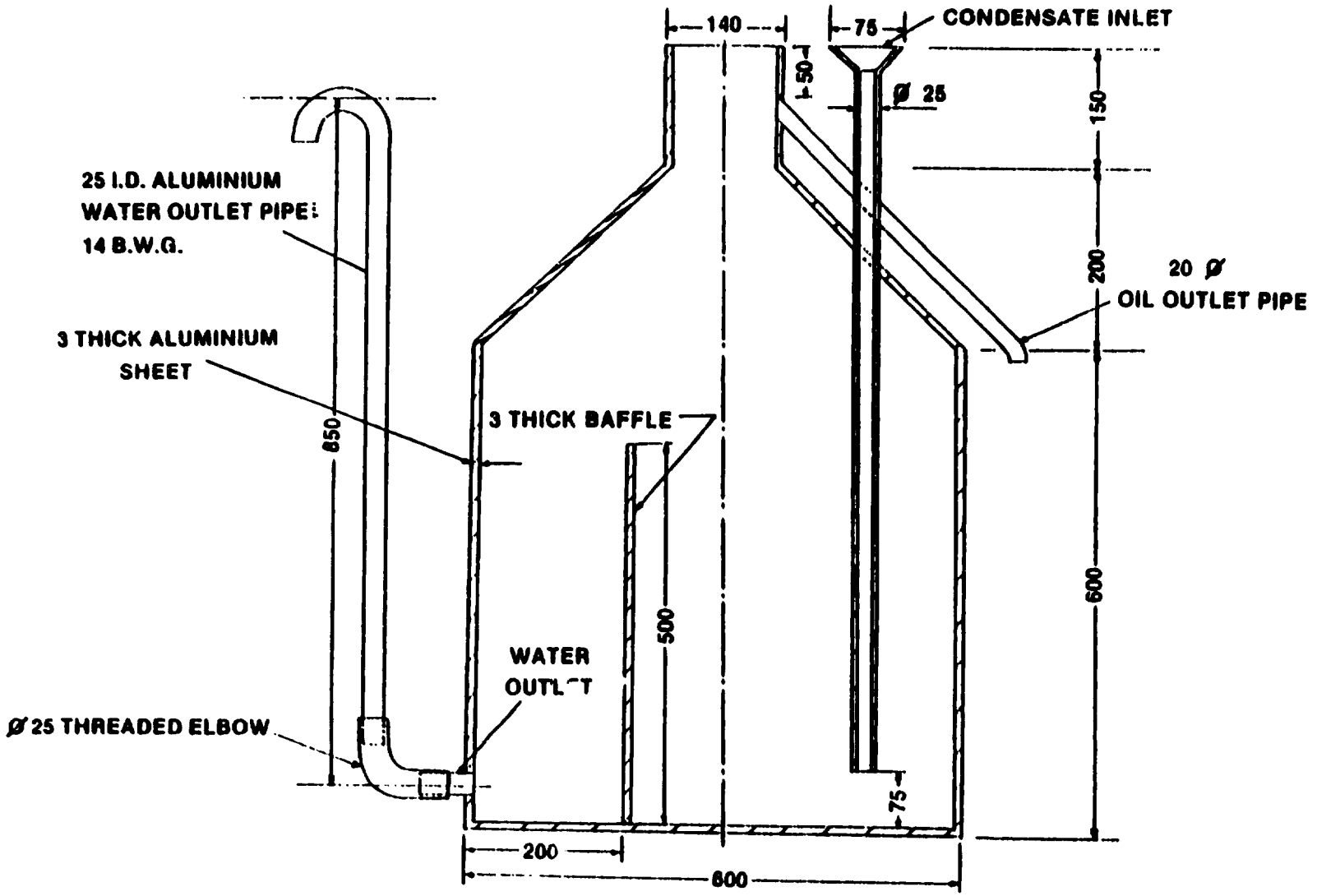


FIG. 6 DESIGN OF OIL SEPARATOR

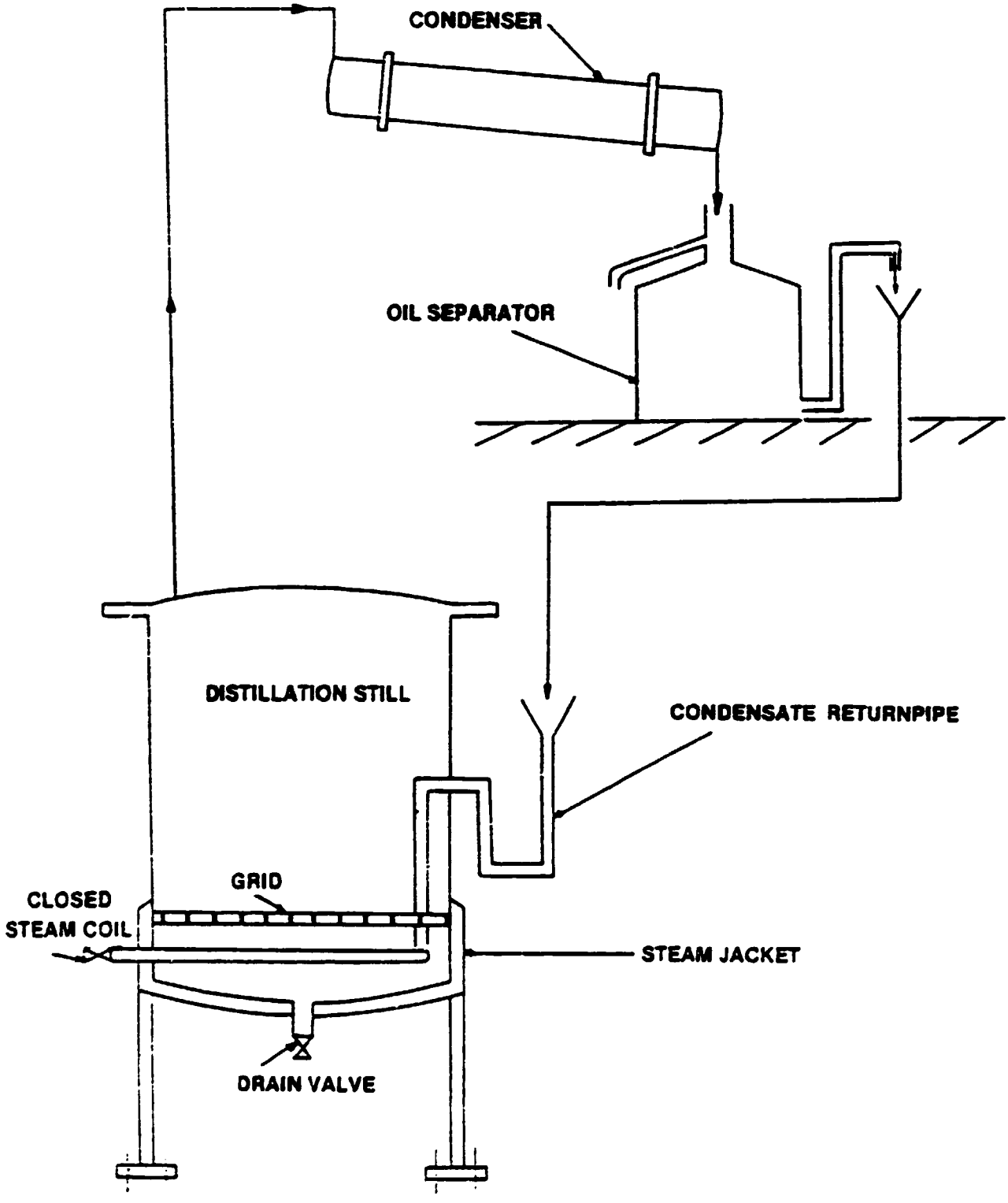


FIG. 7 DISTILLATION WITH COHOBATION

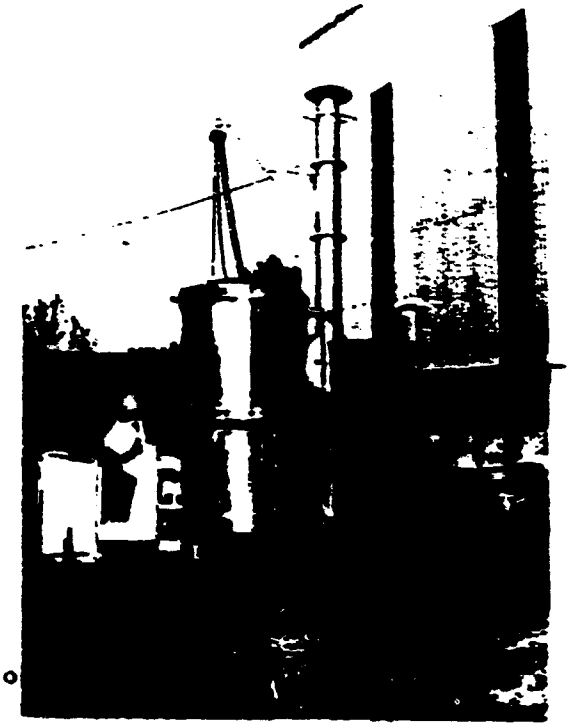
SELF GENERATOR STILL Type 200

MAIN FEATURES

This is a sturdy still, designed and manufactured to allow small producers to obtain highest grade essential oils identical to those obtained in large steam distil--lation devices.

The whole unit is placed on a portable chassis for transport by road on the spot of production. This will avoid raw materials transportations which are often expensive.

Its thorough operation requires only a fresh water source, since generally the distilled plant residues shall be sufficient for heating owing to the special all combustible fire-box which may also fire wood, brushwood, straw, etc.



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PRACTICAL OPERATING CHARACTERISTICS

Heating with distilled dry brushwood.

Time :

Cold starting	30/35 minutes
Normal distillation rate	80 Litres/hour of distilled water.
Normal duration of a distillation operation	1 H 30 maximum.

-:-:-:-:-:-:-

ALAMBIC LABORATOIRE

TYPE A FEU NU ET A BAIN-MARIE

1 - Socle en tôle pliée.
2 - Cuve de distillation à feu nu.
3 - Foyer à gaz.
4 - Niveau d'eau.
5 - Alimentation de la cuve en eau chaude.
6 - Cuve et serpentin de refroidissement.
7 - Tuyauterie d'écoulement et d'évacuation.
8 - Alimentation en eau froide.
9 - Serpentin de refroidissement.
10 - Essencier trieur.
11 - Col de cygne.
12 - Collecteur de tuyauteries.
13 - Brûleur a gaz.
14 - Manometre.
15 - Soupape de sécurité.
16 - Cheminée.
17 - Chaudière avec cuve de distillation à bain-marie.

OPTIONS

- Ces appareils peuvent être livrés dans les contenances de 100 et 200 litres et peuvent fonctionner à la demande, au gaz, à l'électricité ou au bois.

- Notre gamme de fabrication comporte également des cuves de 100 ou 200 litres fonctionnant sur générateur de vapeur séparé.

- Pour toutes autres variantes, étude sur demande.

- Alambic laboratoire pour essais de distillation et de sélection comportant deux types:

  a - alambic à feu nu.

  b - alambic à bain-marie.

- Ces appareils peuvent être prévus pour fonctionner de 0 à 330 gr ou de 0 à 3 kg de pression.

- Seuls les appareils de plus de 100 litres fonctionnant à une pression supérieure à 330 gr, sont soumis au contrôle du Service des Mines.

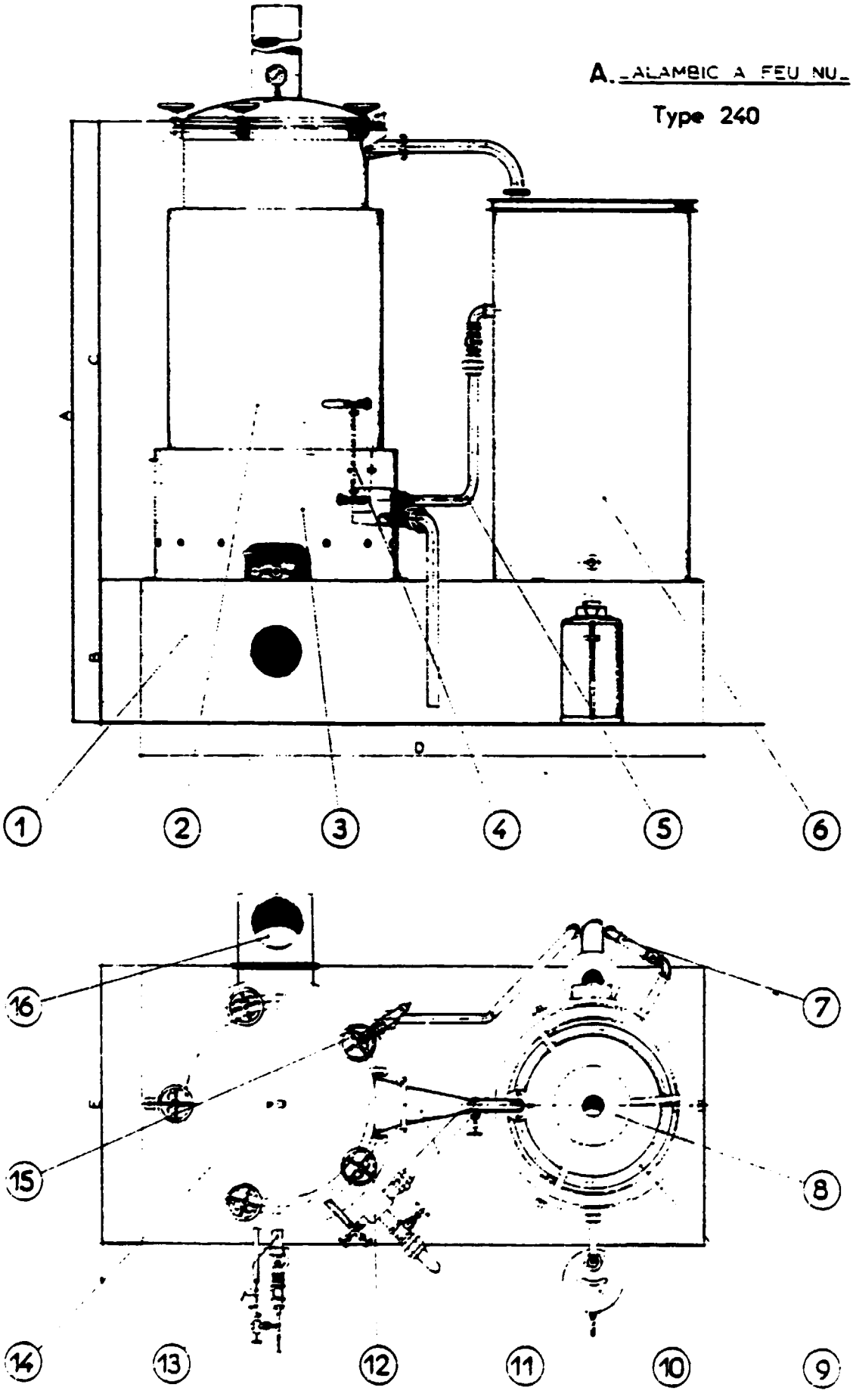
- Les appareils à bain-marie produisant 2 à 3 fois plus de vapeur à l'heure que les appareils à feu nu, sont beaucoup plus rapides que ces derniers.

- Nos appareils peuvent être aménagés pour distiller:

  - De 0 à 3kg de pression.
  - A vapeur directe.
  - A vapeur indirecte, avec serpentin de chauffe au fond de la cuve ou par l'intermédiaire d'un double fond.
  - A bain-marie par l'intermédiaire d'une double enveloppe dans laquelle circule un fluide thermique.
  - Avec cohobation.
  - Par barbotage.

A. - ALAMBIC A FEU NU -

Type 240



B. - ALAMBIC A BAIN-MARIE -

Type 241