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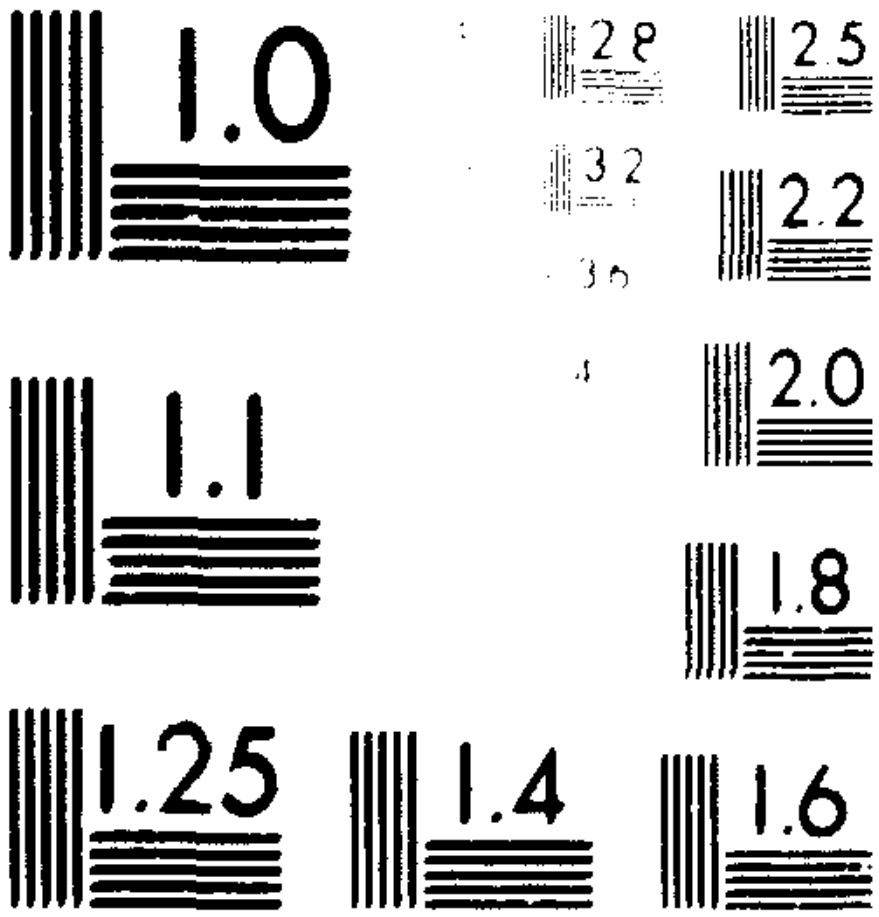

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ASSISTANCE IN THE DEVELOPMENT OF THE USE OF MEDICINAL PLANTS

DP/CMR/79/010

UNITED REPUBLIC OF CAMEROON

Terminal report *

Prepared for the Government of Cameroon by the
United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Mr. A. Naum, expert in the
growing of medicinal plants

United Nations Industrial Development Organization
Vienna

* This is a translation of a document which has not been formally edited.

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Title: Study regarding:

- The preparation of a list of medicinal plants to be grown;
- Recommendations on the agricultural techniques to be used;
- Recommendations regarding the follow-up stage.

Author: Mr. Anastasi Naum

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Subject: Examination of existing conditions with a view to introducing the cultivation of medicinal plants for extraction purposes.

Contents:

Conclusions:

INTRODUCTION

The purpose of my mission to Cameroon was to introduce the cultivation of a number of medicinal plants required by the pharmaceutical industry inside and outside the country, and in this way to make it possible to derive greater benefit from the land and from Cameroon's climatic, economic and social conditions.

The stages of my mission, which consisted of two parts of two months' duration each, were the following:

1. The study of growing and climatic conditions in the country's agricultural zones and of the conditions necessary for the cultivation of the annual medicinal plants listed in annex 1;
2. The start of an agro-technical research programme aimed at acclimatizing particular species to the climatic conditions of Cameroon and at ascertaining the production potential per hectare in terms of crude raw material and active ingredient content;
3. The preparation of a list of the supplies and machinery required for a large-scale growing programme;
4. Immediate experimentation involving the small-scale cultivation of particular varieties (annex 1);
5. The introduction and supervision of a small number of staff to work on the experimental cultivation of medicinal plants.

I. CURRENT SITUATION AND GENERAL CONSIDERATIONS REGARDING THE GROWING OF ANNUAL AND BIENNIAL MEDICINAL PLANTS

A. Current situation

1. Wild-growing medicinal plants

1.1. Production

Thanks to its varied relief and its equatorial and tropical climate, Cameroon is very rich in wild medicinal plants which, since time immemorial, have been used in the country's traditional medicine.

Over the last 15 years these wild medicinal plants have attracted increasing attention on the part of drug manufacturers in Belgium, France, the United States of America and other countries, with the result that exports rose from 350 tonnes in 1969 to 1,818 tonnes in 1977, dropping again to 915 tonnes in 1979.

On the other hand, the number of species harvested and exported (annex 2) is fairly limited, the over-all leaders being the bark of Pygeum africanum, the seeds of Voacanga africana, and the bark of Pausynistalia (corynanthe) yohimbe.

The harvesting and processing for export of medicinal plants is in the hands of ten trading companies (annex 3), the most important of which appears to be the firm Continaf Cameroun S.A.

Following the establishment of the National Company for the Marketing of Medicinal Plants (SONACOM), this activity has been concentrated under State direction.

1.2. Scientific research

Scientific research into wild-growing medicinal plants is conducted by the Centre for the Study of Medicinal Plants (CEPM). There are several parallel research programmes:

- Determination of the botanical classification of the numerous plants used in traditional medicine;
- Scientific study of the therapeutic effects of these plants and the elimination of the many superstitious beliefs that still surround them;
- Scientific determination of possible areas of application of these plants.

A word of praise is due for the dedicated and courageous work of Mr. Bernard Boum, Head of the Centre for the Study of Medicinal Plants, Mr. Fonki Tobias Mbenkum, Head of the Botanical Laboratory, and, since June, Dr. Christiana Nso Mbi.

2. Cultivated medicinal plants

2.1. Current situation

The only plant currently cultivated is the cinchona (quinquina) tree.

There was an unsteady pattern to the growing of this tree during the period 1953-1980. Following the cultivation of 300 hectares in 1953, the plantations were cleared in 1958, and a special effort is now being made to plant 230 hectares at Dschang.

Annual and biennial medicinal plants have never been grown in Cameroon. Nor is this subject covered in the curriculum of the Dschang Institute of Agricultural Techniques or in the research programme of the Nkolbisson Agricultural Research Institute at Yaoundé.

B. General considerations regarding the growing of annual and biennial medicinal plants

1. Economic considerations

1.1. Because of their fairly high price, medicinal plants increase the value obtained from the soil, the climate and the labour of the growers and can double the financial return per hectare.

1.2. Unlike plants growing in the wild, cultivated medicinal plants represent a reliable source of raw materials for chemical and drug industries at home and abroad, removing the element of chance.

1.3. Wild medicinal plants are unlikely to expand in future. In another ten years or so, when medicinal plants harvested on a haphazard basis begin to decrease, the supply of raw materials for the chemical and pharmaceutical industry will have to be ensured through the cultivation of these plants.

2. Social considerations

2.1. The growing of medicinal plants provides a means of creating work for larger numbers of persons, both young and old, in the harvesting of the flowers, the leaves, or the entire plant; this task requires no special skills and can therefore be a source of employment for village families with numerous children.

3. Agro-technical considerations

3.1. Climatic requirements

The seeds of the majority of medicinal plants are small or very small and must be sown on the surface or at a shallow depth (1-2 cm); in addition, they require high soil humidity (about 60-75 per cent).

Climatic requirements vary according to the variety in question:

- Medicinal plants grown for their flowers and seeds require fine, dry weather during the harvest period (three or four months after sowing);
- Medicinal plants grown for their leaves and herbs require steady but moderate rain in order to re-establish growth after the first and last harvest;
- Medicinal plants grown for their roots require a period of dry weather during the harvest.

3.2. Soil requirements

Most medicinal plants need permeable soil with a good structure, rich in humus, free of weeds or with a low biological reserve of herbs.

It is worth while meeting these requirements in order to obtain an abundant harvest which will pay for the expenses involved.

II. DETERMINATION OF THE MEDICINAL PLANTS TO BE GROWN AND OF SUITABLE ZONES FOR GROWING THEM

1. Determination of the medicinal plants to be grown

1.1. The criteria underlying the determination

In preparing this list of plants, I was guided by the following criteria:

- The needs of foreign chemical industries;
- The possibility of processing the plants at the Dschang Extraction Plant;
- The possibility of acclimatizing a number of European species and also of bringing under cultivation certain native varieties;
- The observations of the expert, Professor Finn Sandberg;
- The requests of the Centre for the Study of Medicinal Plants at Yaoundé.

1.2. List of recommended species (annex 1)

This list is divided into:

- Annuals;
- Biennials;
- Trees and shrubs.

A division of this sort is necessary in order to establish the different kinds of soil required for the various species.

2. Identification of a zone suitable for the growing of the annual and biennial medicinal plants

2.1. Success in growing medicinal plants is the result of the favourable concurrence of the following factors during the growing period:

- Soil, with its most important elements:
  - Structure;
  - The presence of organic matter;
- Climatic factors:
  - Temperature;
  - Rainfall;
- Seed quality;
- The skill of the growers.

In order to establish the first two factors and thus locate the appropriate growing zone, it was necessary to consult a large body of pedological and meteorological data. This information was very kindly made available to me by the departments of soil science and meteorology of the Agricultural Research Institute (IRA).

Each of these factors is analysed below in terms of the requirements of the annual and biennial medicinal plants listed in annex 1.

2.2. The soil

The analysis relates only to lands which are allocated to extensive and intensive cash-crop or food-crop agriculture and which total some 3 million hectares or 6.3 per cent of the total area of the country.

This soil is high in laterite and iron and low in organic matter (humus), with a pronounced acid reaction (pH 4-6).

There is, however, in Western Cameroon (annex 4), within the Nkongsamba-Dschang-Bamenda-Foumban-Bafoussam area, a zone with fairly rich ferruginous terrain and extensive inclusions of volcanic tuff covered by very fertile black earth. Within this zone there are some 1.1 million hectares of agricultural land.

I personally visited this area, the fertility of which is demonstrated by the abundant maize harvests; yields are 3,000-3,500 kg per hectare.

2.3. Temperature

The data for the mean annual and monthly temperatures are based on records kept over many years at weather stations located in the zone described above (annex 5).

For the entire zone the mean annual temperature may be taken to be 20-24.4°, which is very satisfactory for the growing of medicinal plants. In addition, the variation in mean monthly temperature is insignificant, at 2-4°, with no abrupt upward or downward swings.

From this point of view, also, the conditions in this zone are highly favourable.

2.4. Rainfall

The mean and monthly data were recorded at the same stations as the temperature (annexes 5 and 5 bis). The annual precipitation for this zone, lying approximately between 1,582 mm/m^2 and 2,685 mm/m^2, is satisfactory for the growing of medicinal plants, even with rapid evaporation, but its monthly distribution is not uniform.

The mean monthly rainfall together with the mean monthly temperature (annex 6, pp. 1-6) will affect particular aspects of growing techniques relating to the best time for sowing, harvesting, drying, etc.

2.5. Conclusions

My opinion, on the basis of these data, is that the only region offering suitable conditions for the large-scale cultivation of medicinal plants is the Nkongsamba-Dschang-Bamenda-Foumban-Bafoussam area (annex 7), possibly extended as far south as Njombé and as far north as Ngaundéré.

Naturally, only close observation and experience will permit decisions on soils and their lateritic or volcanic composition or sowing dates which may offer the likelihood of abundant harvests or not justify cultivation.

The use of methods which have proved successful in Europe and elsewhere for the growing of medicinal plants might well result in total failure.

I believe that some 2,500-3,000 hectares of medicinal plants could be grown in this zone without detriment to the other essential food crops. This represents 0.002-0.0027 per cent of agricultural land, a figure similar to that found in countries with substantial experience in the cultivation of medicinal plants.

Not included in this area are the tree and shrub species that do not require a fertile soil. Land around forest areas or wooded hills can be used for this purpose.

III. SMALL-SCALE CULTIVATION OF MEDICINAL PLANTS

1. The purpose of experimental testing is to ascertain the feasibility, under natural conditions, of growing and harvesting the species recommended for cultivation.

Unfortunately, only six plants have been tested using the seeds available to us (Datura innoxia, Hyoscyamus niger, Glaucium flavum, Digitalis lanata, Pyrethrum cinerariefolium, and Atropa belladonna). No other plants were tested because of the lack of seeds or propagation stock.

2. The experimental test sites

The tests were conducted at four sites (annex 8):

- The Agriculture Research Station at Nkolbisson;
- The Agriculture Research Station at Foumbot;
- The Cinchona Propagation Farm at Dschang;
- The Centre for the Study of Medicinal Plants at Yaoundé.

The most important tests were carried out within the area proposed for the growing of medicinal plants.

3. Information on testing procedures, methods used and observation sheets for each planting can be found as follows:

- Information on testing procedures in annex 9;
- Information on methods used and observation sheets in annex 10.

IV. PERSONNEL TRAINING

I was greatly assisted in the organization of experimental tests by the attention and consideration shown to me. Among the senior staff of the institutes, research stations and study centre I found people of great competence with a keen interest in the conduct of these tests (annex 11).

The test results (annexes 13-19) suggest a number of observations regarding adaptation of plant varieties to the soil and climatic conditions of Cameroon, methods of cultivation, and the feasibility of the large-scale growing of medicinal plants in the future.

The following conclusions may be drawn:

1. Of the six European medicinal plants tested, four (Datura innoxia, Glaucium flavum, Digitalis lanata, and Pyrethrum cinerariefolium) produced the expected positive results, and two (Atropa belladonna and Hyoscyamus niger) failed.

It has not been possible at this time to determine precisely the reasons why the tests with the last two plants were not successful. It may be, however, that the causes were connected either with the unsuitability of the plants themselves or with technical errors (sowing at the wrong time, incorrect depth of planting, etc.).

2. Regarding the four plants which prospered, the following observations are in order:

- The Datura innoxia grew well at three stations (Yaoundé, Nkolbisson, and Foumbot);
- The Digitalis lanata and Pyrethrum cinerariefolium grew well at two stations (Dschang and Foumbot);
- The Glaucium flavum grew well at only a single station (Foumbot).

3. Although these four plants produced good results, nearly identical to those achieved in European plantings and offering a real prospect of further expansion, the techniques used cannot be said to have been the best. Observations of the growth of the plants clearly suggest the need for changes in the time of sowing, intervals and, as a result, the time of harvesting. By improving the growing methods and adjusting them to the climatic and soil conditions of Cameroon, these plants can be expected to exhibit spectacular growth performance.

4. Harvests, past and present, must always be analysed in terms of the plant's content of active ingredients. Here too, on the basis of these analyses, changes in growing techniques will be required.

5. Observations on the growing of Datura innoxia

- Better germination, and faster (10-12 days), than in Europe (minimum 21 days).
- More rapid growth of the plant (an average of 80 days as opposed to 90-100 days in Europe).
- The average yield (herba Datura innoxia) from the first harvest is nearly 40 per cent greater than the European average (222 m^2 under cultivation = 316.9 kg green = 14.274 kg green/hectare).
- Despite these good results, during the first harvest the plants experienced a severe attack of a leaf and root blight tentatively identified as Alternaria and Sclerotinia scleratiniarum. This attack was caused and abetted by the high temperature and humidity during the period in question, and completely destroyed the second harvest. If this blight is to be avoided and a second harvest made possible, it would be best for the sowing time to be moved forward to June-July and thus the second harvest to November and December, the months with the lowest humidity.
- It should be borne in mind that this yield was produced in deficient soil and without the use of chemical fertilizers or herbicides.
- Tests are required to determine the optimal density of the plantings.

6. Observations on the growing of Digitalis lanata

- Seed-bed germination results are similar to those achieved in Europe.
- Little growth in the seed-bed until the plants are set out (73 days at Foumbot and 108 days at Dschang), but compensated by rapid growth after they are set out.
- Although no leaves have yet been harvested, nevertheless, considering the remarkable growth of the plant, the anticipated leaf yield will surpass the customary figure of 6,000 kg green/hectare for Europe.
- Sowing directly in the field does not produce good results because of the time of sowing chosen (March), at the beginning of the rainy season, the rains not yet being sufficient to ensure permanent humidity at the depth at which the seeds are planted.

- Field-sowing tests will be required during the months of May, June, and July.

7. Observations on the Glaucium flavum harvest

- Lengthy germination because of the badly selected sowing time (early April), the rainfall failing to ensure the necessary humidity at the depth of planting. Germination was delayed 20-25 days until the onset of the May rains.
- Although nothing has yet been harvested, nevertheless, considering the remarkable growth of the plant, anticipated herba Glaucium yields will exceed 30,000 kg green/hectare.
- Tests are required to determine the best planting time, the spacing, and the effect of fertilizer.

8. Observations on the growing of Pyrethrum cinerariefolium

- This species thrives very well and presents no particular problems.
- This plant has been and is now being grown in Zaire with good results, and Zairian experience in this area could very easily be adapted in Cameroon.

9. The per-hectare return on these plants, as well as the raw material price to be paid to the growers, has not yet been precisely determined. This can be done later on. Nevertheless, on the basis of the yields actually achieved or merely estimated, it is safe to say that these crops will generate a higher return for their growers than the other crops now grown in the same zone (coffee, cacao, ground-nuts, maize, etc.).

It is expected that further testing will shed light on this aspect.

10. It is quite clear that the raw material obtained from these plants can be turned to profit only if the active ingredients are extracted and processed at a facility located in Cameroon itself. The shipment of the plants to Europe for extraction and processing is not economically sound because of the very high transport costs, which increase exorbitantly the prices of these products so that they are no longer competitive against the same products produced in Europe, without these or only transport costs.

11. At this time, Cameroon has no industrial facilities at which the pharmaceutically active ingredients of these plants can be extracted. However, such a capability will be developed in the very near future (see the renovation of the Dschang plant and other government projects).

Until that time, answers must be sought through agricultural, botanical and chemical research to the numerous questions surrounding this sector, and suitable solutions must be found to the various problems encountered.

What is in any case now certain is that certain medicinal plants can be successfully grown on a large scale in Cameroon.

V. RECOMMENDATIONS

Given the specific conditions in Cameroon (climatic, agricultural, economic, and social), the introduction of the systematic cultivation of medicinal plants, both native and foreign, must be planned and carried out with great care in order to protect both the growers and the companies involved in the harvesting and processing of the plants against economic loss, from the very outset of this undertaking.

In the light of what has been said, it is my opinion that the programme for introducing the cultivation of medicinal plants should be divided into two stages as indicated below.

First stage

A. The establishment in Cameroon of a medicinal plant research laboratory under the auspices of the Agricultural Research Institute (IRA) of the Department of Scientific and Technical Research. The establishment of this laboratory within IRA is justified on the following grounds:

(a) In the final analysis, research on the growing of medicinal plants is agricultural research;

(b) IRA has the space and equipment necessary for this laboratory;

(c) A laboratory set up in this way will be able to take advantage, more readily and more efficiently, of the assistance available from IRA's other research departments (meteorology, soil science, crop protection, agricultural mechanization, etc.).

1. The mission of the laboratory will be to inquire into all the problems of a practical or theoretical nature connected with the cultivation of particular medicinal plants until such time as a Cameroonian facility or industry is established to handle the extraction of the active ingredients.

Following the setting up of this facility and when the requests from industry increase, the laboratory will pursue two goals:

- The popularization of these plants among the peasants;
- The cultivation of its own medicinal plants through the use of available growing areas.

2. The laboratory will have its own research and management programme.

3. The laboratory will have a headquarters and two or three field support points linked with other agricultural research stations.

4. The laboratory will be affiliated to one of the existing research stations in the region proposed for the growing of the medicinal plants.

5. The laboratory will be staffed by the following personnel:

(a) At headquarters:

- Laboratory Head

  The Laboratory Head's main task will be the planning, supervision and implementation of the agricultural research programme. He will work both with his team and in close co-operation with the botanical and chemical laboratory of the Centre for the Study of Medicinal Plants.

  He will also have a research project to carry out.

  The candidate for this position must be an agronomist or agricultural engineer with some experience.

- One or two research assistants to work on all the research projects of the programme.
- One or two agricultural technicians.
- Five or six workers.
- A book-keeper.

(b) At the field support points

- One research assistant (agricultural engineer) for the programme projects.
- One technician.
- Two or three workers.

The field support points will be managed by the research stations or affiliated.

6. The following sites have been proposed for the location of the laboratory:

- The Research Station at Bambili, or
- The Research Station at Foumbot.

7. The following sites have been proposed for the field support points:

- The Research Station at Foumbot or Bambili, or
- The Research Station at Ngaundéré.

8. The required area is as follows:

- For the headquarters: 2-3 hectares;
- For a field support point: 1-2 hectares.

B. For the co-ordination of the research effort and the evaluation of the results achieved both in the field and at the Centre for the Study of Medicinal Plants (CEPM), a co-ordination office must be set up in the framework of the Centre's botanical laboratory.

The person selected to head this office must be an agronomist or agricultural engineer with extensive experience and a background in agricultural and botanical testing. His responsibility will be to co-ordinate agricultural research with the botanical and chemical research conducted at the Centre. He will be required to devote at least 50 per cent of his working time to the cultivation of medicinal plants both within the laboratory and at the field support points.

1. IRA's medicinal plant research laboratory and CEPM's botanical laboratory will submit an annual report summarizing the results of their research.

2. The programme for the first period is given in annex __.

3. For a successful research programme on the growing of medicinal plants it is absolutely necessary that two Cameroonian agricultural engineers (one from the Centre for the Study of Medicinal Plants and the other from the medicinal plant research laboratory to be established) should be sent, through UNIDO, for specialized training in this area.

The period of training will be eight months, coinciding with the growing period of the plants. It will be from 1 March to 30 October.

The countries recommended for providing this training are the following:

- Romania: Research Station for the Cultivation of Medicinal and Aromatic Plants, Fundula, in co-operation with Trust Plafor, Bucharest.
- Hungary: Institute of Medicinal Plant Research, Budakalasz.
- USSR: Institute of Medicinal Plant Research, Simferopol.

The trainees may be sent either to the same country or to different institutes.

In the planning of the specialized training, provision should be made for the specialists from Cameroon to become familiar with agricultural research in this field and with the work of the host country's large enterprises and companies working with medicinal plants.

4. In order to facilitate this activity through UNIDO, it is essential in my opinion that an expert in the cultivation of medicinal plants be assigned to Cameroon to lend technical assistance.

This expert will be required to work with the Agricultural Research Institute, the medicinal plant research laboratory, and the Centre for the Study of Medicinal Plants.

The recommended duration of his assignment is two years.

5. To enable him to carry out his mission, the expert should continue to have the Toyota vehicle at his disposal.

6. The services of this expert in Cameroon will be required only after the medicinal plant research laboratory has been set up.

Second stage

The initial steps towards the establishment of a company to develop the large-scale growing of medicinal plants and apply the results of the research can be taken only after the work on the first stage has been completed.

The development programme in both its stages is given in annex 20.

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Mr. Antoine Abondo	IMPM, Yaoundé
Mr. Bernard Boum	CEPM, Yaoundé
Miss Cristine Mbi	CEPM, Yaoundé
Mr. Fonki Tobias Mbenkum	CEPM, Yaoundé
Mr. Jacques Paul Eckebill	IRA, Yaoundé

Annex 1

LIST OF MEDICINAL PLANTS PROPOSED FOR CULTIVATION

Type	Specific name	Family	Part of the plant used	Application
1. Annuals	Digitalis lanata	Serophulariaceae	Leaves (folia)	Extraction of lanatozide C
	Datura innoxia	Solanaceae	The entire aerial part (herba)	Extraction of scopolamine
	Glaucium flavum	Papaveraceae	"	Extraction of glaucine
	Hyoscyamus muticus (niger)	Solanaceae	Leaves	Antiseptic
	Chrysanthellum americanum	Asteraceae	Young leaves (folia)	Cardiotonic
	Chenopodium ambosioides	Chenopodiaceae	Inflorescence and leaves (sumitates)	Vermifuge
2. Biennials	Gloriosa superba	Liliaceae	Seeds (semen)	
	Gloriosa simplex	"	"	
	Atropa acuminata and belladonna	Solanaceae	Roots and leaves (radix et folia)	Extraction of atropine and antispasmodic
	Pyrethrum cinerariefolium	Asteraceae	Flowers (flores)	Extraction of pyrethrin
3. Trees and shrubs	Cephaelis ipecacuanha	Rubiaceae	Flowers (flores)	Against amoebic dysentery
	Cinchona ledgeriana	Rubiaceae	Bark (cortex)	Extraction of cinchona
	Voacanga africana	Apocynacus	Seeds (semen)	Extraction of tabersonine
	Pygeum africanum	Roseaceae	Bark (cortex)	Against hypertrophy of the prostate

Annex 2
(According to Cam-Av.)

EXPORT OF MEDICINAL PLANTS

1969	-	350 tonnes	1975	-	1 065 tonnes
1970	-	557 "	1976	-	1 136 "
1971	-	61 "	1977	-	1 818 "
1972	-	84 "	1978	-	1 627 "
1973	-	258 "	1979	-	915 "
1974	-	785 "			

The main export products are:

- Bark of the Pygeum africanum: 800 tonnes during 1978-1979
- Yohimbe bark: 150 tonnes
- Seeds of the Voacanga africana: 750 tonnes

LIST OF MEDICINAL PLANTS

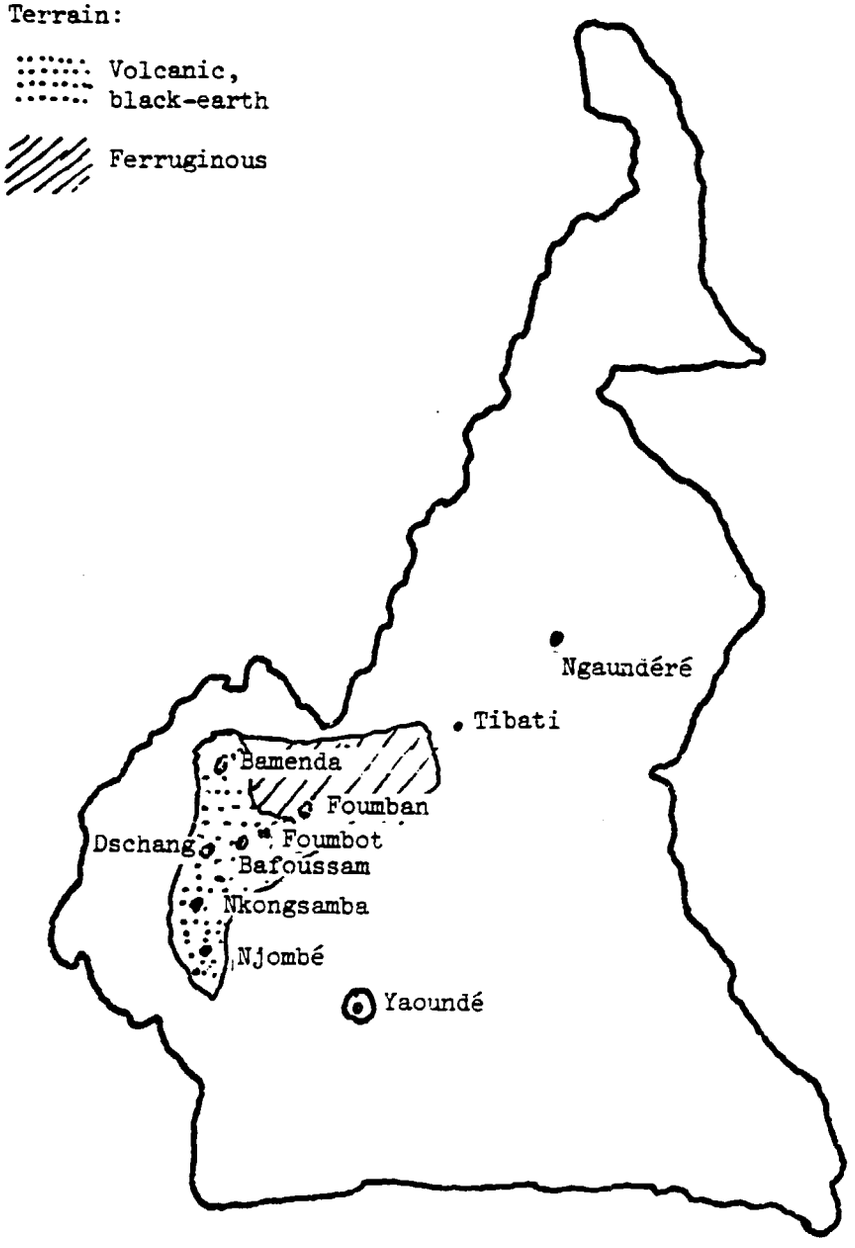
1. Voacanga africana
2. Vinca rosea
3. Rauwolfia vomutoria
4. Pausynistalia yohimbe
5. Pygeum africanum
6. Funtumia elastica
7. Strophantus species
8. Iboga tabernathe

Annex 3
(According to Cam-Av.)

COMPANIES DEALING IN MEDICINAL PLANTS

1. Continaf Cameroun S.A., Douala
2. Groupement libre des exploitants des plantes médicinales et des produits tropicaux, Yaoundé
3. Plantecam, Yaoundé
4. Société des plantes médicinales et tropicales, Douala
5. Société J.P. Papadopoulos, Yaoundé
6. Etablissements Tsanga Onana Laurent, Yaoundé
7. Etablissements Nyang et Frères, Yaoundé
8. Nacho Industries, Bamenda
9. Union Trading Afrique-Cameroun, Yaoundé
10. SONACOM, Yaoundé

Annex 4



MAP

showing appropriate soils for the growing of annual medicinal plants

Annex 5

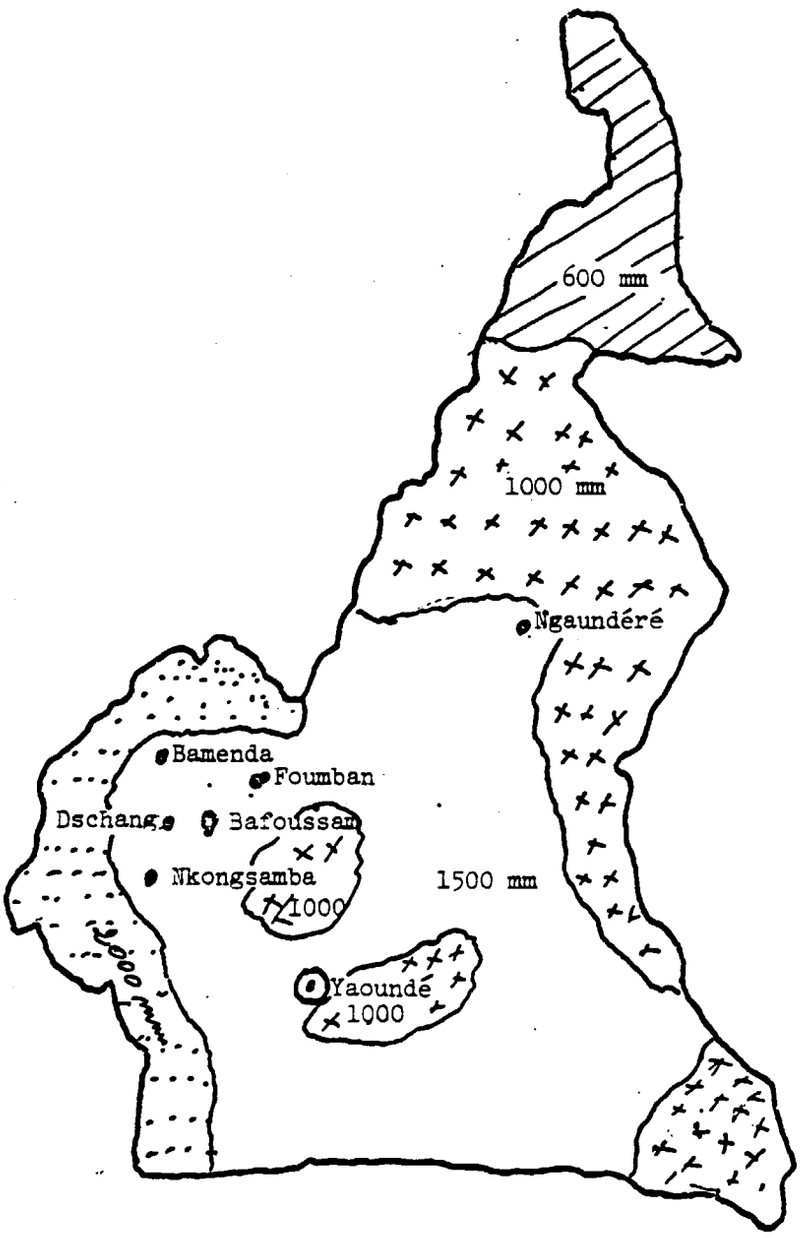
ANNUAL PATTERN OF TEMPERATURE AND RAINFALL

Station	Latitude N.	Longitude E.	Altitude m	Average No. of rainy days *	Av. temp., °C; ev. rainfall, mm/m²	Mean monthly temperatures / Mean monthly rainfall J	F	M	A	M	J	J	A	S	O	N	D	Max. daily temperature	Min. daily temperature	Number of dry months	Observations
BAFOUSSAM	5.3	10.2	1460		20.2	20.9	21.3	21.7	21.2	20.5	19.6	19.1	19.3	19.2	19.3	20	20.2	25.1	15.3		* ≥ 0.1 mm
DSCHANG	5.2	10	1398		20.1	20.2	20.8	21.3	21.2	20.8	19.9	19.1	19.1	19.6	19.8	19.8	19.7	25.1	15		
FOUMBAN	5.4	10.5	1100		21.7	22	22.9	23.1	22.7	22.3	21.5	20.7	20.3	20.9	21.2	21.6	21.7	27.4	16		
NGAUNDÉRÉ	7.1	13.2	1119		22.2	21.6	22.9	24	24.1	22.6	22	21.3	21.2	21.3	21.8	21.6	21.4	28.6	15.7		
NKONGSAMBA	4.5	9.5	877		22.4	22.8	23.2	23.5	23.4	22.9	22	20.8	20.6	22.1	22.7	22.7	22.8	26.4	18.3		
YAOUNDÉ	3.5	11.3	760		23.4	24	24.3	24.5	24.2	23.6	23.2	22.2	22.5	22.9	22.9	23.5	23.7	28	18.8		

Rainfall

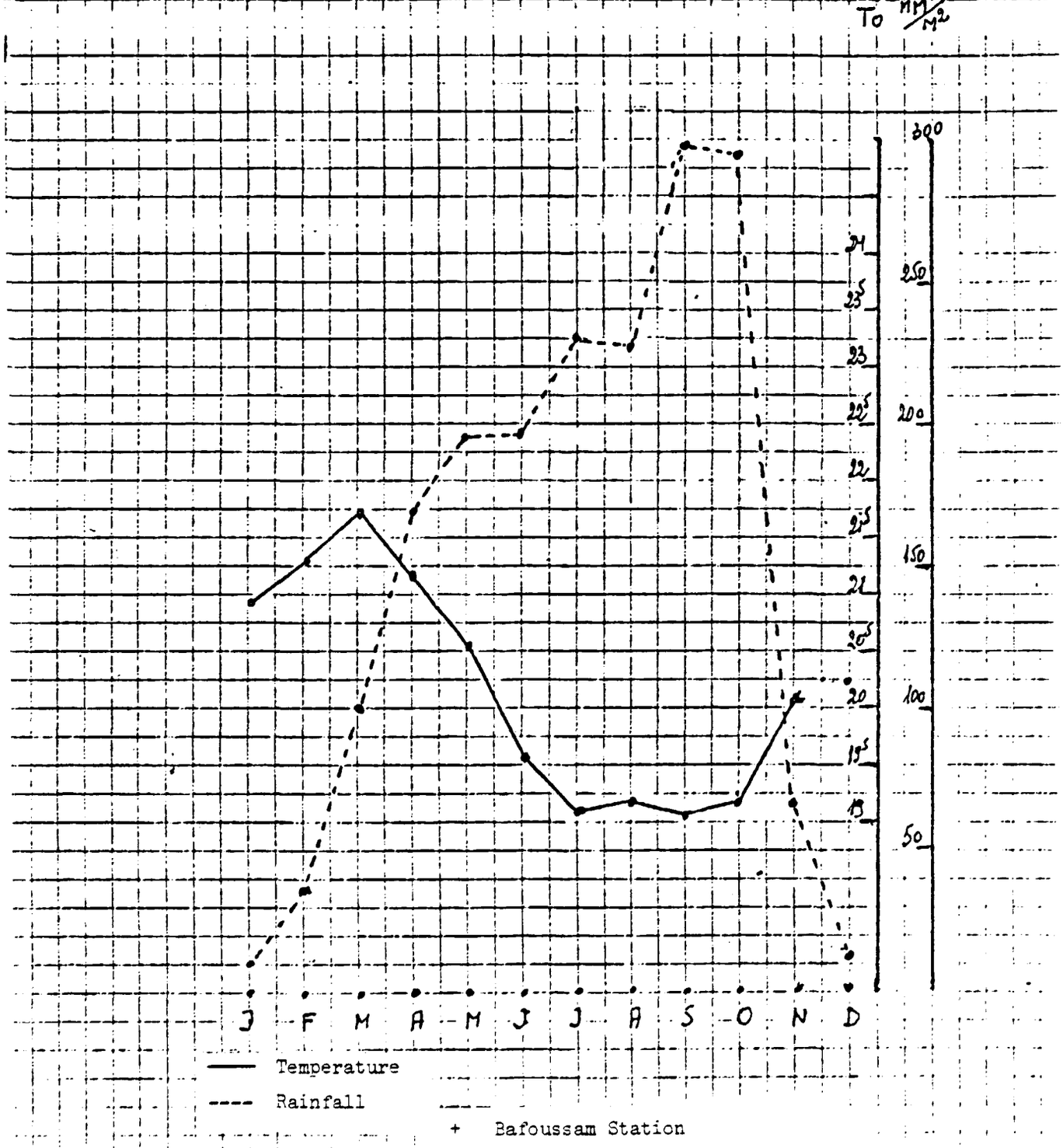
BAFOUSSAM				173	1821	(12)	(33)	99	170	190	194	230	224	289	293	63	(11)			3	O Dry month
DSCHANG				199	1909	(23)	66	136	185	192	230	222	239	336	236	47	(13)			2	
FOUMBAN				145	1877	(6)	(25)	90	131	184	181	268	320	322	218	77	(8)			3	
NGAUNDÉRÉ				128	1582	(5)	(1)	(44)	144	202	237	225	222	236	155	(10)	(3)			5	
NKONGSAMBA				194	2685	(13)	61	141	177	221	241	410	465	477	334	111	(23)			2	
YAOUNDÉ				142	1529	(31)	68	144	125	183	151	54	89	202	288	129	(10)			2	

Annex 5 bis

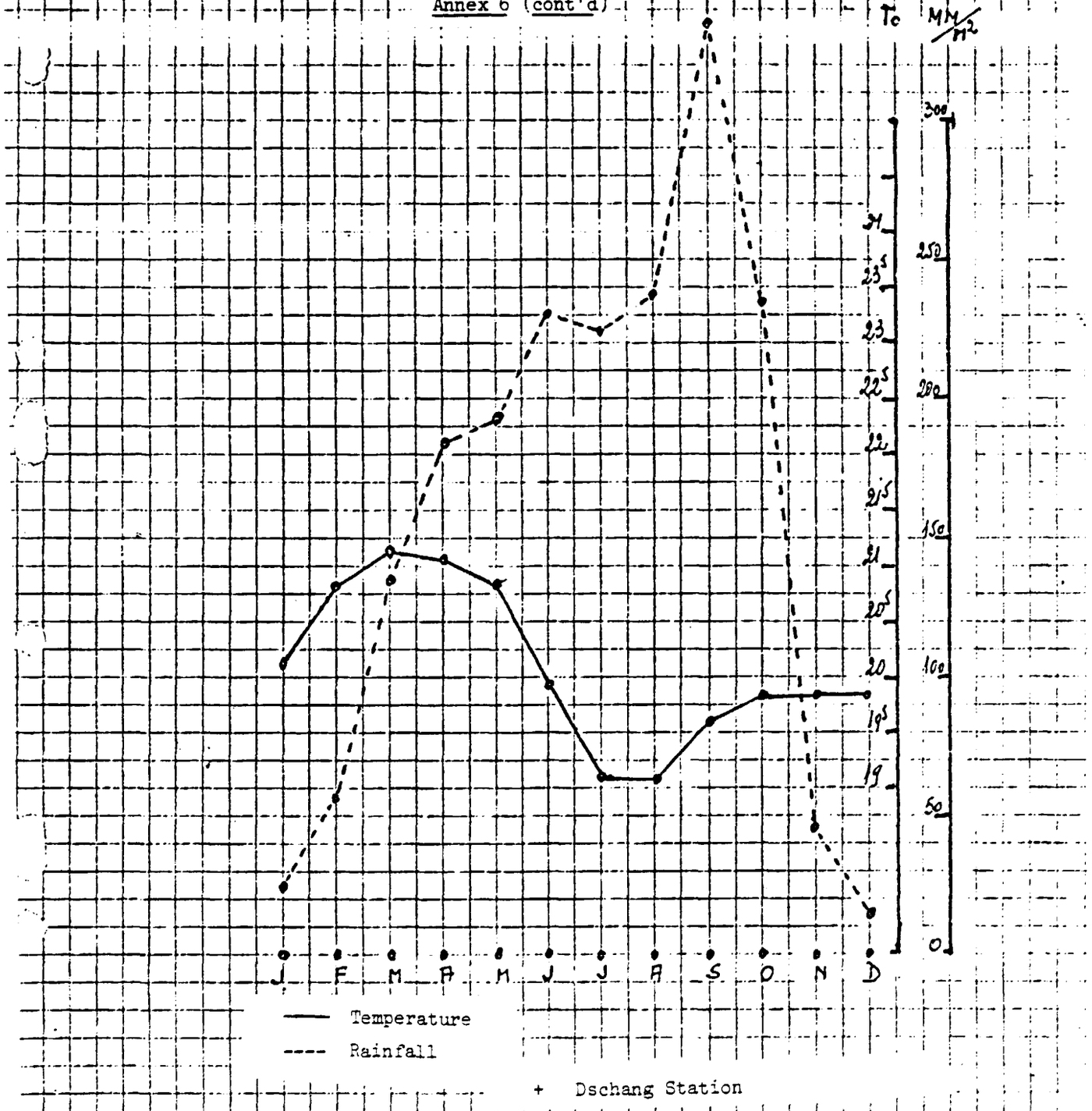


RAINFALL MAP

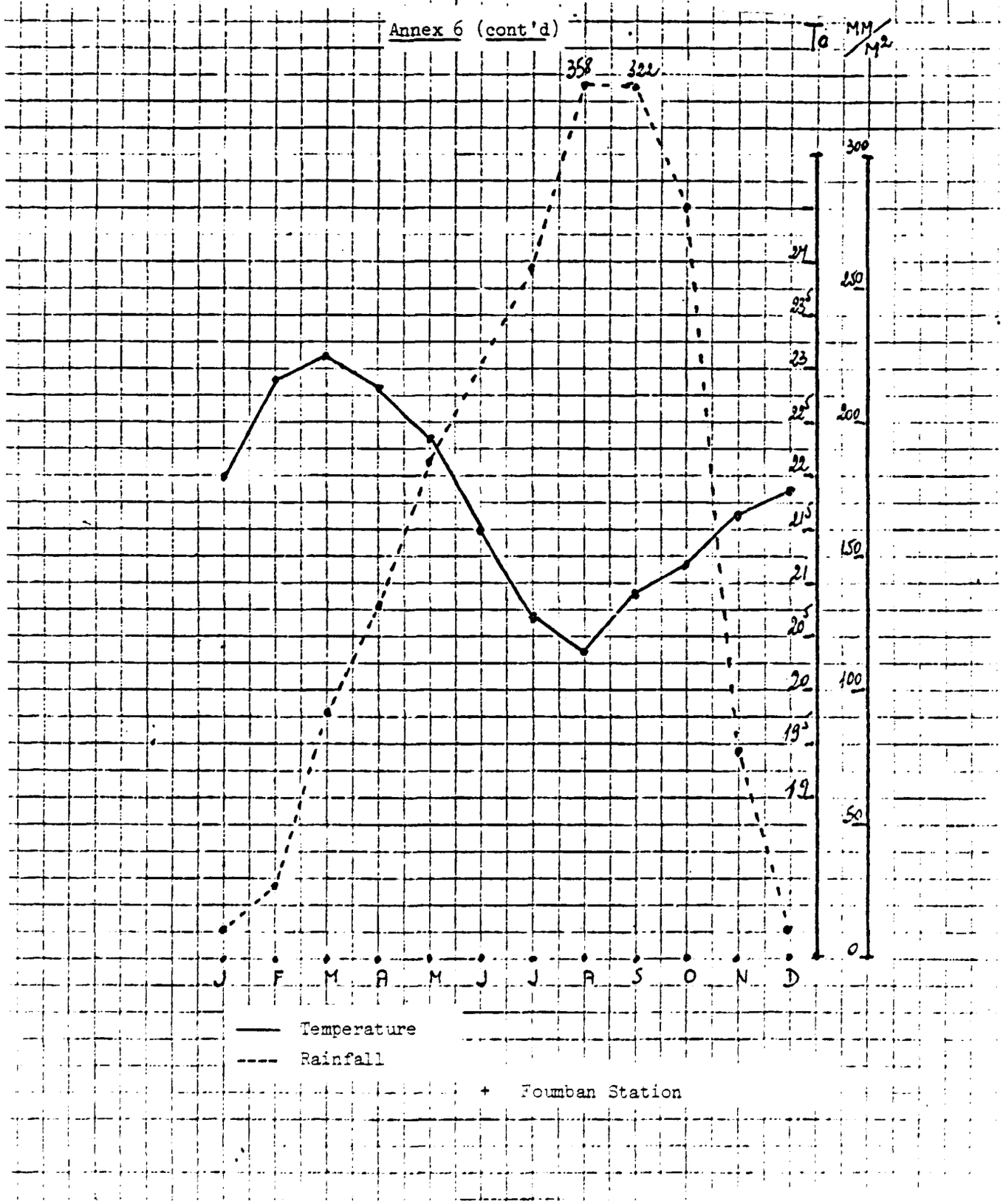
Annex 6


To
mm/m²
300
250
200
150
100
50
24
23,5
23
22,5
22
21,5
21
20,5
20
19,5
19
J F M A M J J A S O N D
Temperature
Rainfall
+ Bafoussam Station

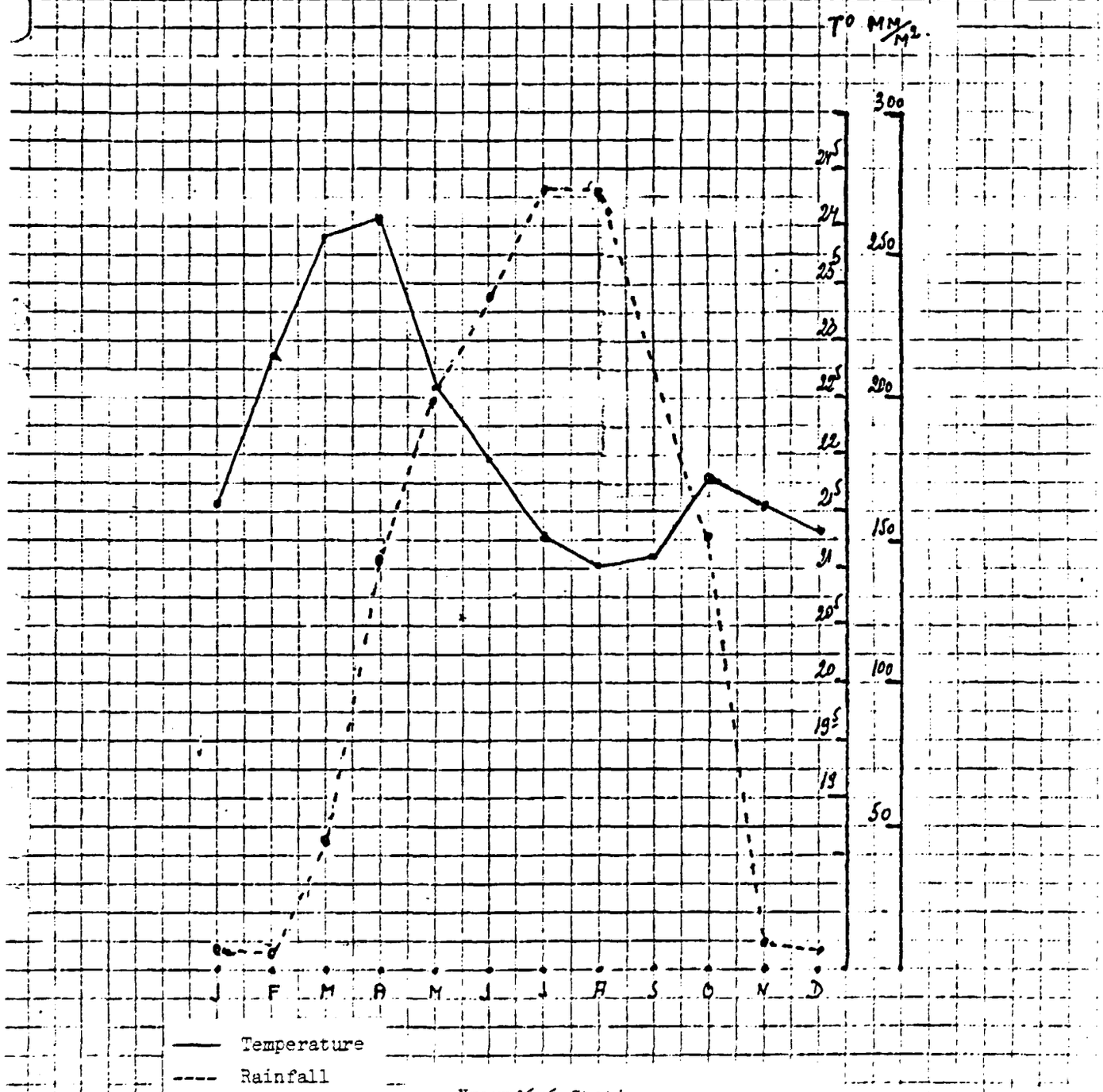
Annex 6 (cont'd)



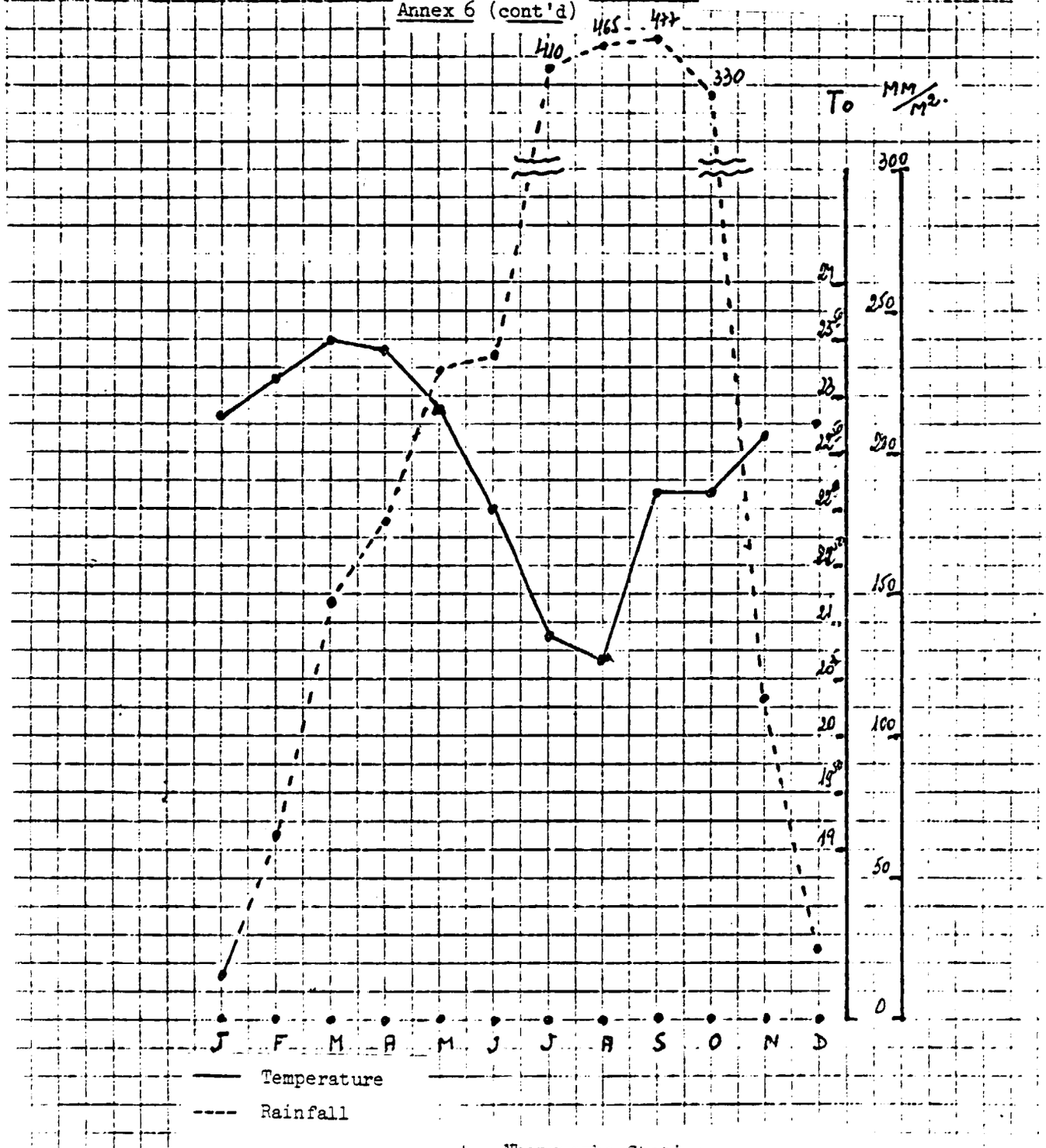
Annex 6 (cont'd)



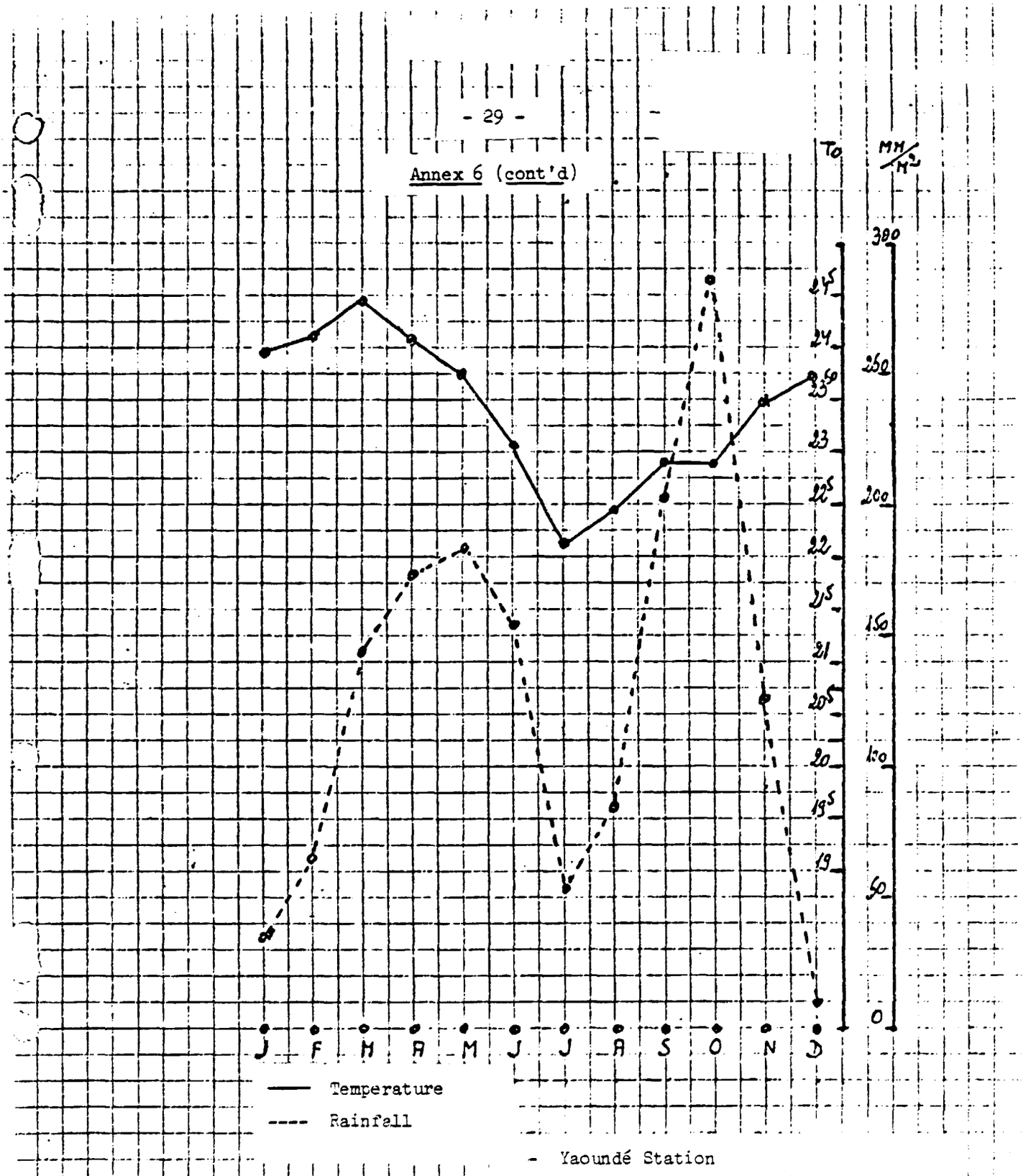
Annex 6 (cont'd)



Annex 6 (cont'd)

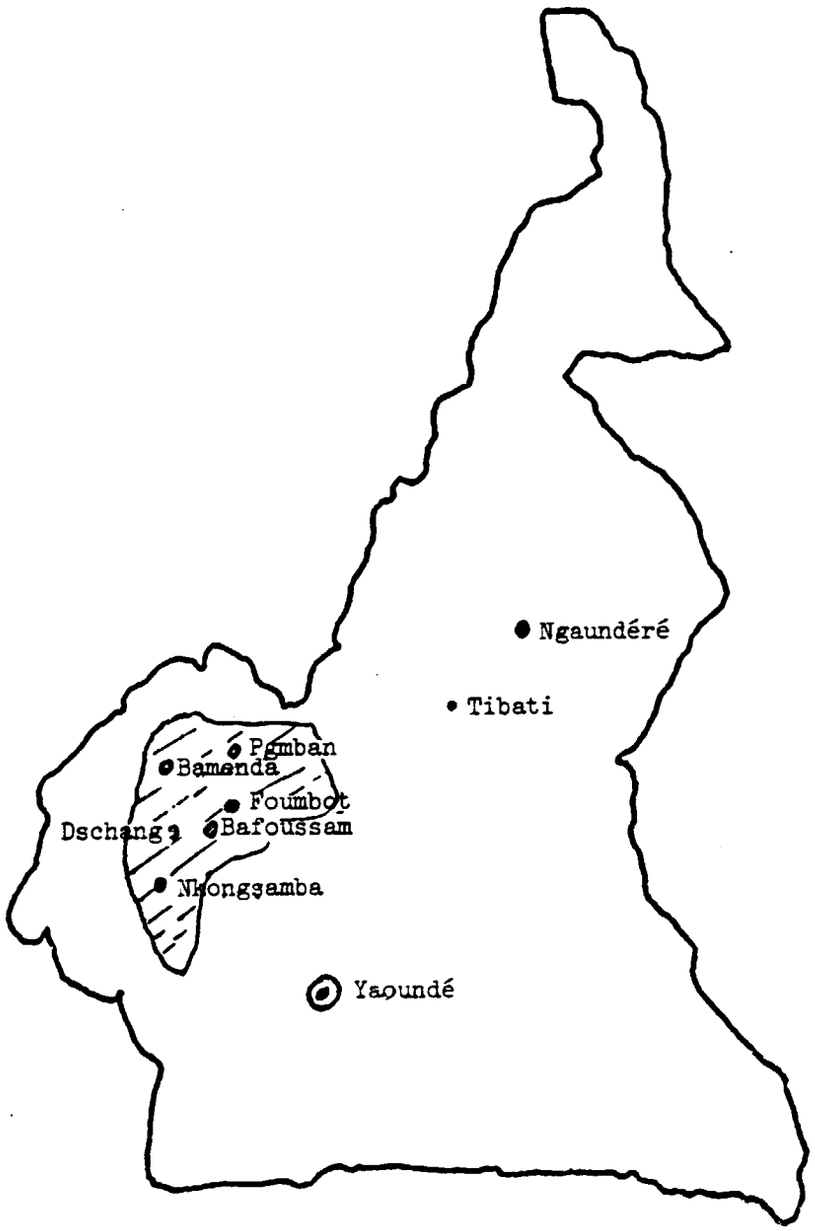


Annex 6 (cont'd)



- Yaoundé Station

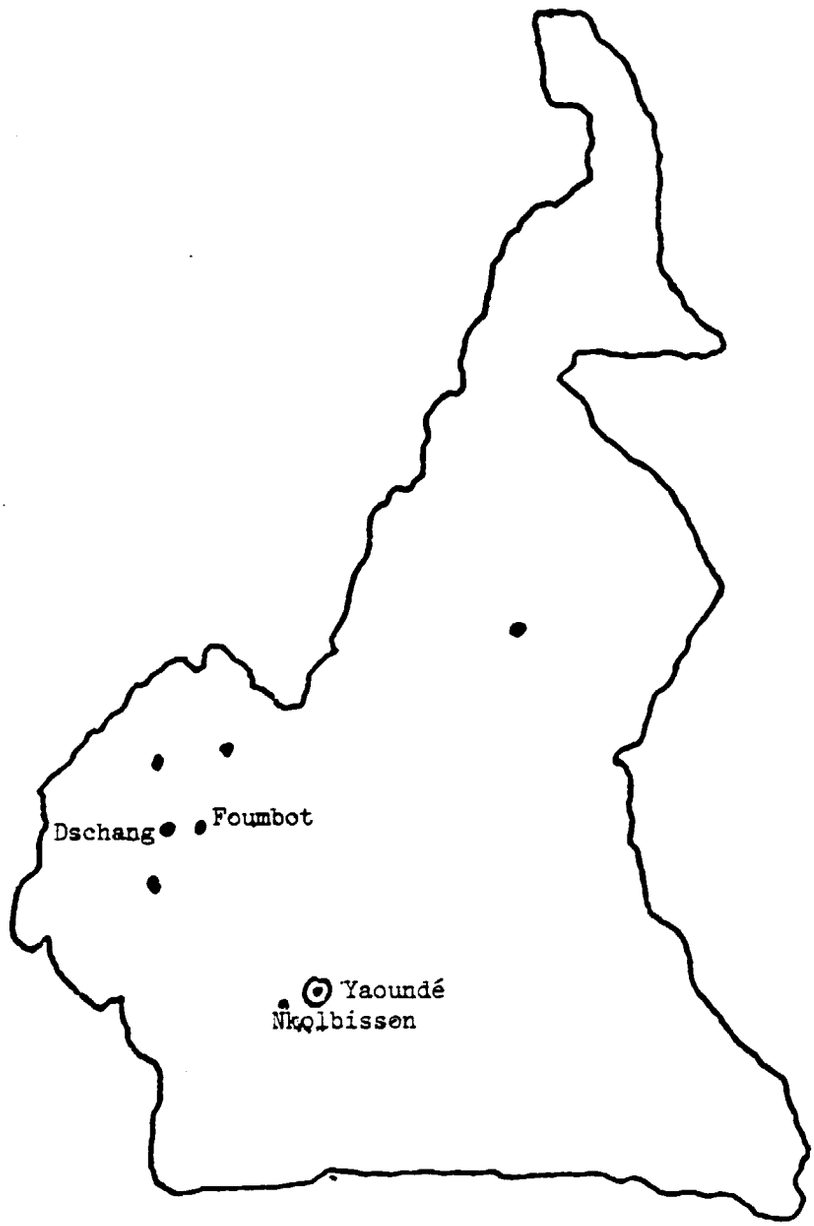
Annex 7



MAP

showing the zone selected for the growing
of annual medicinal plants

Annex 8



MAP

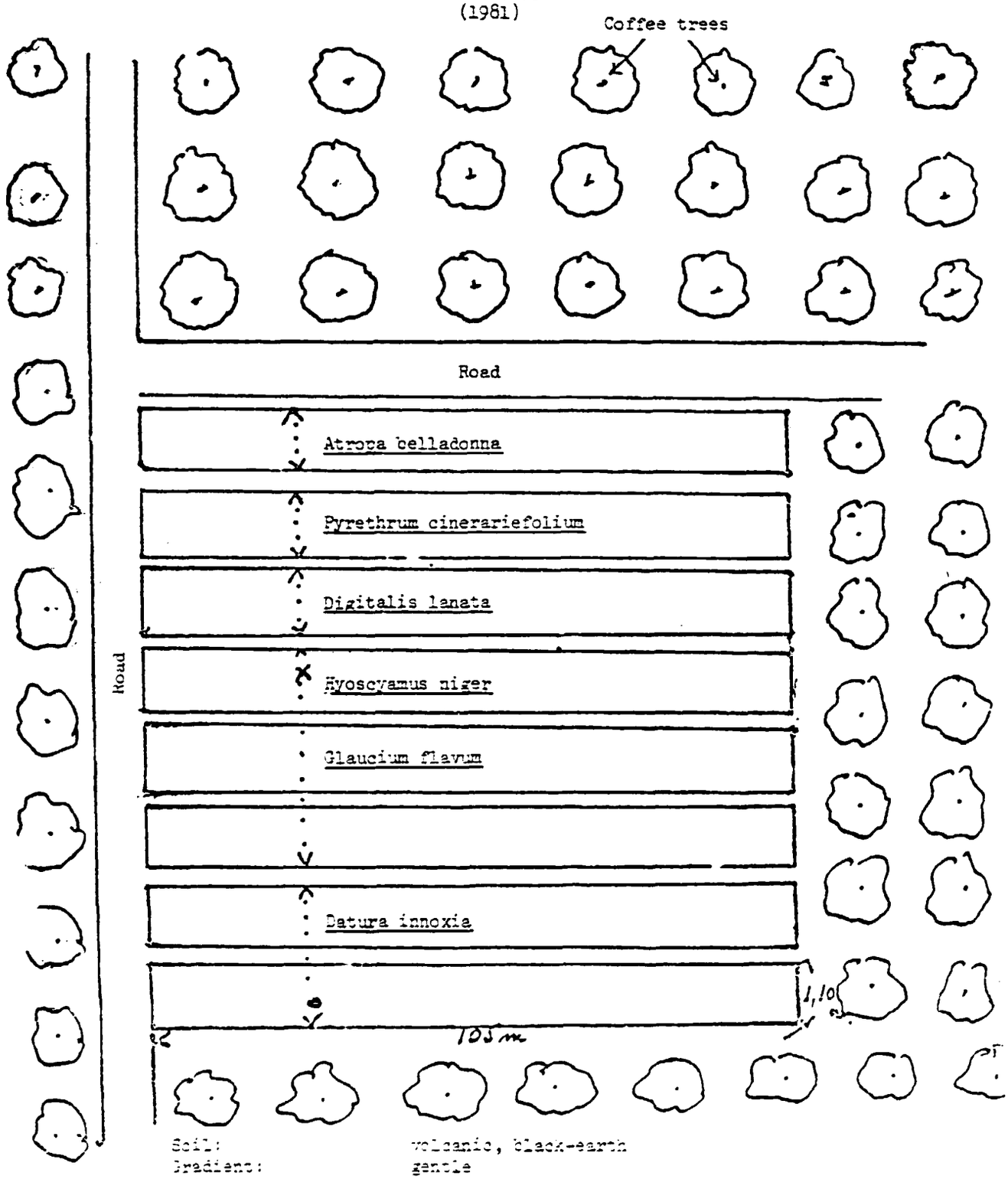
showing the test sites

Annex 9

AGRICULTURAL RESEARCH INSTITUTE
Foumbot Station

Area = 1,000 m^2

TEST LAYOUT
(1981)



Soil: volcanic, black-earth
Gradient: gentle
Soil preparation date:
- Tilling: 2 April 1981
- Preparation: 3-7 April 1981
Sowing date: 8 April 1981
Seed-bed sowing date: 3 April 1981

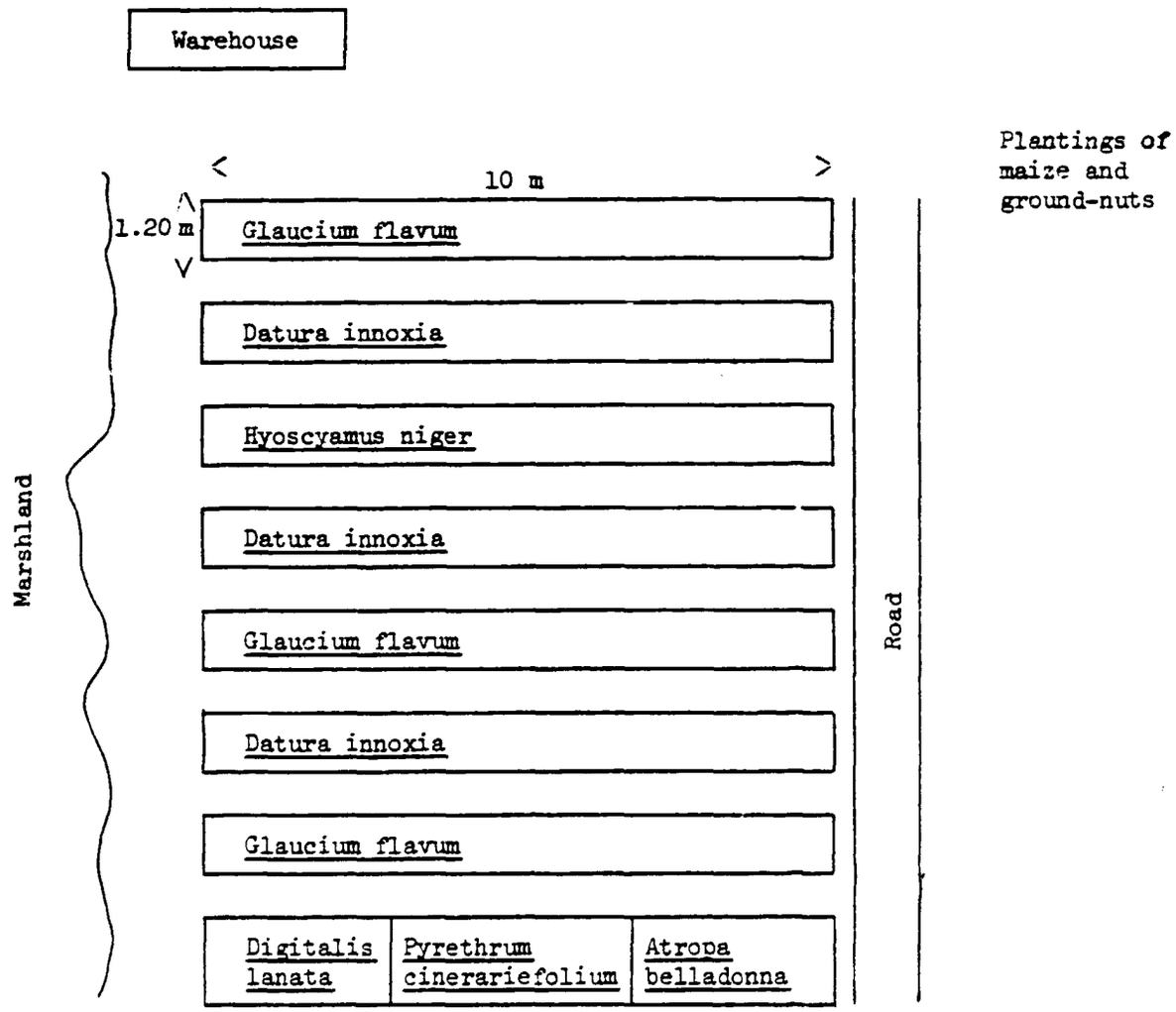
Annex 9 (cont'd)

AGRICULTURAL RESEARCH INSTITUTE

Nkolbisson/Yaoundé Station

TEST LAYOUT

Surface area 200 m^2



Soil: lateritic
Gradient: flat
Soil preparation date:
- Tilling: 23 March 1981
- Preparation: 24 March 1981
Sowing date: 25 March 1981
Seed-bed sowing date: 25-27 March 1981

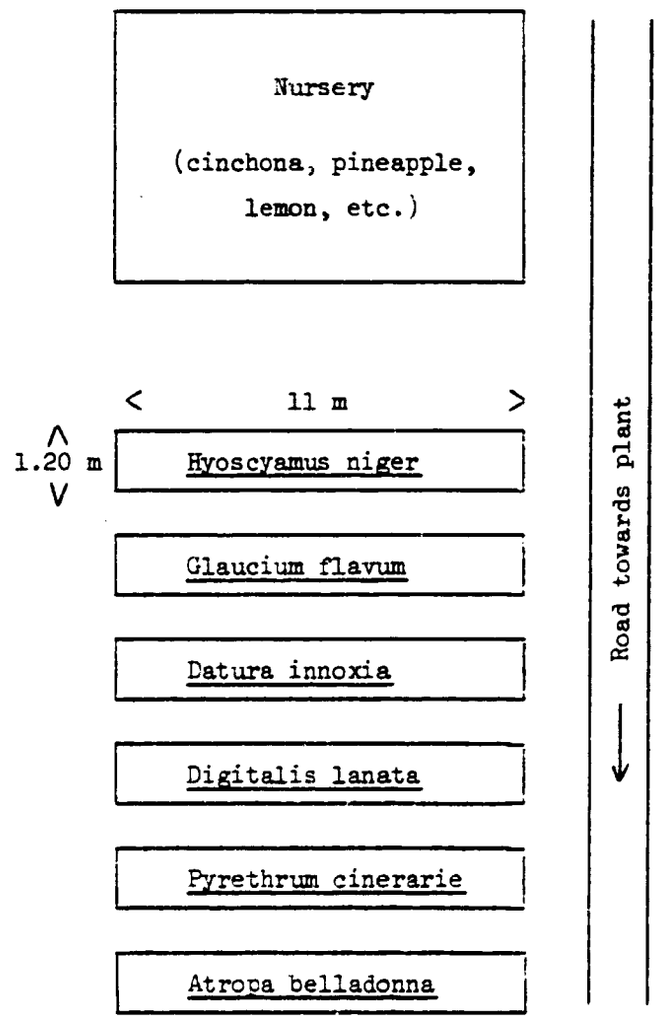
Annex 9 (cont'd)

CINCHONA PROPAGATION FARM

TEST LAYOUT

Dschang

Surface area 100 m^2



Soil: mixture of laterite and black earth
Gradient: flat
Soil preparation date:
- Tilling: 30 March 1981
- Preparation: 31 March
Sowing date: 31 March
Seed-bed sowing date: 30 March 1981

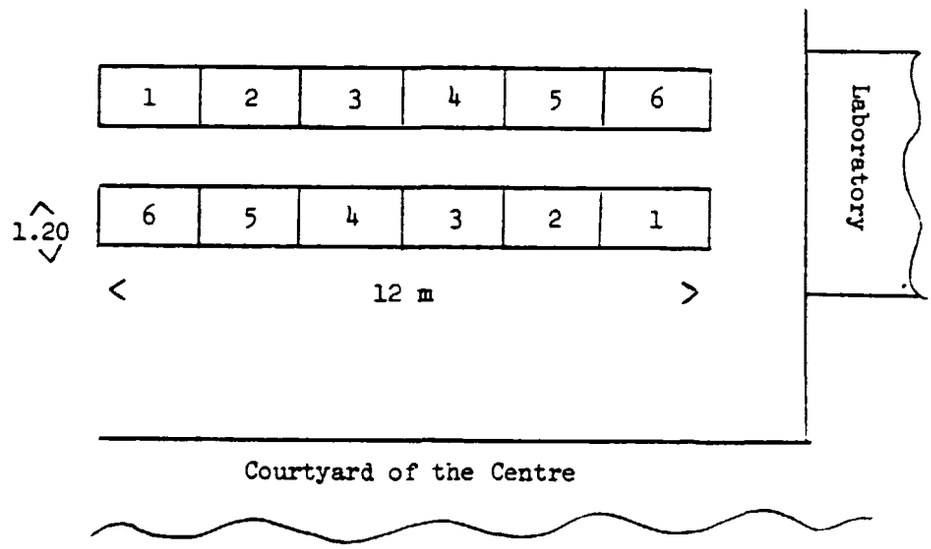
Annex 9 (cont'd)

CENTRE FOR THE STUDY OF MEDICINAL PLANTS

Yaoundé

TEST LAYOUT

Surface area 25 m^2



1. Datura innoxia
2. Digitalis lanata
3. Glaucium flavum
4. Hyoscyamus niger
5. Pyrethrum cinerariefolium
6. Atropa belladonna

Soil: lateritic
Gradient: 30°
Soil preparation date:
Sowing date: in stages, 13-16 March 1981

Annex 10

TECHNICAL ASPECTS OF THE GROWING OF DIGITALIS LANATA
(Family Serophulariaceae)

Digitalis is grown for its leaves, which contain glycosides known for their cardiotonic effect. These are used in the formulation of drugs employed in the treatment of cardiac insufficiency, representing at this time the only available remedy for this disorder.

I. Preparation of the soil

Digitalis requires a fertile, clean, weed-free soil of the black-earth (chernozem) kind. The soil must be ploughed to a depth of 18-20 cm using a plough in conjunction with a harrow.

II. Preparation of the seed-bed

The soil must be levelled, pulverized and mounded no more than one day before sowing or planting.

III. Propagation

The plant may be propagated in two ways:

- Sowing in the field;
- Propagation using plant stock.

In Romania, because of the climatic conditions, the first method is used.

In Cameroon, the use of stock produced in a seed-bed is the best method:

- Surface sowing in lines spaced 5 cm apart, using 2-3 grams of seed per m^2;
- Germination requires 18-21 days;
- Seed-bed care:
  - Daily sprinkling, using approximately 10 litres of water per m^3;
  - Manual weeding between the lines as often as required (once, twice, three times, etc.).

The plants are thinned when they are 1-2 cm in height, leaving no more than 150 young plants to a line. These may be planted out when they have reached a height of 7-10 cm, i.e. 50-60 days after sowing.

Annex 10 (cont'd)

IV. Planting out

This should be done at the beginning of the rainy season, preferably in foggy weather, in moist soil and, above all, towards evening.

V. Spacing

Digitalis is planted in lines spaced 50 cm apart, with an interval of 10 cm between plants.

VI. Tending

Hoeing begins two or three days after the plants have been set out and is performed as required thereafter, depending on how fast the weeds grow.

VII. Harvesting

The best time for harvesting the leaves is when they are three months old. Harvesting should be done on sunny days and when there is no dew at all. The leaves are cut, but not the growth bud, in order to ensure the regeneration of the plants.

Two harvests a year are possible. Harvested leaves must be dried in the shade.

VIII. Yield

The yield per hectare is 5-7 tonnes of fresh leaves; 4-5 kg of fresh leaves produce 1 kg of dry leaves with a moisture content of 13 per cent.

The lanatoside C content is 0.20 to 0.21 per cent.

IX. Special observations

As Digitalis lanata is a poisonous plant, special precautions must be taken when tending, harvesting and drying it.

Children and pregnant women must not be used for this work.

Workers must not smoke or eat while handling the plant.

After handling the plant, workers must wash their hands with soap.

Annex 10 (cont'd)

OBSERVATION SHEET: DIGITALIS LANATA

1. Method of preparing the soil.
2. Date of setting out (planting).
3. Date of first tending.
4. Date of second tending.
5. Date of third tending.
6. Date of first harvest.
7. Yield (fresh) of the first harvest.
8. Date of the second harvest.
9. Yield (fresh) of the second harvest.
10. Total harvest yield following drying.
11. Climatic considerations.

Annex 10 (cont'd)

TECHNICAL ASPECTS OF THE GROWING OF DATURA INNOXIA

Datura innoxia is an annual plant which is grown for the processing of its aerial parts, which contain alkaloids in the form of scopolamine.

I. Preparation of the soil

Following previous early plants, the soil must be ploughed to a depth of 18-20 cm, and kept clean by harrowing until it is seeded.

After previous late plants, the soil must be ploughed to a depth of 22-25 cm and kept clean in the same way.

The soil must be well levelled and homogeneous.

II. Preparation of the seed-bed

The soil must be well pulverized before sowing, relevelled and kept clean by means of the agricultural implements available.

III. Seeding

In Romania, seeding takes place (using a seeder) in April, when the soil is at a temperature of 7-8° C.

In Cameroon, Datura innoxia should be sown at the beginning of the rainy season. The seed, which should be 75 per cent pure and with a 60 per cent guarantee of germination, is to be sown in amounts of 12 kg per hectare.

IV. Spacing

Datura is sown by placing 2-3 seeds in seed holes 3-4 cm deep and 15 cm apart in lines separated by an interval of 50 cm.

V. Tending

Hoeing begins immediately following emergence, either manually or using a cultivator equipped with protective discs.

In Romania, where Datura takes 21 days to emerge, the seed is mixed with a little lettuce seed to mark the line before the Datura breaks ground. Subsequent hoeing should be performed as required and depending on how fast the weeds grow.

Annex 10 (cont'd)

VI. Harvesting

Harvesting takes place when the third set of leaves is in flower and the first is carrying the unripe green-thorned fruits.

Harvesting is carried out either by mowing machine set at a cutting height of 12-15 mm or manually at the same height. Following the first harvest, the growing area must be hoed.

The entire plant is harvested. It should be taken to a drying shed or else dried in the shade.

VII. Yield

The yield per hectare (fresh) runs to about 15-20 tonnes in two or three harvests; the yield of dry product is 1.7 tonnes. The dry product must contain 0.20-0.22 per cent alkaloids in the form of scopolamine, the figure for the green product being 0.04-0.06 per cent.

VIII. Special observations

As this is a poisonous plant, special precautions must be used in tending, harvesting and drying it.

Children and pregnant women must not be used for this work.

Workers must not smoke or eat while handling the plant.

After handling the plant, workers must wash their hands with soap.

Annex 10 (cont'd)

OBSERVATION SHEET: DATURA INNOXIA

1. Method of preparing the soil.
2. Sowing date.
3. Emergence date.
4. Date of first tending.
5. Date of second tending.
6. Date of third tending.
7. Date of fourth tending.
8. Date of first set of flowers.
9. Date of third set of flowers.
10. Date of the first harvest.
11. Yield of the first harvest.
12. Date of the second harvest.
13. Yield of second harvest.
14. Date of third harvest.
15. Yield of the third harvest.
16. Quantity of dried plant obtained.
17. Climatic considerations.

Annex 10 (cont'd)

TECHNICAL ASPECTS OF THE GROWING OF GLAUCIUM FLAVUM
(Family Papaveraceae)

Glaucium flavum is an annual species, which is cultivated for the glaucine contained in its aerial parts. Glaucine is an alkaloid and is used as a substitute for codeine.

I. Preparation of the soil

Glaucium flavum requires a fertile, clean, weed-free soil of the chernozem kind. After previous early plants the soil must be ploughed to a depth of 18-20 cm and after late plants to a depth of 20-25 cm using a plough in conjunction with a harrow.

II. Preparation of the seed-bed

The soil must be levelled, pulverized and mounded no more than one day before seeding.

III. Seeding

In Romania, the sowing period is in November, before the onset of the winter, or else between the end of winter and the beginning of spring.

In Cameroon, the best time for sowing should be at the beginning of the rainy season, when the soil humidity is about 60-70 per cent.

IV. The amount of seed used per hectare

The recommended amount is 4 kg per hectare.

V. Spacing

Glaucium is sown with a seeder, maintaining an interval of 50 cm between lines. In experimental plots, seeding is along lines spaced 50 cm apart in holes at 10-cm intervals, using three or four seeds in each hole. The depth of seeding is 1-2 cm.

VI. Tending

Hoeing begins immediately after emergence, either manually or using a cultivator equipped with protective discs. Thereafter, hoeing should be performed as required and depending on how fast the weeds grow.

Annex 10 (cont'd)

VII. Harvesting

The harvesting period occurs when the plant stops flowering and the first pods develop. Harvesting is carried out either using a mowing machine or manually, when there is no dew.

The entire plant is harvested. Where experimentally grown, the harvested plants must be taken to the drying shed or else dried in the shade. In large-scale production, on the other hand, the harvested plants are left to dry directly on the ground.

VIII. Yield

The yield per hectare is 30-35 tonnes fresh aerial parts; 6-7 kg of fresh aerial parts produce 1 kg of the dry product with a moisture content of 13 per cent.

The glaucine content is 1.1-1.2 per cent.

Annex 10 (cont'd)

OBSERVATION SHEET: GLAUCIUM FLAVUM

1. Method of preparing the soil.
2. Sowing date.
3. Date of first pre-emergence tending.
4. Date of second pre-emergence tending.
5. Date of third pre-emergence tending.
6. Emergence date.
7. Date of first hoeing.
8. Date of second hoeing.
9. Date of third hoeing.
10. Date of first flowers.
11. Date of first buds.
12. Date of first harvest.
13. Yield of first harvest (fresh).
14. Date of second harvest.
15. Yield of second harvest.
16. Quantity of dried product obtained.
17. Climatic considerations.

Annex 10 (cont'd)

TECHNICAL ASPECTS OF THE GROWING OF HYOSCYAMUS NIGER
(Family Solanaceae)

Henbane

Henbane is grown for its leaves, which contain alkaloids (hyoscyamine, atropine, scopolamine) used in many drugs for treating disorders of the respiratory and nervous systems.

I. Method of preparing the soil

Hyoscyamus requires a fertile, clean, weed-free soil of the chernozem kind.

After previous early plants the soil must be ploughed to a depth of 18-20 cm and after late plants to a depth of 22-25 cm using a plough in conjunction with a harrow.

II. Preparation of the seed-bed

The soil must be levelled, pulverized and mounded no more than one day before seeding.

III. Seeding

The seeds are very small and require a very moist soil.

In Romania, the time for sowing is at the beginning of spring.

In Cameroon, the best time for sowing is from the beginning to about the middle of the rainy season.

IV. The amount of seed used per hectare

The recommended amount is 3 kg per hectare.

V. Spacing

Hyoscyamus is sown, by means of a seeder, in lines 50 cm apart and at a depth of 0.5 cm.

VI. Tending

Hoeing begins immediately after emergence either manually or using a cultivator equipped with protective discs. Thereafter, hoeing should be performed as required and depending on how fast the weeds grow.

Annex 10 (cont'd)

VII. Harvesting

The harvesting of the leaves should start when the plant begins to flower. Thereafter, only well-developed and healthy leaves are periodically harvested.

The harvested leaves are to be taken to a drying shed or else left to dry on paper or on drying frames in the shade.

VIII. Yield

The yield per hectare is 10-15 tonnes of fresh leaves; 5-6 kg of these leaves produce 1 kg of dry leaves with a moisture content of 13 per cent.

The content of alkaloids in the form of hyoscyamine is 0.05-0.1 per cent.

Annex 10 (cont'd)

OBSERVATION SHEET: HYOSCYAMUS NIGER

1. Method of preparing the soil.
2. Sowing date.
3. Emergence date.
4. Date of first tending.
5. Date of second tending.
6. Date of third tending.
7. Date of fourth tending.
8. Date of commencement of flowering.
9. Starting date of harvest.
10. Ending date of harvest.
11. Yield of the entire harvest, dry.
12. Climatic considerations.

Annex 10 (cont'd)

TECHNICAL ASPECTS OF THE GROWING OF ATROPA BELLADONNA

Belladonna or deadly nightshade

Belladonna is grown for its leaves and roots, which contain a large number of alkaloids, the most important of them being atropine, belladonna and hyoscyamine. Belladonna is a perennial species, but when cultivated it is kept for two years only.

I. Method of preparing the soil

Belladonna requires a deep, clean, weed-free soil rich in humus. The soil must be ploughed to a depth of 28-32 cm using a plough in conjunction with a harrow.

II. Preparation of the seed-bed

The soil must be levelled, pulverized and mounded no more than one day before the planting of the stock.

III. Propagation

The only method is the use of stock:

- Surface sowing in lines 5 cm apart;
- Germination requires 25-30 days;
- Seed-bed care:
  - Daily sprinkling, using approximately 10 litres of water per m^3;
  - Manual weeding between the lines as often as required (once, twice, three times, etc.).

The plants are thinned when they are 1-2 cm in height, leaving no more than 150 young plants in a line. The young plants may be planted out when they have reached a height of 7-10 cm, i.e. 50-60 days after sowing.

IV. Planting out

This should be done at the beginning of the rainy season, preferably in foggy weather, in moist soil and, above all, towards evening.

V. Spacing

Belladonna is planted in lines spaced 50 cm apart, with an interval of 10 cm between plants.

Annex 10 (cont'd)

VI. Tending

Hoeing begins two or three days after the plants have been set out and will depend thereafter on the requirements of the plant and the rate of growth of the weeds.

VII. Harvesting

The leaves and roots of this plant are harvested. The leaf harvest begins during the first year and the root harvest during the second year, after the leaf harvest. The best time for harvesting the leaves is when the flower buds appear, the best time for the roots being after the leaf harvest.

The leaves are harvested by hand and should as soon as possible thereafter be placed in the drying shed to prevent rotting. The roots may be recovered either with a plough or by hand, using a spade. They must be washed and split in order to facilitate drying, which must be done in the shade.

VIII. Yield

The yield per hectare is as follows:

- Leaves:
  - First year: 2,800-3,000 kg of fresh leaves;
  - Second year: 4,200-4,500 kg of fresh leaves.
- Roots: 3,500-5,000 kg of fresh roots.
- Dry yield:
  - Leaves: 6-7 kg of fresh leaves produce 1 kg of dry leaves;
  - Roots: 4-5 kg of fresh roots produce 1 kg of dry roots.
- Alkaloid content in the form of hyoscyamine:
  - Leaves: 0.30-0.35 per cent;
  - Roots: 0.45-0.55 per cent.

IX. Special observations

As belladonna is a poisonous plant, special precautions must be taken when tending, harvesting and drying it.

Annex 10 (cont'd)

Children and pregnant women must not be used for this work.

Workers must not smoke or eat while handling the plant.

After handling the plant, workers must wash their hands with soap.

Annex 10 (cont'd)

OBSERVATION SHEET: BELLADONNA

1. Method of preparing the soil.
2. Date of setting out.
3. Date of first tending.
4. Date of second tending.
5. Date of third tending.
6. Date of fourth tending.
7. Starting date of leaf harvest.
8. Ending date of leaf harvest.
9. Harvest yield (fresh).
10. Harvest yield (dry).
11. Climatic considerations.

Annex 10 (cont'd)

TECHNICAL ASPECTS OF THE GROWING OF PYRETHRUM CINERARIEFOLIUM

Pyrethrum

Pyrethrum is grown for its leaves, which contain pyrethrin. This is a very powerful insecticide which has a sledge-hammer effect but presents no problems in the way of accumulation and is highly degradable.

I. Method of preparing the soil

After previous early plants, the soil must be ploughed to a depth of 18-20 cm, and after late plants to a depth of 22-25 cm. A plough in conjunction with a harrow should be used for this work. The soil must be kept clean by harrowing until it is seeded.

II. Preparation of the seed-bed

The soil must be well levelled and homogeneous, and must be pulverized before seeding.

Where the ground is flat, strips 1.10-1.20 m in length and raised 15-20 cm are prepared. In the case of broken ground, ridges of 1-1.20 m are laid out.

III. Propagation

Propagation is by two methods:

- Seeding directly in the field;
- Stock propagation.

In Romania, the first method is used because of climatic conditions, but in Cameroon it is best to use stock produced in the seed-bed:

- Surface sowing in lines 5 cm apart, using one or two grams of seed per m^2 (80 m^2 of seed-bed are required for the planting of one hectare);
- Germination requires 25-35 days;
- Seed-bed care:
  - Daily sprinkling, using approximately 10 litres of water per m^3;
  - Manual weeding between the lines as often as required (once, twice, three times, etc.).

Annex 10 (cont'd)

Thinning begins when the young plants are 1-2 cm in height, with only 150 plants left to a line. The plants are ready to be set out 50-60 days after sowing, when they are 7-10 cm tall.

IV. Planting out

This should be done at the beginning of the rainy season, preferably in foggy weather, in wet soil and, above all, towards evening.

V. Spacing

Pyrethrum is planted in lines spaced 50 cm apart, with an interval of 10 cm between plants.

VI. Tending

Hoeing begins two or three days after the plants have been set out and is performed as required thereafter, depending on how fast the weeds grow.

VII. Harvesting

The best time to harvest the flowers is during fertilization. The flowers may be picked over a period of 14-20 days, the standard quantity being about 20 kg of fresh flowers, without the stalk.

VIII. Yield

The yield per hectare is 1-2 tonnes of fresh flowers; 4 kg of fresh flowers produce 1 kg of dry flowers with a moisture content of 12 per cent. The flowers must be dried in the shade.

The pyrethrin content is 1.5 to 2 per cent.

Annex 10 (cont'd)

OBSERVATION SHEET: PYRETHRUM CINERARIEFOLIUM

1. Method of preparing the soil.
2. Date of setting out.
3. Date of first tending.
4. Date of second tending.
5. Date of third tending.
6. Date of fourth tending.
7. Starting date of the harvest.
8. Ending date of the harvest.
9. Harvest yield (fresh).
10. Harvest yield (dry).
11. Climatic considerations.

Foumbot, 9 April 1981

Annex 10 (cont'd)

SEED-BED WORK FOR ATROPA, PYRETHRUM AND DIGITALIS

1. Daily sprinkling, using approximately 10 litres per m^2.
2. Manual weeding between the lines, as often as required (once, twice, three times, etc.).
3. Thinning begins when the young plants are 1-2 cm high, leaving only 150 plants to a line.
4. The plants should be set out in the field when they are 7-10 cm tall.

For further details, refer to the information on technical aspects for each plant.

SEED-BED OBSERVATION SHEET FOR ATROPA, PYRETHRUM AND DIGITALIS

1. Date of sowing: 30 March 1981.
2. Date of first weeding.
3. Date of second weeding.
4. Date of third weeding.
5. Date of fourth weeding.
6. Date of fifth weeding.
7. Emergence date.
8. Date of first tending.
9. Date of second tending.
10. Date of third tending.
11. Date of thinning.
12. Date of second thinning (if required).
13. Date of setting out the plants in the field.

Annex 11

LIST OF PERSONS WHO CO-OPERATED IN THE WORK AND RECEIVED THE INFORMATION ON TECHNICAL ASPECTS AND THE OBSERVATION SHEETS

1.	Nkolbisson Agricultural Research Station	Mr. J. Bakala Mr. Cheuka Zangue	Station Head Researcher
2.	Dschang Cinchona Propagation Farm	Mr. Etienne Mbiakop	Plantation Head
3.	Foumbot Agricultural Research Station	Mr. Romaine Kamdem Mr. Joseph Tchamago Mr. Thomas Touoyem	Station Head Researcher Team Leader
4.	Head of the Yaoundé Centre for the Study of Medicinal Plants	Mr. Justin Atangana	

Annex 12

SEED QUANTITIES NEEDED FOR THE 1982 TESTING

	Specific name	Quantity, kg	Countries of origin
1.	Digitalis lanata	3	Hungary, Romania
2.	Datura innoxia	10	Romania
3.	Glaucium flavum	10	Romania, Bulgaria
4.	Hyoscyamus muticus	1	India
5.	Chrysanthellum americanum	3	Cameroon
6.	Chenopodium ambrosioides	3	Cameroon
7.	Gloriosa simplex	4	Cameroon
8.	Gloriosa superba	4	Cameroon
9.	Atropa acuminata	3	India
10.	Pyrethrum cinerariefolium	3	Zaire, France, Romania
11.	Cephaelis ipecacuanha	2	Brazil, Peru
12.	Voacanga africana	2	Cameroon
13.	Pygeum africanum	2	Cameroon

Annex 13

OBSERVATION SHEET

1.	Plant:	Datura innoxia
2.	Test site:	Nkolbisson Agricultural Research Centre
3.	Soil:	Ferruginous
4.	Area:	12 m^2
5.	Method of preparing the soil:	Deep tilling, fine pulverization by hand, growing area at ground level
6.	Sowing date:	25 March 1981
7.	Sowing method:	Manual, in lines 50 cm apart, in seed holes at intervals of 15 cm, with 2-3 seeds per hole at a depth of 3-4 cm; total number of seed holes: 160
8.	Emergence date:	3 April 1981 (83 plants counted)
9.	Date of first tending:	24 April 1981 (weeding)
10.	Date of second tending:	27 April 1981 (thinning)
11.	Date of third tending:	5 May 1981 (weeding)
12.	Date of fourth tending:	25 May 1981 (weeding)
13.	Date of first set of flowers:	29 April 1981 (36 plants in flower or 57.1 per cent)
14.	Date of third set of flowers:	22 May 1981 (17 plants or 27 per cent)
15.	Date of the first harvest:	5 June 1981: Quantity green: 7 kg Quantity dried: 1.250 kg Yield: 6.50 kg green = 1 kg dried
16.	Average production per hectare:	5,833 kg/hectare
17.	Number of days for germination until emergence:	10 days
18.	Number of days between emergence and the first set of flowers:	26 days

Annex 13 (cont'd)

19. Number of days between emergence and the first harvest: 62 days

20. Number of days between seeding and the first harvest: 70 days

Remarks

1. The growth pattern was very irregular. Plants with their third set of flowers could be seen growing alongside plants with their first set or with no flowers at all.

2. A plant disease characterized by withering followed by a stunting of the growth of the plants and, in some cases, even their death was observed. Cultures taken and examined at the Phytopathology Laboratory indicated fusariosis.

3. The second harvest was entirely lost as a result of a very severe attack of fusariosis between 10 June and 30 July 1981, which led to the rotting of all the plants.

4. These tests were monitored by research engineer Cheuka Zangue.

Annex 14

OBSERVATION SHEET

1.	Plant:	Datura innoxia
2.	Test site:	Foumbot Agricultural Research Station
3.	Soil:	Black, volcanic, fertile
4.	Area:	210 m^2
5.	Method of preparing the soil:	Deep tilling, fine pulverization using a rotary cutter, manual levelling, growing area raised 10-15 cm
6.	Sowing date:	8 April 1981
7.	Sowing method:	Manual, in lines spaced 50 cm apart, in seed holes at intervals of 15 cm, with 2-3 seeds per hole at a depth of 3-4 cm; total number of seed holes: 2,561
8.	Emergence date:	21 April 1981
9.	Date of first tending:	24-30 April 1981 (weeding)
10.	Date of second tending:	13-18 May 1981 (weeding and thinning)
11.	Date of third tending:	5 June 1981 (hoeing and weeding)
12.	Date of first set of flowers:	2 May 1981
13.	Date of third set of flowers:	13 July 1981
14.	Date of the first harvest:	13 August 1981: Quantity green: 304.900 kg Quantity dried: 50.400 kg Yield: 6.05 kg green = 1 kg dried
15.	Number of days for germination until emergence:	13 days
16.	Number of days between emergence and the first set of flowers:	12 days

Annex 14 (cont'd)

17. Number of days between emergence and the first harvest: 113 days

18. Average production per hectare: 14,500 kg/hectare (green)

Remarks

1. At the time of harvest, these were the average data for the plants:
   - Height: 1.30 m;
   - Number of leaves per plant: 273;
   - Unripe fruits: 13;
   - Flowers and flower buds: 8.

2. A mild attack of fusariosis persisted until the time of the first harvest.

3. The second harvest was entirely lost as a result of a very severe attack of fusariosis between 13 August and 30 September 1981, which led to the rotting of all the plants.

4. The tests were monitored by Mr. Romaine Kamdem, Station Head, and Mr. Thomas Touoyem, Team Leader.

Annex 15

OBSERVATION SHEET

1.	Plant:	Glaucium flavum
2.	Test site:	Foumbot Agricultural Research Station
3.	Soil:	Black, volcanic, fertile
4.	Area:	105 m^2
5.	Method of preparing the soil:	Deep tilling, fine pulverization by means of rotary cutter, levelling; growing area raised 10-15 cm
6.	Sowing date:	8 April 1981
7.	Sowing method:	Manual, in lines spaced 50 cm apart, in seed holes at intervals of 10 cm, with 3-4 seeds per hole at a depth of 1-2 cm; total number of seed holes: 2,050
8.	Emergence date:	18 May 1981
9.	Date of first tending:	24-30 April 1981 (weeding)
10.	Date of second tending:	19-25 May 1981 (weeding)
11.	Date of third tending:	4 June 1981 (weeding and thinning)
12.	Date of fourth tending:	7 July 1981
13.	Number of days for germination until emergence:	40 days

Remarks

1. The current status of the planting (11 November 1981):
   - Number of plants standing: 787;
   - Vigorous growth;
   - Average number of leaves per plant: 65;
   - Length of leaves: 12-35 cm;
   - No flower buds have been observed;
   - A number of basal leaves have rotted.

Annex 15 (cont'd)

2. Emergence was very late. I believe the reason for this delay was the sowing date, which should be pushed back to June.

3. The tests were monitored by Mr. Romaine Kamdem, Station Head, and Mr. Thomas Touoyem, Team Leader.

Annex 16

OBSERVATION SHEET

1.	Plant:	Pyrethrum cinerariefolium
2.	Test site:	Dschang Cinchona Propagation Farm
	Seed-bed work	
3.	Soil:	Black earth, humus, well loosened and free of hard objects; shady site
4.	Area:	2 m^2
5.	Sowing date:	30 March 1981
6.	Sowing method:	In lines spaced 5 cm apart
7.	Emergence date:	11 April 1981
8.	Date of first weeding:	7 April 1981
9.	Date of second weeding:	20 April 1981
10.	Date of third weeding:	21 May 1981
11.	Date of fourth weeding:	10 June 1981
12.	Daily watering	
	Work in the growing area	
13.	Soil:	Ferruginous
14.	Area:	56 m^2
15.	Method of preparing the soil:	Deep tilling, fine pulverization by hand; growing area raised 10-15 cm
16.	Setting-out date:	23 July 1981
17.	Date of first tending:	27 July 1981 (hoeing and weeding)
18.	Date of second tending:	20 August 1981 (hoeing and weeding)
19.	Date of third tending:	12 September 1981 (hoeing and weeding)
20.	Date of fourth tending:	18 October 1981 (hoeing and weeding)
21.	Number of days for germination until emergence:	12 days
22.	Number of days between emergence and setting out:	102 days

Annex 16 (cont'd)

Remarks

1. The setting-out of the plants was 42 days late.

2. The current status of the planting (8 November 1981):
   - Number of plants standing: 536;
   - Average number of leaves per plant: 148;
   - Vigorous growth;
   - Length of the leaves: 8-18 cm;
   - No evidence of disease or blight;
   - No flower buds have been observed, indicating a delay in this stage.

3. The tests were monitored by Mr. Etienne Wanda Mbiakop, Plantation Head.

Annex 17

OBSERVATION SHEET

1.	Plant:	Digitalis lanata
2.	Test site:	Foumbot Agricultural Research Station
	Seed-bed work	
3.	Soil:	Black earth, humus, well loosened; shady site
4.	Area:	3 m^2
5.	Sowing date:	8 April 1981
6.	Sowing method:	In lines spaced 5 cm apart
7.	Emergence date:	24 April 1981
8.	Date of first tending:	31 April 1981
9.	Date of second tending:	13 May 1981
10.	Date of third tending:	22 May 1981
11.	Daily watering	
	Work in the growing area	
12.	Soil:	Black, volcanic
13.	Area:	105 m^2
14.	Method of preparing the soil:	Deep tilling, fine pulverization by means of a rotary cutter, levelling; growing area raised 10-15 cm
15.	Setting-out date:	9 July 1981
16.	Date of first tending:	3 August 1981 (hoeing and weeding)
17.	Date of second tending:	21 August 1981 (hoeing and weeding)
18.	Date of third tending:	19 September 1981 (hoeing and weeding)
19.	Date of fourth tending:	12 October 1981 (hoeing and weeding)
20.	Number of days for germination until emergence:	16 days
21.	Number of days between emergence and setting out:	73 days

Annex 17 (cont'd)

Remarks

1. There has not yet been a harvest, the delay being due to an ignorance of technical aspects. The harvest will be begun at the earliest possible date and the results will then be communicated.

2. The current status of the planting (11 November 1981):
   - Number of plants standing: 982;
   - Vigorous growth;
   - Average number of leaves per plant: 83;
   - Length of leaves: 12-22 cm;
   - No evidence of disease or blight.

3. The tests were monitored by Mr. Romaine Kamdem, Station Head, and Mr. Thomas Touoyem, Team Leader.

Annex 18

OBSERVATION SHEET

1.	Plant:	Digitalis lanata
2.	Test site:	Dschang Cinchona Propagation Farm
	Seed-bed work	
3.	Soil:	Black earth, humus, well loosened; shady site
4.	Area:	2 m^2
5.	Sowing date:	31 March 1981
6.	Sowing method:	In lines spaced 5 cm apart
7.	Emergence date:	8 April 1[illegible]
8.	Date of first tending:	9 April 1981
9.	Date of second tending:	20 April 1981
10.	Date of third tending:	21 May 1981
11.	Date of fourth tending:	10 June 1981
12.	Daily watering	
	Work in the growing area	
13.	Soil:	Ferruginous
14.	Area:	45 m^2
15.	Method of preparing the soil:	Deep tilling, fine pulverization by hand; growing area raised 10-15 cm
16.	Setting-out date:	24 July 1981
17.	Date of first tending:	27 July 1981 (weeding)
18.	Date of second tending:	20 August 1981 (weeding)
19.	Date of third tending:	12 September 1981 (weeding)
20.	Date of fourth tending:	18 October 1981

Annex 18 (cont'd)

21. Number of days for germination until emergence: 8 days

22. Number of days between emergence and setting out: 109 days

Remarks

1. There was a 49-day delay in setting out the plants and hence there has been a delay in the harvesting of the leaves as well.

2. The harvest has not yet begun (9 November 1981). Harvesting will take place on 15-16 November and the results will be communicated thereafter.

3. The current status of the planting (8 November 1981):
   - Number of plants standing: 465;
   - Vigorous growth;
   - Average number of leaves per plant: 83;
   - Length of leaves: 12-22 cm;
   - A number of plants were struck by a form of blight characterized by withering followed by stunted growth and death. The plants so affected had enlarged roots and tumours, suggesting an attack of Phoma. It is expected the laboratory analysis will reveal the true cause.

4. The tests were monitored by Mr. Etienne Wanda Mbiakop, Plantation Head.

Annex 19

OBSERVATION SHEET

1.	Plant:	Pyrethrum cinerariefolium
2.	Test site:	Foumbot Agricultural Research Station
	Seed-bed work	
3.	Soil:	Black earth, humus, well loosened and free of hard objects; shady site
4.	Area:	3 m^2
5.	Sowing date:	8 April 1981
6.	Sowing method:	In lines spaced 5 cm apart
7.	Emergence date:	29 April 1981
8.	Date of first weeding:	5 May 1981
9.	Date of second weeding:	23 May 1981
10.	Date of third weeding:	20 June 1981
11.	Date of fourth weeding:	2 July 1981
12.	Daily watering	
	Work in the growing area	
13.	Soil:	Black, volcanic
14.	Method of preparing the soil:	Deep tilling, fine pulverization by means of a rotary cutter and by hand; growing area raised 10-15 cm
15.	Area:	105 m^2
16.	Setting-out date:	3 July 1981
17.	Date of first tending:	4 August 1981 (hoeing and weeding)
18.	Date of second tending:	11 September 1981 (hoeing and weeding)
19.	Date of third tending:	5 October 1981 (hoeing and weeding)
20.	Number of days for germination until emergence:	21

Annex 19 (cont'd)

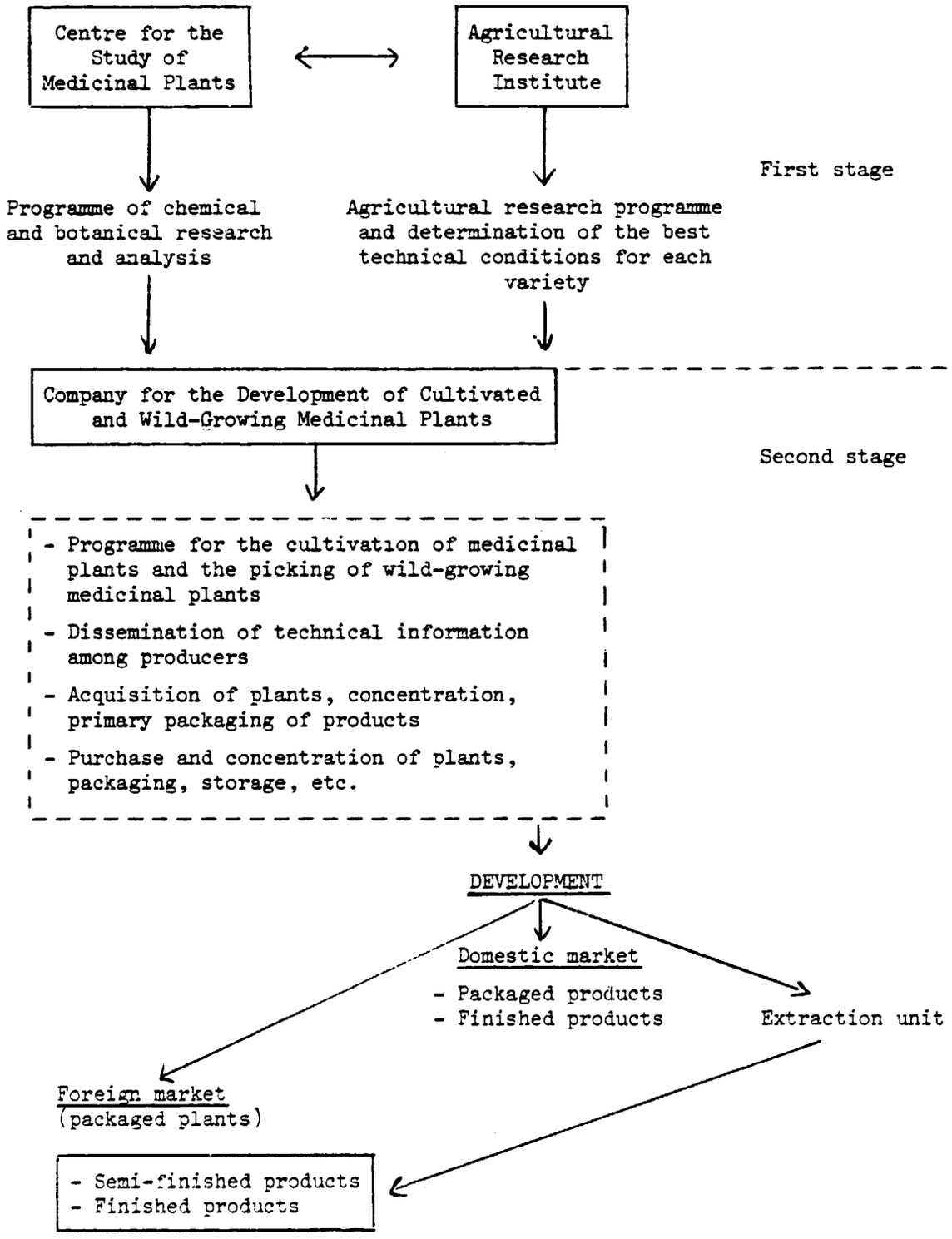
21. Number of days between emergence and setting out: 64

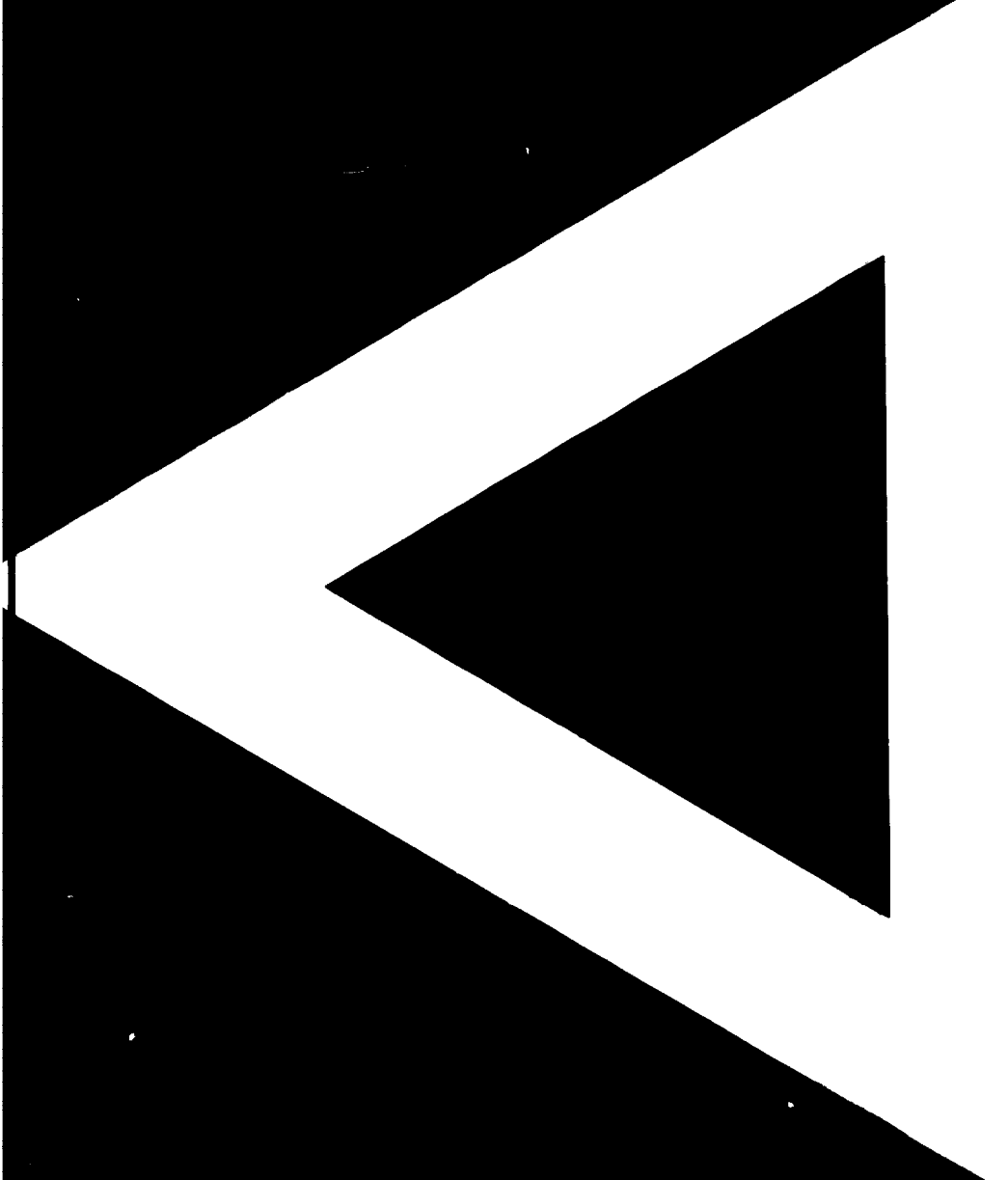
Remarks

1. Present status of the planting (11 November 1981):
   - Number of plants standing: 860;
   - Vigorous growth;
   - Average number of leaves per plant: 160;
   - Length of leaves: 8-18 cm;
   - No evidence of disease or blight;
   - No flower buds have been observed.

2. The tests were monitored by Mr. Romaine Kamdem, Station Head, and Mr. Thomas Touoyem, Team Leader.

Annex 20


Centre for the Study of Medicinal Plants
Agricultural Research Institute
First stage
Programme of chemical and botanical research and analysis
Agricultural research programme and determination of the best technical conditions for each variety
Company for the Development of Cultivated and Wild-Growing Medicinal Plants
Second stage
- Programme for the cultivation of medicinal plants and the picking of wild-growing medicinal plants
- Dissemination of technical information among producers
- Acquisition of plants, concentration, primary packaging of products
- Purchase and concentration of plants, packaging, storage, etc.
DEVELOPMENT
Domestic market
- Packaged products
- Finished products
Extraction unit
Foreign market
(packaged plants)
- Semi-finished products
- Finished products



municaciones, una "importación" efectiva, ha conducido a la pérdida de cerca de 11 000 empleos de procesamiento de información en el Canadá hasta la fecha. Y se espera que esta cifra aumente a unos 23 000, o sea el 14% del total del personal de procesamiento de información en el país hacia 1985. En 1978 el valor de los servicios de computadora importados por el Canadá fue estimado en cerca de US$350 millones. Esta cifra podría aumentar a $1,5 billones hacia 1985.

Sobre las implicaciones de transmisión de información a través de fronteras dice Robinson: "La incumbencia de gobiernos aquí debiera ser similar a la de las corporaciones. Ninguna corporación – que quiera mantenerse en existencia – está dispuesta a confiar en que sus competidoras le proporcionen información vital. Ni va a confiar en el comportamiento caballeroso de sus competidores para permitir que sus propios datos e información sean almacenados por ellos."

Cuál haya de ser el efecto de todos asuntos sobre las corporaciones es algo que, sin embargo, está lejos de verse con claridad. Pipe, de Transnational Data cree que habrán de transcurrir dos años antes de que surjan indicaciones claras. Esto se debe a que los controles de información a través de fronteras que ya existen han sido implementados tan solo en épocas recientes y muchos países están todavía apenas considerándolos.

Hay ya, sin embargo, no menos de diez países donde leyes en vigencia o en proyecto para la protección de información y de la intimidad personal imponen también condiciones sobre la transferencia internacional de información (véase cuadro, página 37).

En países de la Europa occidental las leyes de protección de información cubren con frecuencia a "personas jurídicas" o "entidades legales." Estas asociaciones, fundaciones y, a veces, compañías tienen el mismo derecho a la confidencialidad que los individuos particulares. Un informe preparado para la Cámara Internacional de Comercio (ICC) por su comisión de estudio de empresas multinacionales, puso bien en claro las implicaciones de esto para los negocios.

Parte del informe dice: "Excepto en áreas tan bien definidas como la banca, y los sistemas de información de viajes y personal, es muy poca la información que cruza fronteras con respecto de individuos particulares. Por otra parte, en su mayoría el comercio internacional se ejerce entre entidades jurídicas (corporaciones) e involucra la distribución internacional de información relativa a clientes, clientes potenciales y proveedores.

"La definición más amplia de información personal podría significar que se precisa la aprobación de las agencias gubernamentales para exportar una más vasta gama de información de negocios, con el riesgo de que tal aprobación no fuera otorgada por razones proteccionistas."

Los hombres de negocios se muestran preocupados también ante la posibilidad de que los gobiernos emplearan las tarifas de comunicaciones para ejercer control sobre el flujo de la información.

El consultor Hebditch del RU, cree que algunas tarifas internacionales están obrando ya a modo de "barreras de información" que recargan a los usuarios por el envío de información a través de fronteras. El cita cifras de 1979 de US$50 000 al año por una línea entre Suiza y el RU y $30 000 al año entre Bélgica y Holanda como ejemplos de tan altos costes.

El informe de ICC, preparado bajo la jefatura de Jacques Maisonrouge, presidente de IBM World Trade Corp., y presidente de IBM Europe, señala que la comunidad de los negocios debe afrontar ahora la preocupación de los dirigentes gubernamentales y el público acerca de los abusos potenciales de la información computerizada. El informe urge a los hombres de negocios a "argüir el caso enérgicamente en favor de la circulación libre de la información si las preocupaciones y recelos conducen a propuestas en favor de innecesarios reglamentos restrictivos."

Tanto el Consejo de Europa como la OECD están intentando en la actualidad la fórmula de principios generales y estipulaciones para la transmisión de información a través de fronteras y confidencialidad a fin de conciliar los intereses de la industria y el individuo.

La situación internacional es resumida por Hans Peter Gassman, jefe de información, programa computador y de comunicaciones. Gassman explica: "El interrogante que ha de responderse es éste: ¿Operará la nueva infraestructura de transporte de la información lo mismo que el transporte marítimo – de una manera *ad hoc*, con numerosas excepciones a las reglas acordadas internacionalmente (hay una válida comparación, por ejemplo, entre los refugios de información y las banderas de conveniencia)?

Gassman compara las actuales discusiones sobre protección de información con las que se efectuaron diez años atrás en torno a la protección del medio ambiente. Y declara que las reglamentaciones ambientales han hecho de los argumentos en su contra elementos fútiles en virtud del crecimiento de un gran consenso de la opinión en favor de la limpieza de nuestro medio ambiente.

La información, dice Gassman, es un ingrediente esencial de la vida moderna. "Nuestra libertad personal depende de ella, y no es exagerado decir que la protección de la vida privada es la forma más moderna de la protección de derechos, y se hará más importante con cada computadora que se instale."

Por tanto, si las reglamentaciones de la información parecen a primera vista un gasto innecesario, Gassman considera que "acabarán siendo no una pesada carga sino una buena inversión para el futuro." //

Malcolm Peltu
Colaborador Special

ANEXO 8

ENCUESTA SOBRE LAS NECESIDADES DE INFORMACION [illegible]

1) ¿Cómo se informa Vd.?

- LIBROS:

- REVISTAS:

- OTROS:

- ¿DONDE?:

2) ¿Que sabe Vd. de las necesidades de información en la industria?
- Tipos de pedidos de información según 1 y 2 del Código interno de consultas:

- ¿Quién busca la información en la industria (Ingenieros, técnicos, capataces, etc

- ¿Que buscan? Ejs: Fórmulas; nuevos procesos; información económica (estadísticas, cotizaciones, índices); etc.

- Sugiera visitas a pequeñas y medianas industrias (con y sin centros de información) y dos o tres grandes industrias en su área de interés.

3) Enumere 5 o 6 palabras-claves en su especialidad (concisas, representativas de los intereses tratados: técnicos, económicos, etc.). ¿Cómo agruparía la información sobre este tema?

4) Dificultades actuales en el trámite de acceso a la información industrial o económica (fuera y dentro del DAT).

5) Fuentes que Vd. sugiere: libros, revistas, otros.
Tratamiento: Nivel ajustado a las necesidades de la pequeña y mediana industria y

(sigue)

a las mismas. Idioma castellano. Sugerencias de expertos, becas, otros medios.

6) Plan de funcionamiento del DFIT:

PREMISAS: (DAT DFIT)

- Centralización del material bibliográfico a su llegada y distribución racional interna.
- Derivación de las consultas n°1 y 2 del Código interno al DFIT.
- Indización.- Clasificación.
- Difusión de la existencia del Centro de Información.

SERVICIOS A PRESTAR: (DFIT DAT)

- Capacitación en los diferentes tipos de materiales bibliográficos.
- Información permanente para Ud. y sus consultantes.
- Difusión individualizada de la información (perfil) a las distintas secciones del DAT.
- Bibliografía retrospectiva.
- Ordenamiento de los informes, (¿de las estadísticas de consultas?).
- Boletín de actualización:
  Noticias sobre laboratorios y demas secciones del DAT.
  Información bibliográfica.

7) ¿ Le parece conveniente el plan propuesto de colaboración mutua?

8) ¿ Que preguntas considera que no fueron realizadas?