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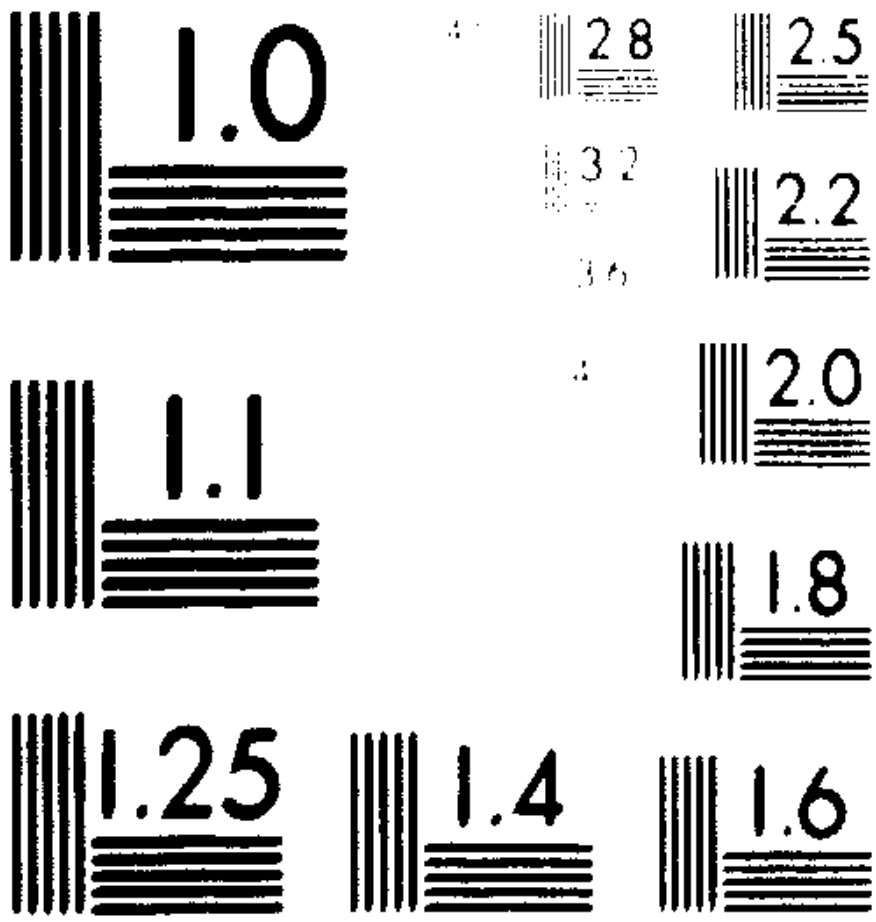

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

12434

SURVEY OF THE PHARMACEUTICAL INDUSTRY IN MONGOLIA

SI/MON/79/801

- 1. May 1983

UNIDO PROJECT SI/MON/79/801

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INDEX

1. INTRODUCTION

In Mongolia, the pharmaceuticals available to the population come form two sources:

- local production
- imports

The Country meets the greatest part of its needs of pharmaceutical products by means of imports, that reached, in 1981, a value of 4.6 Millions roubles.

On the other side there is a pharmaceutical factory, located in Ulan Bator, that produces since 1959 several kinds of tablets, injectables and medicinal plants extracts as well as para-pharmaceutical products like bandages, cotton, wool etc. Most of pharmaceuticals are produced using raw materials imported in bulk.

The Government of Mongolia required the assistance of UNIDO to improve the operation of the existing factory and to make it suitable to meet with the increase of demand of drugs.

This assistance was provided in the month of October 1981 by a team of 4 experts, including one pharmacologist, one botanist, one marketing expert and one industrial economist.

The team provided direct assistance to the factory by analizing the present situation and by recommending several solutions to improve the lay-out of the existing building to make possible the increase of

production needed to meet the demand of drugs foreseen for 1983.

The result of this analysis is given in the present report.

On the other side our team made projections on the demand of pharmaceutical products in Mongolia by 1990. On the basis of these data a list of equipment that will be needed to meet with the demand has been proposed together with the infrastrucutres needed.

As far as the medicinal plants is concerned the team collected comprehensive information on the flora existing in the Country; for each plant information on its pharmaceutical application (kind of active ingredient, use etc) are provided.

Furthermore guidelines for the development of the sub-sector are recommended.

From the pharmacological point of view the list of drugs presently imported or locally manufactured have been carefully revised with the help of medical doctors and pharmacologists. This list has been compared with the "Essential Drugs list" as prepared by W.H.O. and some consideration are provided.

Further technical assistance is recommended in the following area:

- supervision of the plant up-dating works
- rationalization of the pharmacopea.

Baldo & C. whishes to express its appreciation for the valuable support and guidance received from the numerous representatives of the counterpart entities (Ministery of Health, Pharmaceutical Factory,) and of the other institutions in Ulan Bator as well as of the local UNDP office.

Team included: Dr. R. SCIAKY
Mr. M. DE CARVALHO
Mr. F. CELLI
Mr. R. BENVENUTI
Mr. R. REPETTI

2. THE SITUATION OF HEALTH IN MPR

2.1 The Health Policy

The sector of public health fares high in the list of priorities of the MPR: the Government has allocated to it an important share (varying between 9 and 12%) of the State budget. The health expenditure has evolved, in the past, as follows:

1955	1965	1975	1977	
49.9	118.0	270.0	312.0	(million of tugriks)

With regard to the five-year period 1971-1975, the health expenditure increased during the years 1976-80 by 40%, while in the current period the rate of increase will reach 42% and will amount in 1985 to 235 tugriks per capita per year; in the year 2000 it will be of 450 tugriks per capita per year. The MPR firmly shares the principles set out in the improvement of living conditions by securing a greater availability of food to the population and providing every family with an apartment and a centralised supply of drinkable water. Moreover, the health policy of the MPR is based on prevention, the greatest attention being devoted to the education of the masses on matters regarding sanitary problems and the development of "physical culture" and sports on a mass scale.

Last but not least, the health policy of the MPR includes the extension and improvement of public services with the aim of rendering medical care available to all citizens and free of charge.

Specific attention is being paid to the development of MCH (Maternal Child Health) services, which have been set as a national priority by law.

2.2 The health situation of the MPR'S population

The morbidity pattern of the MPR'S population is presently shaped according to the following list which shows, in order of importance the no. of cases per year. The major groups of diseases are:

.1. Respiratory diseases

.2. Diseases of the digestive system

.3. Diseases of the nervous system and sensory organs

.4. Infections and parasitic diseases

.5. Diseases of the skin and subcutaneous tissue.

As far as the first four groups are concerned, no changes have occurred since 1966 in the respective position in the list; however, the fifth position has occupied in that year by the group of diseases of blood circulation organs.

As a result of industrial development, injuries and accidents, peculiar to a faster and more dangerous way of life, are beginning to spread; moreover, the demographic structure of the population is rapidly changing, standards of life are greatly improving, so that the morbidity structure is expected to evolve into that of developed countries.

The mortality pattern shows that respiratory diseases are the first cause of death: however, the other diseases occupying positions from 2nd onwards on the morbidity pattern are diffe-

rently situated in the mortality structure, which is as follows:

.1. Respiratory diseases (pneumonia first)

.2. Cardio-vascular diseases (hypertension first)

.3. Cancer (to stomac in 1/3 of cases)

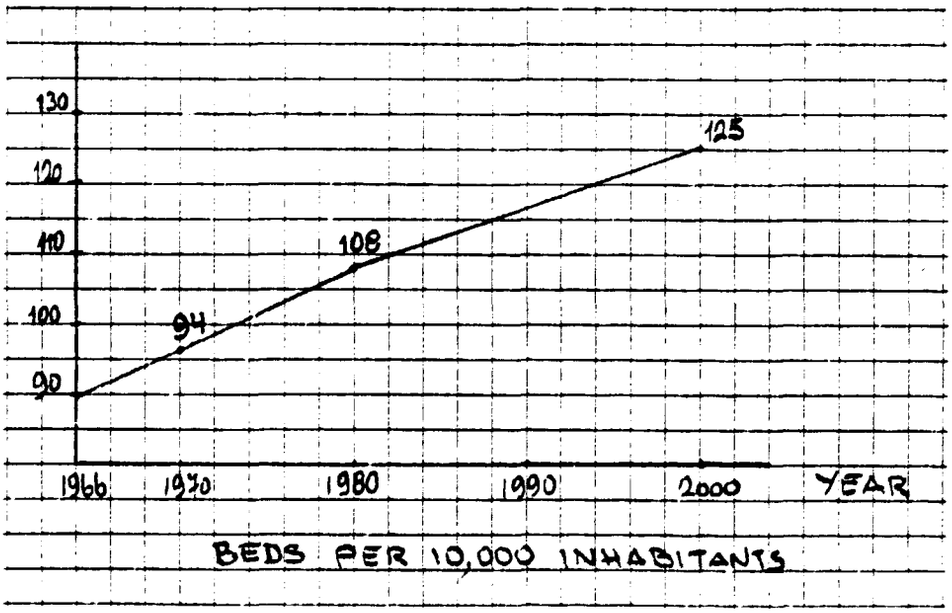
.4. Accidents.

Infant mortality is still high, though it has gone down by 8 times in the last 60 years; during the same period the mortality rate has dropped by 2,2 times.

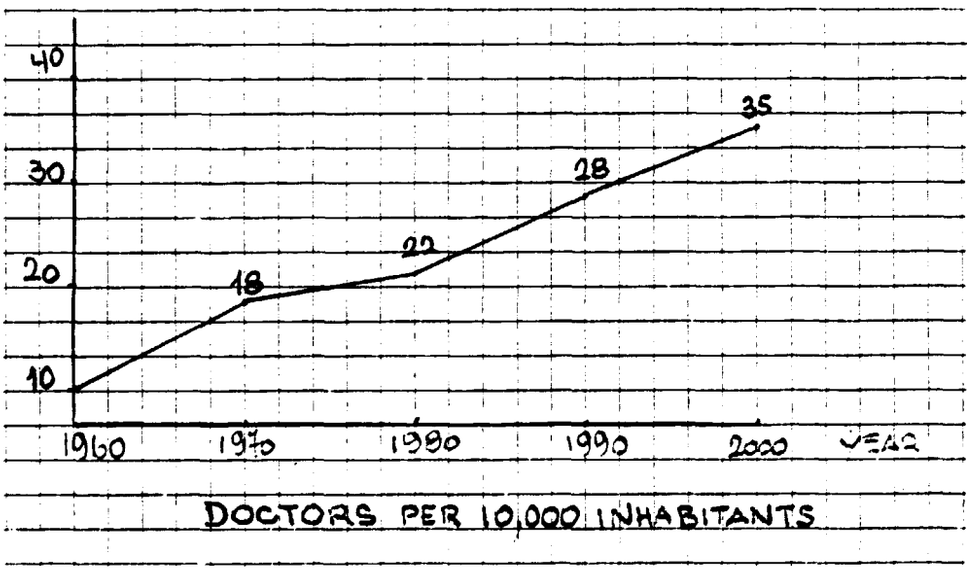
2.3 The health structures

The health services are available to all citizens of the MPR free of charge; these services consist of a variety of institutions, ranging from the larger hospitals (having a capacity of up to 600 beds) to the Somon hospitals (having a capacity of 15/20 beds). There are also, in rural areas, smaller health stations for emergency cases.

The no. of beds per 10.000 inhabitants is presently of 108, while it is steadly increasing as follows:



The gap presently existing between the no. of beds per 10.000 inhabitants in urban and rural areas is expected to progressively narrow; in the year 2000 these parameters will respectively be 150 and 100. The staffing of health services is steadly increasing as follows:



The supplying of pharmaceutical is channeled to through a Central Medical Supplies Store and a Central Drug Control Laboratory, to which both imports and local productions are delivered. The distribution of pharmaceuticals is done by the following institutions:

. Aimak and City Directorate of Apteks,

. Aimak, City, District, Village and Somon pharmacies,

. Specialized pharmacies,

. Drug kiosks.

The delivery of medicines is done against payment, however hospitals' in-patients and in any cases people suffering from some diseases such as TB, VD and brucellosis are entlited to supplies free of charge.

Several establishments are involved in the fulfilment of the pharmaceutical needs of the population. Among the others, the following:

. Pharmaceutical factory

. Research institute for Biological and blood products,

. Workshop for repairs and maintenance of medical equipment,

. Aimak and City stations for blood products,

. Prosthetics workshop,

. Cosmetic treatment Centres.

Medical Scientific research is carried out in the following establishment:

. Academy of Medical Sciences

. Academy of Maternal and Child Health

. State Medical Institute

. Medical Technicum

. Scientific Research Laboratory.

3. PHARMACEUTICAL SITUATION

In Mongolia, the pharmaceuticals available to the population come from two sources:

.1. Local production

.2. Imports

3.1 Local Production

Finished pharmaceutical forms are mainly produced from raw materials imported in bulk; extracts from medicinal plants are an exception since they use locally available raw materials. The existing pharmaceutical factory also produces some para-pharmaceuticals (bandages, cotton, wool for medical use etc) and, in a section called 'Biotec',nutritive solutions for animals.

In the year 1979, the local production of drugs has reached the amount of 2,028,100 roubles (=8,477,500 tugriks).

This figure has been obtained from:

Sector	No.of products	Value (roubles x 1000)
Tablets	27	937,13
Ampoules	6	444,02
Galenics	40	646,96

The above mentioned galenics include extracts from plants in their various forms (syrups, extracts, etc.), ointments, tinctures, liquids of several sorts (hydrogen peroxyde, iodine tincture etc.), vitamines and other products in form of pills or of powder.

The confections produced in 1979 are the following:

Tablets	32,684,600 (6 pieces confections)
Ampoules	7,300,000
Galenics	26,822,000 (confections + approx 1,570 tons of products)

Further details have been provided in Annex No. 1.

3.2 Imports

The MPR meets the greatest part of its needs of pharmaceutical products by means of imports.

The European countries are its main suppliers and, among them, the USSR occupies the first place, followed by Hungary, the German Democratic Republic and Bulgaria.

Data regarding imports have been subdivided into 12 groups; only three of whom concerning pharmaceuticals, the rest being to ascribe to para-pharmaceuticals such as bandages, syringes rubber objects, etc.

We have only taken into consideration the items concerning pharmaceuticals.

Since the lists given to us contain several imprecisions (raw materials listed together with specialities, etc), as well as frequent additions of data, we have tried to rearrange them in order to obtain significant figures, depurating the items not strictly regarding pharmaceutical specialities.

We have been able to identify the most important and significant products. The imports forecast of pharmaceutical products

for 1981 amounts globally to 4,757,815 roubles, distributed as follows:

- Antibiotics	2,086,875 roubles
- Vitamines	370,730 roubles
- Other pharmaceuticals	1,964,270 roubles
- Vaccines and bio-products	335,940 roubles
	4,757,815 roubles

The following table (Table I) shows the imports in detail (divided into types of products):

TABLE I

BUDGET-PHARMACEUTICAL IMPORTS IN MONGOLIA FOR 1981

(IN ROUBLES x 1000)

	USSR	HUNGARY	BULGARIA	CZECHOSLOVAKIA	D.D.R.	POLAND	RUMANIA	YUGOSLAVIA	OTHER	TOTAL
Antibiotics	1,293.21	471.8	453.7	--	--	--	33.0	--	--	2,086.875
Other pharmaceuticals	704.31	664.75	58.06	73.04	16.75	180,85	55.81	51 63	159.07	1,964.270
Vitamines	263.13	--	--	--	107.6	--	--	--	--	370.730
								SUBTOTAL		4,421.865
Vacines and bio-products	322.59	--	--	4.25	5.5		--	--	3.6	335.940
								TOTAL		4,757.815

On the whole, 367 specialities are imported, including Antibiotics, Vitamines and other products.

With regard to the countries of origin, the first place is occupied by the USSR, followed by Hungary and Bulgaria.

Table II offers an analytical quotation of data concerning the imports from different countries.

We can thus notice that over 95% of imports come from the socialist countries.

(Table II in the next page)

TABLE II

IMPORTS FOR 1981 BY COUNTRY

COUNTRY	TOTAL IMPORT	
	NUMBER OF PRODUCTS	TOTAL VALUE (x 1,000 ROUBLE)
U S S R	158	2,260.65
HUNGARY	82	1,136.55
BULGARIA	12	511.76
CZECHOSLOVAKIA	15	73.04
D.D.R.	25	130.42
POLAND	19	180.85
RUMANIA	9	88.81
SWITZERLAND	14	81.44
OTHER COUNTRIES	33	129.26
	367	4,592.78

% ON THE TOTAL	
BY NUMBER OF PRODUCTS	BY VALUE
43.1	49,3
22.3	24,7
3.3	11,2
4.1	1,6
6.7	2,8
5.2	3,9
2.5	1,9
3.8	1,8
9.0	2,8
100.0	100.0

Specialities with an annual global cost over 10,000 roubles have been identified and singled out from the Imports budget. The 10,000 roubles figure has been chosen, it being the limit within wich almost all the most important therapeutical products fall.

The mentioned limit includes 86 specialities (23.4% of the totality of imported products), with an overall cost of 3,716,035 roubles (= 82% of the global cost of the pharmaceutical products to be imported).

Annex 2 draws a list of these products, comprising confection, number of pieces, unit prices and global cost subdivided among the countries of origin.

Table III, on the contrary, contains the consolidated data regarding the main 86 imported specialities, subdivided according to their country of origin, and a comparison with the total of imports.

(see table III in the next page)

TABLE III

SUMMARY OF PHARMACEUTICAL IMPORTS

(IN ROUBLES X 1,000)

COUNTRY OF ORIGIN	MAIN IMPORTED PRODUCTS		TOTAL IMPORT		% MAIN PRODUCTS ON TOTAL	% VALUE OF MAIN PRODUCTS ON THE TOTAL
	N° of products	Total Value	N° of products	Total Value		
I [illegible]	36	2,066.50	158	2,260.65	23	91,4
	30	890.57	82	1,136.55	37	78,4
	7	496.70	12	511.76	58	97,1
	2	35.2	15	73.04	13	48,2
D	2	107.6	25	130.42	8	82,5
POLAND	2	143.25	19	180.85	10	79,2
RUMANIA	3	68.75	9	88.81	33	77,4
SWITZERLAND	4	72.30	14	81.44	29	88,8
OTHER	-	-	33	129.26		
TOTAL	86	3,716.035	367	4,592.78		

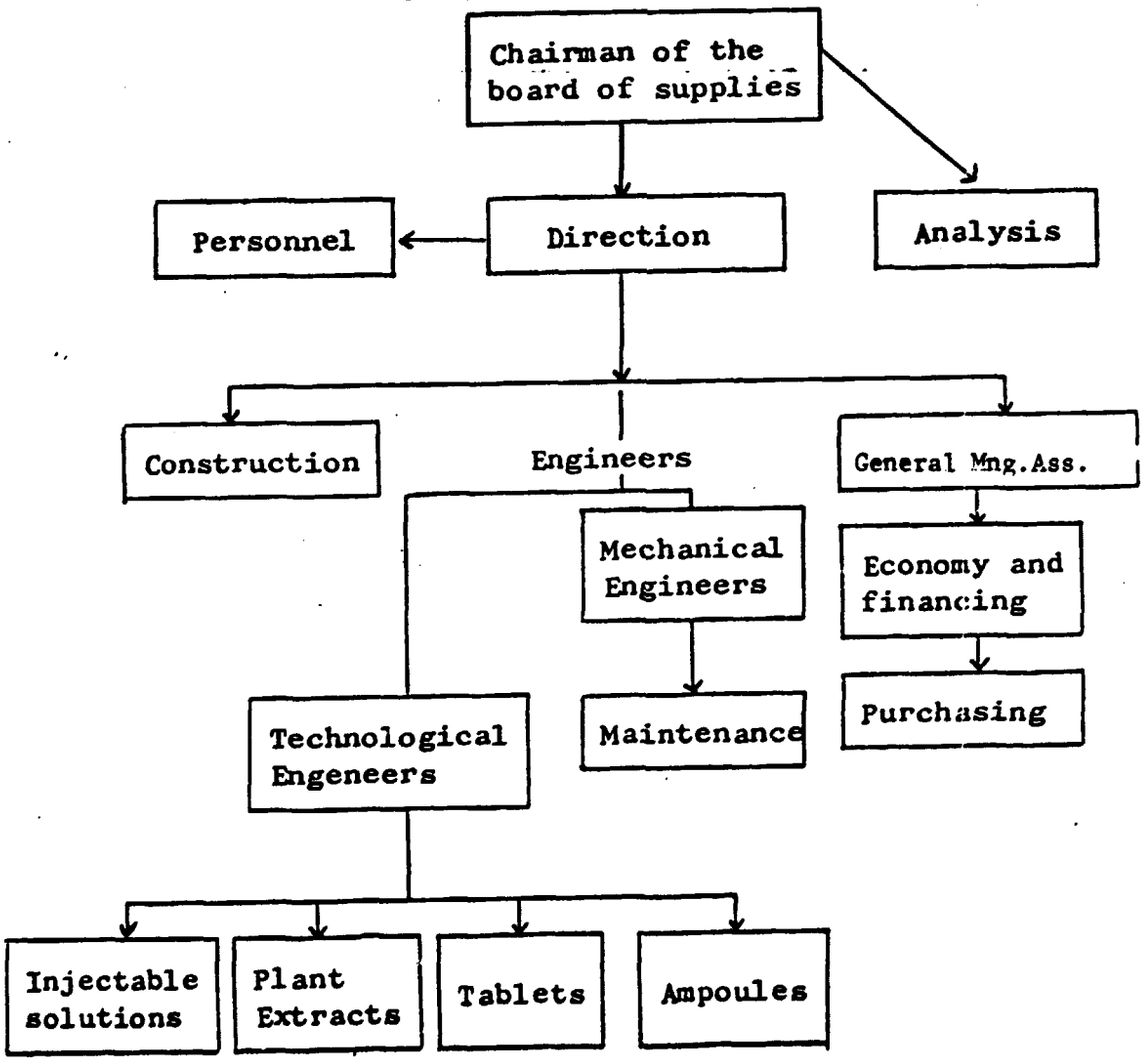
24% of the products account for 82% of the total value

4. THE PRESENT PHARMACEUTICAL INDUSTRY IN MPR

Pharmaceutical products are formulated in a factory located in Ulan Bator.

This factory, built in 1959, started production with the manufacture of tablets and injectables, proceeding, later on, to produce extracts from medicinal plants and para-pharmaceuticals (bandages, cotton, wool etc.).

The factory has been placed under the direction of the chairman of the board of supplies for drugs and medicaments as per the following organization chart:



The plant consists of a main building, where the pharmaceutical production takes place, as well as of three additional buildings where the production of bandages and cotton wool and the extractions are carried out. There is also another building, called "Biotec", devoted to the preparation of solutions to be used in the zootecnical field.

The factory is complete with utilities (including a steam producing station), a packing section, a maintenance section, ect.

The present report will pay specific attention to the pharmaceutical and extractive production.

The main building, whose surface is of approx. 900 square meters, has two storeys. The tablet and ampoule manufacturing sections are located in the ground floor.

The production of injectable solutions, the control laboratories and the offices , are at the first floor.

4.1 Production of tablets

This department occupies a surface of about 300 square meters where the various operations of granulating, drving, compressing and packaging are carried out.

The flooring and the walls are in poor conditions and should be renovated and made to fit the conditions requested by a modern pharmaceutical industry.

The granulation section includes a mixer with a capacity of about 40 kg/batch, a steam - heated reactor for the preparation of the binder, a wet-granulator and a mill. All this equipment is obsolete and should be replaced (with the possible temporary exception of the wet-granulator and the mill).

Working conditions are unsatisfactory, especially because considerable quantity of dust is developped. The drying takes place into a static dryer (capacity: 400 kg), very old and obsolete, whose exhaust air outlet is in the same room. From the hygienical point of view, here too, working conditions are poor. There are three compressing machines, one of them obsolete, which is at present being used only in case of emergency. Of the remaining two, one is russian made, with 40 punches and a nominal capacity of 40,000 tablets/hour (10 kg/hour), while the other one comes from Eastern Germany (Kilian), has 15 punches and a capacity of 35,000 tablets/hour (16 kg/hour).

On the whole, there is a production of 75,000 tablets/hour, 6-7 hours/day, that is, a daily production of 450-525,000 tablets (this figure being subject to variation, depending on the size of tablets as well as on the pressure used to produce the tablets).

An additional output of 200,000 tablets/day could be obtained by operating the obsolete compressing machine (total output would therefore be 700,000 tablets/day).

The room where the tablets compression takes place is very small, several different kind of production being carried out at the same time, which increase the possible risk of errors and the contamination, there being around great quantities of dust too.

No intermediate storage room is available after the compression department.

The packing takes place manually in an adiacent room. The tablets are packed in packages of 6 with paper strips indicating the

contents and lot number. The rolls are then packed in 500 piece boxes. There is no leaflet containing instructions for use.

4.2 Ampoules production

4.2.1 The ampoules department is located in the ground floor of the main building. It occupies a surface of approx. 300 square meters, partly situated in a recently built annex to the main building. The complete ampoule production cycle takes place here, from the glass tubes to the finished pharmaceutical form.

4.2.2 The glass tubes are withdrawn from a small storage room near the entrance, and washed vertically as well as horizontally, by means of a shower system (in bad conditions).
The drying is made manually (the drying stove is out of use) with a long metal tube carrying a piece of cloth tied at the top. This causes a lot of inconvenients, ranging from the presence of foreign bodies inside the finished ampoules to the danger of wounding for the workers.

4.2.3 The glass tubes are then taken to the ampoule manufacturing room. Four machines are being used, presently, three of them very old and to be eliminated as soon as possible. Each machine produces 5,500 ampoules in 8 hours (total: 16,500). There is a bigger machine old but still in operation, with an output of 6,000 ampoules in 8 hours.
On the whole, these machines have a production capacity little

above 6 million ampoules/year (in 285 working days).

A new hungarian made machine, Tungsram UO 19, is being installed now. It has an output of 3,000 ampoules/hour (the production capacity varies according to the size of ampoules) and will manufacture goblet necked ampoules (that do not need manual trimming). The above mentioned trimming operation is presently carried out by 6-8 workers in a small adiacent room. The trimmed ampoules are placed on trays containing 1,000 ampoules each. They are then taken to the washing-room close-by.

4.2.4 The washing-up takes place in the following way: the trays carrying the ampoules are placed into a cleaning unit (autoclave-like), the ampoule tips are then dipped into distilled water while creating a vacuum in the apparatus (french system). Allowing the ambient pressure back, the water fills the ampoules. This is done repeatedly; this system can wash 1.000 ampoules in 7 - 8 minutes. that is, more than 6,000/hour.

This does not seem to be a very efficient washing system, the more modern ones being based on the injection of pressurized water in the ampoules through needly.

A Hungarian Tungram machine, type GYB, with trays for 500 2-ml ampoules has been purchased, but it has not been started up yet. Anyhow, this machine would only be able to wash the goblet necked ampoules, not the ones produced now, and would need, besides to be started up by specialized engineer provided by the supplier. We consider, moreover, after comparison with similar machines, that its output is in the range of about 15,000 ampoules/hour (30 cycles/hour).

4.2.5 The drying-up of the ampoules takes place into steam-heated cabinets.

4.2.6 The preparation of the solutions and subsequent filling is carried out in a room that is not suitable for this purpose. First of all, the approx. 12 square meters room is in poor conditions (floors, walls and raceways). There is no air filtration system; the solutions are being prepared into a non-stirred container; filtration takes place through gauze, and the ampoules filling by means of a device identical to the one used for their washing. The ampoules are sealed in the next room by means of a small machine and, given the filling system now in use, some carbonization and decomposition of the product takes necessarily place in the welding zone.

A new hungarian Tungsram machine, type GYT 1, has been installed but it is not yet in use. It has an output of 2,100 - 5,200 ampoules /hour and carries out the filling of ampoules (by means of needles) as well as the subsequent sealing.

This machine, too, can only be used with goblet necked ampoules.

4.2.7 Ampoules are sterilized into a steam-heated autoclave. It has a capacity of 10,000 ampoules (10 trays). Conditions of sterilization are highly variable, depending, as they do, on the temperature of the available steam. The operation takes about 1 - 2.5 hours.

There is no control to accertain whether the sterilizing temperature has been reached overall as well as maintained through the complete cycle to the end.

4.2.8 Sterilized ampoules are cooled and taken to inspection which is made manually. A Hungarian machine to be used in this operation could not be seen by us as it has not been unpacked, yet.

4.2.9 Packing takes places manually in the adjoining room, after printing the ampoules as to their contents, by means of an obsolete machine now almost out of use.

A hungarian packing machine (Tungsram GXE 3), with an output of 6,300 - 10,500 ampoules/hour, recently purchased, has not been used yet. (*)

4.3 Injectable solutions department

4.3.1 The injectable solutions department, located in the main building's first floor, covers a surface of approx. 150 square meters, subdivided into 5 rooms.

Its present equipment is perfectly fit for the preparation of injectable solutions in glass containers, while the use of disposable plastic bottles would require some integration of the existing equipment

The equipment is new and, apparently, only shortly used. At the time of our visit, it was not in operation for lack of glass bottles

The mentioned equipment is in a good condition, but still, we belive it would be convenient to upgrade cleanness and tidness.

4.3.2 The first room houses the pre-washing of glass bottles. The eqipment consists only of sinks and revolving brushes.

4.3.3 The final washing takes place in the second room. There are here, besides tables and sinks, 3 Czechoslovack made Chironay distillers, complete with refrigerators, for a capacity of

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(*) NOTE: We recommend that this machine and all other hungarian equipment recently purchased, be started up by supplier's engineers that should also provide adequate training to local personnel.

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40 l/hour (distilled water) each, employed to wash the bottles, rubber plugs and caps.

4.3.4 The following rooms contains three more distillers which are used in the preparation of distilled water and of the solutions.

The overall production capacity would thus reach approx. 120 l/h (=240 ampoules 500 ml each).

4.3.5 An autoclave (capacity 200 l) which can be heated up to 130°C is used for the preparation of the solutions. The filtration of these solutions is carried out by means of a glass porous filter. The same room contains the head to fill the bottles.

4.3.6 The last room houses 2 autoclaves used for the sterilization of bottles each of whom has a capacity of about 1 cu.mt. The loading capacity has been estimated at approx. 600 bottles/autoclave.

If we consider a sterilization cycle of 4 hours, and 2 daily cycles, each one of the autoclaves can treat 1,200 bottles in 8 hours. That would mean a total of 2,400 ampoules per day. In the course of a year (285 workirg days), it would be possible to produce 680,000 pieces, against a forecast requirement of 220,000 pieces for 1983.

The handling of glass bottles now done manually up and down the stairs (since the production department lies upstairs), constitutes a still unsolved problem.

4.4. Quality control

The quality control is one of the main features in a modern pharmaceutical industry, whose purpose is not limited to a constant control of the quality of the products being manufactured, but verifies that the manufacturing standards are respected.

There are two kinds of quality control in Mongolia:

(1) a central quality control

(2) a factory quality control

The central quality control carries out supervision of imported products (raw materials ans specialities) as well as of local production.

The controls, however, appear to be rather sporadic.

The factory's quality control is carried out by two specialists and several assistants in a two rooms laboratory.

We recommend to improve the laboratory equipment and especially the instrumentation:

a spectrophotometer, gaschromatograph and some other instruments should be purchased.

Moreover, the purchase of an analytical weighing device would be highly advisable, as well as laboratory glassware, reagents and some manuals on analytic chemistry.

4.5 Production of Galenics

The department for extracts production is located in a 570 sq.mt. one story building, located near the main building.

Main equimpent are:

- 8 extractors, by percolation, 200 liters each

- 1 1,000 liters distillation unit
- 2 hydroextractors, 60 cm. diameter
- 1 centrifugal separator
- 1 stirred reactor, 300 lt.

Most of presently installed equipment is in good order.

5. SHORT TERM EXPANSION OF PRESENT PRODUCTION

During the team mission in PRM, the officials of the Pharmaceutical factory stressed the importance and urgency of a short term expansion of present production of pharmaceutical products.

The team had the opportunity of revising a techno-economical study carried out by Mongolian experts and team members were required to study the expansion of the present production on the basis of the goals stated in the report and already approved by the concerned Authorities.

The expanded production lines should assure the following increase in yearly about:

- Tablets: from 195 million pieces to approx. 360 million pieces
- Ampoules: from 7.3 million pieces to 16.7 million pieces
- Injectable solutions: to 220,000 500-ml bottles
- Galenics (including ointments): from 120 to 400 tons

The mentioned expansion should take place within the existing buildings, modifying, if needed, their lay-out in order to allow the installation of new machinery.

We have analyzed the present situation together with the Mongolian experts and proceeded to a survey of the whole factory and of the equipment presently available.

The mentioned survey originated this proposal, which should be understood as an attempt at improving the present situation.

Moreover, it will enable the PRM to cover, by 1983, its forecast pharmaceutical needs.

In drawing up this proposal we have followed some general indicative principles; that is to say:

(a) We have tried to reduce imports to the minimum, using local production capacity as far as possible. More particularly, we have tried to use the existing equipment whenever still utilizable (even when not exactly up-to-date). On the other hand, we have suggested the import of rather expensive machines only when they are likely to be ammortized on short terms.

(b) Expansion can take place gradually, by means of subsequent purchasing of machinery, without need of an initial heavy investment.

(c) Civil works have been reduced to the minumum, in the attempt of using the present structures as far as possible such as they are.

(d) Attention has been paid on qualitative improvement of production and of the environmental conditions.

The following basic assumptions have been made:

- 285 working day/year
- 8-hour work for 5 days, and 4-hour work for one day (44 hours/week)
- 1 shift/day (subject to exceptions).

5.1 Production objectives

5.1.1 Tablets

The goal would be to reach a production of 59,500,000 6-piece packings, that is, 357 million tablets in 1983, which would double the present output.

Daily production would thus amount to 1,252,000 tablets. If we consider an average of 7 working hours/day and an efficiency (as far as the machinery is concerned) of 80%, an output of 223,000 tablets/hour would be needed.

5.1.2 Ampoules

A production of 16,700,000 ampoules in 1983 is forecast, which would mean to double the present output.

Daily production would have to reach 58,000 ampoules, and we would have to consider the percentage of discards around 10% (higher than european standards, but still quite realistic given the present skilness of Mongolian workers, an efficiency of 80% and the equipment in function 7 h/day, which results in a production of 11,600 ampoules/hour.

5.1.3 Injectable solutions

The goal for 1983 is a production of 220,000 500-ml bottles, which means a daily output of approx. 800 bottles.

5.1.4 Galenics

The objective here would be to reach a production of 400 t of extracts.

In the following paragraphs, suggestions for the expansion of production are offered. Please refer to drawings A and B for the new lay out.

5.2 Tablets

5.2.1 Buildings

The part of the building now being used for the manufacture of tablets is suitable for the foreseen extension of production, provided that minor changes and improvements take place. The enclosed drawing B swhows the proposed lay out of the tablets department. Some space has been gained with the removal of the central passage. Moroever, the automatic packing system will allow a better utilization of the space, while reducing the number of persons and, consequently, of tables where packing now takes place manually. From the contamination point of view and in order to improve the present situation, it is recommended to supply this department with a filtrated air ventilation system (with at least 5 changes per hour).

The rooms will have to be rearranged according to the principle that surfaces likely to get easily dirty (where micro-organisms thrive) should be reduced to the minimum.

We therefore recommend, at first the elimination of raceways (for cables and pipes), as well as all the edges (the joints of floor, walls and ceiling should be rounded).

Windows should stay shut; here, too, edges and corners should be avoided.

Walls, ceilings, windows and doors will have to be painted with washable paint, while the floor will have to be covered with linoleum, with the least possible junctions.

The department will have to be furnished with doors (better even double doors), which will stay always shut in order to avoid inleackage of non-filtered air. The two production lines will be separated by a partition (painted wood and glass) in order to avoid risks of product confusion and of cross-contamination as much as possible.

5.2.2. Generalities on the choice of equipment

(a) It would be appropriate and advisable to manufacture the most requested products locally, and also those with a higher unit price. This would allow the planning of longer production campaigns and a considerable saving in foreign currency.

(b) It is suggested to carry out not more than three production compaigns for the same product in a year.

(c) It is recommended to install two indipendent high output production lines.

It will be useful, in a near future, to add to these a third low-capacity line, to be devoted to the manufacture of products requested in minor quantities (see development programmes for 1990).

If we assume a weekly change of production, at the end of every four-month period and with two production lines, 34 different types of tablets could be manufactured.

(d) We have assumed to produce 0.5 gr.-tablets (infact, they will vary between 0.2 and 0.5 gr). This would mean a slight over-sizing, which would enable future production increases.

Detailed recommendations for the various sections are provided in the following paragraphs:

5.2.3. Preparation of the granulate

Approx. 630 kg of mixture are needed to produce 1,252,000 0.5 gr tablets/day. At the rate of one batch/hour, twelve 50kg mixing-batches will be necessary (that is to say, 6 batches for 2 machines). Two 50-60 kg mixers will therefore be necessary, as well as two 50 kg balances, and two smaller ones (5kg each). Required will be also some stainless steel containers for the weighed material coming out the mixers.

Furthermore, two steam-heated kettles for the preparation of the binder (starchpaste) will be needed .

One kettle could be enough provided that an accurate production planning is carried out.

Wet granulation requires two oscillating granulators (one already available and in use). Granulate drying will be carried out by two different types of dryers: static, and fluid-bed (Glatt type). The overall drying capacity should reach 650-700 kg of granulate/day.

The subsequent process of dry-granulation can take place into the same oscillating granulators used for wet-granulation provided the sieves are changed. Finally, the equipment will be completed by 2 mills where the mixing subsequent to the addition

of lubrifiers takes place (one already available and in use).

5.2.4 Tablet preparation

Granulate compression will require the use of 4 fast rotating machines,with a production capacity of 60,000 tablets/hour each. The availability of 4 machines allows wider production possibilities, if needed, and on the other hand enables the foreseen increase in production to take place gradually according to the growth of demand.

The four machines will be supplied with dust-exhausting systems.

A 0-50 kg range weighing device would also be needed. It is important to carry out some physical analysis on the tablets being produced in this same room where compression takes place.

With that purpose in mind, several simple devices will be necessary:

- balance to weigh tablets
- tablet thickness tester
- tablet hardness tester

The remaining analysis to be carried out on single lots will be made by the quality control department.

5.2.5. Dust problem

The main problem to be solved in the process of tablet manufacture, as far as industrial hygiene is concerned, is that of dust. In fact, dust is generated in all process stages.

In order to improve the present situation, we deem it indispensable to have a central dust exhausting system installed in this department.

All the machines (mixers, granulators, mills, compressors) will have to be placed into wood boxes with glass windows connected to the central exhausting system.

5.2.6 Intermediate storage

Once the manufacturing cycle is over tablets will be placed into proper containers and transferred to an intermediate store-room which should be divided into two parts: one for tablets still to be examined by the Quality Control, and the other for those already approved and waiting to be packed.
Every single container should bear a label clearly indicating tha name of the product, the lot number and whether it has been tested and approved by the Quality Control or not.

5.2.7 Packing

There are several possibilities, more or less expensive, when facing this phase. The choice will depend, also, from local needs and means. However, it is important to pass from manual to automatic packing.
Different packing solutions con be adopted, they depend mainly on the type of product. In general, however, blisters will suit the majority of forms. We therefore suggest the installation of two blister packing machines to undertake the production of 220,000 tablets/day of two different products. Each of them should, therefore, have a capacity of 110,000 tablets/day and, considering 6 daily working hours, that would mean a capacity of 18,000 pieces/hour.

The blisters will then be packed into boxes, according to market needs, manually introducing the instructions for use into the boxes (it is not done now).
Another, less advantageous, alternative would call for the installation of an automatic machine packing the tablets in rolls of six or more.
The advantages, here, would be: mechanization, which would result in an increase of production; the use of paper, which is much less expensive and more easily available than plastic and aluminium foils. There is, however, the drawback of introducing a packing system not wholly in accordance with the present standards of quality and conservation.

5.3 Ampoules

5.3.1 The ampoule manufacturing section is presently located in the ground floor of the main building, partly occupying also, a recently built annex.

Even if it will imply some difficulties, it will be possible to use the available space and to increase production up to 16,700,000 apoules/year.

A suggestion for the lay-out of the ampoule manufacturing area is given in the enclosed drawing A. It is obviously conditioned by the present situation (main walls, doors, windows, etc.) and by the goal of making some area available for additional equipment.

A part of the area must be sterile. We therefore recommend the already mentioned elimination of raceways for pipes and cables. Walls will have to be painted and edges eliminated (the joints of floors, walls, and ceiling should be rounded). Windows should stay shut or even be sealed. All edges should be avoided. Walls, ceiling, windows and doors will have to be painted with washable paint, while the floor will have to be covered with linoleum with the least possible junctions.

Here, too, whole production area, from the washing of ampoules to the sterilizing autoclave should have a filtered air ventilation system (with at least 10 changes/hour).

The utmost precaution should be taken to avoid bacterial contamination both of the product and of the equipment.

The personnel should be in good health, well aware of the rules

regulating the handling of sterile products and should wear clean dresses, which will have to be changed daily.

The rooms will have to be supplied with germicidal lamps to be lighted upon the workers leaving the place at the end of their shift, and remain in operation the whole night.

5.3.2 Production of water suitable for 'Injectable use'

This water must be practically sterile (contamination not higher than 0.1 colonies/ml at the delivery point) and apyretogenous.

A ion-exchange demineralizer and a continuos distiller (capacity: 20-25 lt/hour) will be needed to obtain this type of water (the distiller's global capacity should be calculated, always keeping in mind the consumption of the ampoules washing machine, see below).

Distilled apyretogenous water should be preserved and distributed so as not to allow microbial growths. Such aim can be attained when water is kept at a temperature of + 80°C and not longer than 24 hours.

The containers within which the water is transported should be apyretogenous and sterile, too.

5.3.3 Ampoules production

Ampoules are produced locally from imported glass tubes.

Goal for 1983 is the production of 16,700,000 ampoules/year (58,500 ampoules/day for 285 days/year).

The store of glass tubes is enough to meet future requirements.

Washing and drying up of tubes will have to be sized as indicated in the enclosed drawing A.

It will be necessary, however, to change the showers used to wash the tubes. Washing should be carried out by using water first and demineralized water afterwards; drying up should take place in a filtered air stove or alternatively in a filtrated hot air tunnel. All manual operations are to be eliminated, for safety reasons, too.

The area devoted to the production of ampoules as from glass tubes is sufficient. It requires some refitting, only. (floor repairs, repainting of walls, doors and windows). Of the existing machines, only one could be utilized to manufacture ampoules. Nevertheless, it is old, has a productivity of 6,000 ampoules in 8 hours and, besides, can only produce ampoules not able to be used by the following new washing and filling machine.

A hungarian-made machine (Tungsram, mod. U.O.19) was recently installed but has not been started up yet. Not having been able to see it in operation, we cannot judge about its realiability. The equipm nt should be tested and if the results are satisfactory, the purchase of other machines of the same type, to increase production, could be taken into consideration.

The hungarian machine has an output of 3,000 ampoules/hour (this figure may vary depending on the size of ampoules), and therefore, four units would be necessary to meet with the foreseen requirements.

In case the daily working time of the machines is increased, three machines only would be needed to produce the required 58,500ampoules/day.

As a first step , it could be taken into consideration to employ one machine for two shifts (thus producing 45-48,000 ampoules in 16 hours). Only later, a second and third machine could be purchased.

All these calculations are subject to revision depending on the actual productivity rate of the hungarian machine, once it starts production.

5.3.4 Ampoule washing

The washing of ampoules will be carried out by one (not yet in operation) hungarian Tungsram GYB machine (Strunk type). Not having been supplied with data concerning its production capacity, we must assume it will run like any machine based on the same principles (like the german made Strunk). We belive it to be able to reach an output of 15,000 2 ml-ampoules/hour (2minute washing cycle). The same may be said of the machine used to place the ampoules on trays. The machine, therefore, would be suitable to meet with the foreseen needs.

Some hundreds liters/hour of distilled water will be needed and therefore a suitable size distiller should be installed.

The drying up of ampoules should take place into high-temperature stoves. We recommend that two electrical stoves be installed instead than steam heated units. In fact, the steam now being produced by the plant's thermal central does not permit autoclaves and stoves to operate normally. The stoves used to dry up ampoules link the washing room to the sterile area where ampoule filling and sealing take place.

5.3.5 Sterile area - Ampoule filling and sealing

The filling and sealing of ampoules is a delicate operation, it must be carried out in a sterile area and special care is required.

The room in which this operation is carried out should be adequately modified as above described for the other area;

this department should be irradiated by means of germicidal lamps in order to kill bacteria as much as possible.

The workers should be accurately trained and acquainted with the problems related with sterility. There should be two dressing-rooms, one to take off the clothes worn outside the plant and to put on overalls, and another (see drawing B) to take the latter off and put on those to be worn only within the sterile area.

These clothes, which will have to be changed at least once every day, must be carefully washed, kept apart from other clothing and steam sterilized at 121°C for 30 minutes.

The method presently followed to fill and seal the ampoules should be given up as soon as possible.

A hungarian made filling and sealing machine (Tungsram GYT 1), with an output of 2,100 - 5,200 ampoules/hour has been installed, but has not been used yet.

Not having seen it at work, we are not quite informed about its efficiency. We would suggest that Mongolian experts give their own opinion on this subject, which, should it be satisfactory, would allow to increase production by purchasing other machines of this same type.

To reach the foreseen output of 11.600 ampoules/hour, three Tungsram GYT 1 machines would be needed.

We would suggest to attain the maximum output gradually, by first increasing the machine's daily operation time to two shifts/day, and afterwards purchasing a second machine.

In case the daily operating time of the machines is increased, we beleve that two machines only will be enough to meet the foreseen needs.

Machines should be carefully cleaned every day and unused solution residues must be eliminated.

Since the solutions used are water solutions the cleaning of machines and equipment is quite easy. Moreover, since the solutions to be filled into the ampoules are prepared daily, it is extremely easy to change the kind of production.

Anyway, it is convenient to go on with long production campaigns of single specialities, in order to avoid confusions with different products.

5.3.6 Preparation of sterile solutions

These solutions are prepared in the room (see drawing A) next to where the filling of ampoules takes place.

It would be advisable that this room, too, be considered as belonging to the sterile area, even if the products handled here are not sterile yet.

This room will house a solution tank with agitator for the preparation of solutions (it should be jacketed to allow its heating or cooling) and glass containers to be filled with the prepared solutions and with distilled water.

The mentioned solutions must be filtered through sterilizing filters. We would recommend the use of cartridge filters; should it represent a problem, Seitz-type candle filters could be chosen

instead since they can be used again after counter-current washing.

The solutions prepared in the laboratory are filtered and collected in the sterile room close-by. They should be placed into sterile containers, and preferably this operation should be carried out under a laminar flow hood.

It is recommanded to prepare just the quantities to be used daily in order to avoid storing, and also to eliminate possible product residues from the filling machines.

5.3.7 Sterilization

A steam heated autoclave, too, where ampoules are sterilized, is installed in the room where ampoules filling and sealing is carried out. The present autoclave has a capacity of 10,000 ampoules/batch. However, being steam heated and since the steam flow is not quite regular sometimes, sterilization can last as long as 1 ~ 2.5 h. with danger of deterioration of products.

We recommend to take steps to stabilize steam pressure and temperature and to repair measurement and recording systems of temperature inside the autoclave. Provided that these conditions are met the existing autoclave can remain in operation.

Since more than 3 batches in 8 hours are not considered possible (with a total production of 30,000 ampoules), an extension of the autoclave working time is needed, while a second step could be the purchase of another autoclave to completely meet

with new production requirements.

If the presently installed autoclave cannot operate efficiently, we would suggest to purchase a larger electric one with a capacity of 20,000 ampoules/batch in order to carry out the sterilization of all ampoules in the same day they are produced (and this solutions is definitely the best). With that goal in mind, it would be most convenient to dephase the working hours of the workers engaged in ampoules filling and those working in the sterilization department.

It is worth to remembering that it has become a normal practice to place the sterilized ampoules under vacuum into the autoclave and then plunge them into coloured liquids (methylene Blue) in order to discover any microfracture in them improving the inspection.

5.3.8 Inspection

Ampoule inspection can still be carried out through manual control by means of the recently purchased hungarian machine. If the results obtained are considered satisfactory, another machine could be purchased.

5.3.9 Ampoule printing

The machine currently employed for ampoule printing is out of use It will be necessary to replace it with a new one with a capacity of 12,000 ampoules/hour. Next to this section it will be necessary to insert an intermediate storage in order to ena

ble the Quality Control to test and approve the lots of ampoules before they are packed.

5.3.10 Packing is presently carried out manually.

A hungarian Tungsram GXE 3 packing machine has been purchased and installed but not used yet.

The mentioned machine has an output of 6,300 -10,500 ampoules/hour. Ampoules are packed in corrugated plastic sheets. The above production capacity being quite near to the required one, if the Mongolian experts should deem it satisfactory enough, it could be made to meet future demand by getting it to run on more than one daily shift.

5.4 Injectable solutions

The goal for 1983 would be to produce 220,000 500-ml bottles/year (that is, approx. 800 bottles/day).

The available equipment id suitable to meet the foreseen needs.

The only part that requires improvement is the filtration system of solutions before bottling.

It would be convenient to use a membrane filter, though only if future regular supplies of filtering cartridges are considered possible. Alternatively a Seitz-type filter could be used.

A pump can furnish the needed pressure (or vacuum) to obtain filtration, or else the reactor could be placed under pressure by means

of a nitrogen bottle to reach the same goal.

In addition the handling of filled and empty glass bottles should be improved.

We suggest the installation of a small goods-hoist in the room next to where the pre-washing takes place. (We have already checked its suitability).

In the future, to avoid the recycle of glass bottles, semi-rigid bottles in polytene or polypropilene or PVC bags can be used.

We suggest the use of PVC bags that can be easily filled and sealed and can be bought complete with the administration set.

The present average selling price of the PVC bag is very similar to the one of glass bottles (10.5 - 12 US cents) but transport cost is incomparably in favor of the plastic bags.

On the other side the recycle of the glass bottles is only partially possible because of the long distances involved from the production factory to some of the users.

The use of PVC bags would involve the following changes in the production equipment:

- a new filling and sealing machine (worth 10 -15,000 US Dollars) has to be installed
- Modifications on the two autoclaves are needed. In fact when the sterilization is over and the temperature decreases there is the risk of explosions of bags due to the difference in temperature between the liquid and the surronding atmosphere.
  Back pression injection of water and/or air is needed during this phase to equalize the situation.

These modifications are estimated in 3 - 5,000 US Dollars. Therefore the total cost would be 20,000 US Dollars approx. Considering that these additional equipment can be amortized on 5 years we have:

$$\frac{\text{20,000 US Dollars}}{\text{1,100,000 bottles/bags}} = 0.018 \text{ Dollar/piece}$$

This small cost is largely compensated by the difference in transportation cost and lack of losses due to breackages of glass bottles.

An additional advantage is due to better storing (less space needed) and faster delivery terms.

5.5 Medicinal plants: extracts production program

The 1983 program for the extracts production is the following:

SPECIES	FAMILY	TONS
Adonis mongolica Simonovich	RANUNCULACEAE	2
Artemisia spp. (A. admsii, A.siversiana Ehrh.)	COMPUSITAE	25
Astragalus mongholicus Bunge	LEGUMINOSAE	60
Ephedra equisetina Bunge	EPHEDRACEAE	10
Glycyrrhiza uralensis Fisch.	LEGUMINOSAE	60
Hyoscyamus niger L.	SOLANACEAE	15
Juniperus spp. (J. communis L., J. sabina L.)..	CUPRESSACEAE	60
Matricaria chamomilla L.	COMPOSITAE	10
Pinus sylvestris L.	PINACEAE	60
Plantago spp. (P. major L., P.mongolica Decne).	PLANTAGINACEAE	3
Rosa acicularis Lindl.	ROSACEAE	3
Sedum roseum Scop. (Syn. Rhodiola rosea L.)....	CRASSULACEAE	2
Sophora alopecuroides L.	LEGUMINOSAE	5
Thermopsis lanceolata L.	LEGUMINOSAE	30
Thymus spp. (T. mongolicus Ronniger, T. serpyllum L.	LABIATAE	5
Valeriana officinalis L.	VALERIANACEAE	3
	TOTAL	353

To optimize the operation of the existing extraction plant and to permit the production increase the following criteria could be followed:

- operate the plant continuously, on three shifts/day
- limit the number of plants to process; the processing cycles could be organized by very large batches, so allowing an intensive utilization of machineries as well as a considerable cut of idle time for setting up and cleaning operations. However, it has been noted that the extraction unit will be able to work at the above-mentioned capacity, only if the existing equipment would be integrated with some additional items.

We believe that, first of all, it is necessary to make available a number of tanks, both on wheels and fixed, in order to allow rational operations of conveying, clearing and crystallization. Moreover, an homogenization facility (of TURRAX J.K. type) could well be used as an alternative line for some special processes such as the one for the Glycirrhiza.

It seems that in any case the following would be necessary:
A general overhauling of the whole extraction plant and a positioning of the pipelines, suitable for the setting up of autonomous processing lines, to be dimensioned according to the required capacity.

As a result of the implementation of the above-mentioned suggestions, each line would essentially consist of the following:

- Extraction facility, whose capacity is to be determined by the ratio crude drug/solvent;
- Isolation facility, consisting of a reactor or concentrator and filter and centrifuge unit;
- Distillation section, for possible solvent recovery;
- Drying.

The grinding operations are considered as common to all the lines and they need anyhow to be strengthened.

In any case it is very important that any manufacturing activity is backed by research institutions and by an up-to-date analysis and quality control laboratory.

The equipment of this facility should be designed for the carrying out of the following operations:

- Titre measurement of drugs to be extracted;
- Assesment of the exhaustion in the various phases of the process;
- Quality control of finished products.

In respect of the production program as formulated by the Pharmaceutical Factory Management, a policy decision is to be taken, because - as it is - it appears of very difficult implementation for the number of drugs to be extracted and the difference among them, which would result in the necessity of setting up several processes during the year, all quite different one from each other.

5.6 Other facilities

The increase in production implies in turn the development of other facilities such as storehouses, laboratories, utilities etc.

We wish to stress the importance of storehouses and the Quality Control and few notes are given in the following paragraphs.

5.6.1 Storehouses

5.6.1.1 Raw materials: the raw materials storehouse, which now covers present needs, will not suffice as soon as production is doubled.We therefore recommend the doubling of the present surface.

Moreover, we would also recommend to separate the various lots of products carefully and to label them so as to indicate whether they have been already analyzed and approved by the Quality Control.

5.6.1.2 Finished products: Here, too, the present warehouses should be expanded and lots of products labelled.

However, space problems are here less serious, since finished specialities are sent very frequently (once-twice every week) to the general storage.

5.6.1.3 Packing materials: Again, what we have stated above would apply here. An exact apprisal of the required increases (development) will only be possible after having established the rythm of supplies regarding packing material.

We recommend to improve conditions everywhere, especially with regard to floors, walls and ceilings.

5.6.2 Quality Control

The Quality Control Laboratory cannot face present and future needs due to lack of suitable equipment, documentation and experienced personnel.

Its improvement is mandatory.

6. PROPOSED DEVELOPMENT OF THE DRUGS PRODUCTION

We will try now to establish the frame within which the country's pharmaceutical needs by 1990 will be defined. We will, therefore, have to take several factors into account, such as the population growth, larger pharmaceutical coverage, the expanded use of drugs (as far as it exceeds bare and strict needs) etc.

We shall also provide basic data and the preliminary design for a new drugs factory to be located in the same area of the existing one.

Furthermore information will be provided on other facilities like warehouses for raw materials, quality control laboratories etc.

6.1 Consumption of drugs in the PRM by 1990

The data collected during the mission have allowed us to ascertain the figures of the present drug consumption in Mongolia. They are made up of the figures regarding imports together with those concerning local production, as quoted in the Imports program for 1981 and in production forecasts for 1979.

Even though these data are not wholly homogeneous, being, as they are, referred to different years, we consider them significant enough and have taken them as a basis for projections.

These data have been drawn after a very accurate analysis of all lists of imports in order to obtain figures referring only to the pharmaceutical products under consideration. The present apparent demand is the following:

Tablets

Local production	192 million pieces
Imports	540 million pieces
TOTAL	732 million pieces
% Local production	26%

Ampoules

Local production	7 million pieces
Imports	14 million pieces
TOTAL	21 million pieces
% Local production	35%

The following factors have been taken into consideration to formulate the projections of the apparent demand to 1990:

- population growth
- urbanization
- health services coverage
- expanded use
- rationalization of drugs consumption

Information on these factors are provided in the following paragraphs.

6.1.1 Population growth

According to the present trend, not likely to be modified in the next ten years, by 1990 the population of Mongolia will have reached 2.1 million.

It is belived, though, that the birth-rate will increase in the nineties, when the younger generations (presently about 50% of the population is under 16 years of age) reach maturity.

6.1.2 Urbanization

Here, too, as all over the world, an urbanization process is in progress. According to Mongolian sources, from 1969 to 1979 the urban population has grown from 44 to 51% of the total.

If we keep in mind that the industrialization process is in expansion with the consequent increase in manpower demand, we may well conclude that this trend will continue in the decade 1980-1990. Thus, we estimate that 60% of the population will live in urban areas by 1990.

An increase in urban population weighs heavily on drug consumption, since the access to health assistance is easier in the towns. Consequently, the newly established urban populations will contribute noticeably to increase drug consumption.

6.1.3 Extended health services coverage

One of the most important goals of the Mongolian Government is to assure the health service to the population. With that goal in mind, one of the main objectives to achieve is to increase the number of doctors and, in general, of the personnel involved in health services, as well as the capillary diffusion of health centres, reaching even the most out-of-the-way regions.
This, too, will contribute to increase drug consumption.

6.1.4 Expanded use

We mean by this the increase in the use of drugs beyond their present utilization (for instance, the use of antibiotics to treat light diseases). In industrialized countries, with the amelioration of standards of living and a greater availability of pharmaceuticals there is a growing trend to a somewhat abnormal (and not always justified from the medical point of view) increase in drug consumption.
We may assume that this will happen in the future in Mongolia, too, even if not too markedly in the 1980 - 1990 decade.

6.1.5 Rationalization of drug consumption

A growing awareness and sensibilization among doctors as well as the population with regard to the efficiency of drugs will lead to a new and more correct appraisal of certain drugs of uncertain (or even dubious) effects.
A consequence of this will be a reduction of drug consumption.

6.1.6 Calculation of the index for the projections .

1) Population growth	+ 25 %
2) Larger health coverage	+ 5 %
3) Urbanization (1)	+ 2 %
4) Expanded use	+ 5 %
5) Rationalization of drug consumption	- 7 %

On the whole, then, we can foresee that by 1990 the consumption of drugs will be approximately 30 % higher than the present one.

6.2 Standards to be adopted when increasing drug production

The following main guidelines are recommended by Unido and WHO when developping the pharmaceutical industry:

a) produce and use, primarly, those "first level" pharmaceuticals indicated on the WHO Essential Drug List and, only in a later phase (particularly if already locally used), the second level drugs.
b) give priority, as far as local production is concerned, to those drugs that are requested in large quantity.
c) produce those pharmaceuticals whose local manufacture allows important savings of foreign currency, even if their consumption figures are moderate.

Note: 1) Newly established urban populations (estimated 200,000 persons) in the decade 1980 - 1990 will account for an increase in their previous consumption of approx. 20%.

The development of the pharmaceutical industry in Mongolia should take place along two main lines: increase of the quantity of drugs produced locally and of the types of pharmaceutical forms.

6.3 Goals

We have seen that 26 % of the tablets and 35 % of the ampoules consumed in the country are produced locally.
A figure of 50 % for tablets and 70 % for ampoules should be considered reasonable goals for 1990.
As far as the increase of the types of pharmaceutical forms is concerned, we recommend to add a local production of capsules to that of tablets, ampoules, injectable solutions and syrups.
Moreover, it is essential to ensure the quality of production by increasing the staff and the activity of the Quality Control Department.
From the quantitative point of view, the foreseen local production will include:

Tablets

Assuming that, as indicated above, 50 % of total consumption has to be produced locally, the quantity to manufacture should be of 475 million pieces.

Ampoules

According to the above estimations (70 % of local production), the quantity to manufacture should be 19 million pieces.

Capsules

Since capsules will partly substitute tablets, 16 million pieces of them should be produced.

Injectable solutions

From a forecast of 220,000 pieces to be produced in 1983, a quantity of 280,000 pieces has been calculated for 1990.

Buildings

A new building will be needed to house the new equipment needed.

The area upon which the new building will be erected has already been cho

sen within the area (see enclosed drawings) of the existing factory.
A one-storey building will cover future needs.
It will have to be built according to all the most recent standards in the pharmaceutical field (filtrated air system, etc.). A preliminary lay-out is herewith attached.
Basic information for each process are given in the following paragraphs.

6.4 Production equipment and utilities of the new building

6.4.1 Tablet production: the goal is to produce 475 Millions tablets, corrisponding to 1,667,000 tablets per day or 300,000 pieces/hour. We shall make here some basical assumptions which will enable us to determine the needs as far as equipment is concerned.

a) It is necessary to manufacture all the most important products in 4-months cycles: that is, the same most important productions will be repeated three times every year.
b) The machines must run at least five days before changing the kind of production (which implies the necessity of cleaning the machines which, in turn, takes some time and keeps the equipment not operating).
c) It is convenient to carry out at the same time the production of two important products and of a lesser one.

With this in mind and supposing 5-days cycles (as an average) for the manufacture of one main product (and half a work-day, saturday, to clean the machines), after the 4-months period the two production lines will be able to manufacture 32 different products. To this we must add the possibility of manufacturing 16 less important products with a smaller production line (and assuming each of them to take one week).
If the production of these less important products should take less than 5 days, it will be possible to increase the number of specialities of minor entity. On the whole, then, we may

estimate at about 50 the number of specialities that can be manufactured every 4 months. As for the two main production lines, it is advisable to use (whenever possible) the same equipment already suggested for the 1983 expansion with the due adjustments, and transferred to the new building.

6.4.1.1 Preparation of the granulate.

840 kg of mixture are needed to produce 1,667,000 tablets/day.
The already suggested mixers are suitable for this quantity, even if the working time as well as the size of the kettle for the preparation of the binder and the oscillating granulators might be increased.
It will be necessary, though, to add a third dryer (of the fluid-bed type, if possible).
The process of dry granulation will require a third mill to face production peaks.
New equipment, even if of reduced capacity , will be necessary for the line carrying out smaller productions.
The drying up, given the smaller quantities to be treated, could take place in a small static dryer.
We have not taken into consideration other accessory equipment, such as, for instance scales, etc.

6.4.1.2 Tablet preparation

The use of 5 high-productivity rotatory tabletting machines is recommended (an increase of one unit with regard to 1983) for the main productions. The rest would need an alternative tabletting machine, instead, which can reach a higher pressure and has wider productive elasticity.
It would be convenient to supply every machine with a dust exhauster, in order to eliminate dust as much as possible.
All the machines will have to be placed into wood-and-glass boxes connected to the dust exhausting system to prevent dust being formed and to provide better working conditions for the personnel.

Product control equipment such as, for instance, scales, tablets thickness tester and tablet hardness tester should be located in the same room where tablets are manufactured.

6.4.2 Ampoules production

Local production of ampoules is of the utmost importance, for many reasons. In the first place, noticeable savings can be achieved in transport costs (as compared with the cost of imports), and then, also, in most cases, these are indispensable products (antibiotics, etc.). Since Mongolia is geographically quite far away from drug production centres, it would be certainly justified to produce them locally (even leaving aside the cost of importing finished vials). As far as the production of sterile ampoules is concerned, it would be advisable to limit it, for the moment, to those substances to be sterilized by means of heat, since the technology involved is simple

The manufacture of products requiring other means of sterilization (sterilization by filtration) may be undertaken only when workers and management get larger experience.

The quantity of ampoules to be manufactured by 1990, according to our estimates, is only 10% larger then the amount foreseen for 1983; therefore the same equipment suggested for the first factory extension (1983) could be used, the only difference being the machines working time.

On the other side the transfer to the equipment to the new building would allow a more rational lay-out with consequent advantages.

The production of distilled water needed for ampoules washing and filling will need the installation of:

- one resins ions exchange type demineralizer
- one distiller
- a number of jackted tanks to stock distilled water at a temperature of 80°C.

The laboratory for the preparation of solutions will be located within the sterile area; the solutions will be filtered and transferred to the filling department.

The filling machines will be three so that more than one product can be manufactured at the same time.

The same considerations as given for the 1983 factory extension apply to this department.

6.4.3. Manufacture of capsules

Presently, capsules are not produced in Mongolia; we feel capsules are extremely effective pharmaceutical form and therefore we recommend their local production.

Taking into account the population expected to live in Mongolia by 1990, we feel that one manual type production line would be enough. This line would have an output of 16 millions capsules/year.

An optimum production mix. could be the manufacture 4 products, 4 Million pieces each.

The main equipment needed are the following:

- 1 scale
- 1 mixer, 30 kg batch
- 1 capsules filling machine, ZUMA type,
- 1 manual sieve
- 1 capsule inspection unit with belt conveyor
- 1 packing unit (Packing could be done manually in polytene bags and than in aluminium boxes, 100-500 or 1,000 pieces or, in alternative a Blisters paking machine could be used).

The manufacture of capsules could be located in the area presently used for the tablets production when these equipment will be transferred to the new building.

Some additional considerations on the production of capsules are given here below:

.A. The type of process used is generating large amount of dust and the ingredients are very active ones (tetracycline, chloroamfenicole, penicillins etc), therefore the installation of a dust exhausting system is mandatory.

In particular we deem necessary a suction point in the area of the mixer; dust exhaust system should be complete with filters to avoid dispersion of active ingredients to the athmosphere.

A hood with aspiration should be foreseen in the filling area.

.B. In case the production of penicillins and/or cefalosporine (B--lattamics) is envisaged, we reccomend that a second production line be installed, devoted only to these productions and should be located in a different area to avoid cross-contamination.

In case the investment for the second line is not possible just one production line can be used but after the processing of penicillines the whole unit and even the rooms must be carefully cleaned by means of caustic soda.

6.4.4 Quality control laboratory

We recommend that at this stage of development the laboratory be equipped with the necessary equipment (microbiologicy laboratory and stabularium) to carry out analysis of sterility and pyrogenicity analysis. Furthermore new instruments like UV and IR spectrophotometers, new gas chromatographs and an high pressure liquid chromatograph (HPLC) should be installed.

6.4.5 Medicinal plants processing

The Mongolian Authorities are planning a further extension of the processing of medicinal plants.

We think that before starting the implementation of the development program a comprehensive analysis of the following two alternatives should be carried out:

(a) processing of crude drugs for production of total extracts to be used locally;

(b) Processing of crude drugs for production of pure principles for local consumption as well as for export.

It is very important to note that this kind of decision on which plants are to be processed at the Pharmaceutical factory is to be taken before any improving or overhauling of the existing unit is carried out.

It is worth noting that while alternative (a) requires the extension and improvement of the existing extraction department, the alter

tive (b) requires not onlv the equipment needed for alterna_ ternative (a) but also the installation of a completely new plant, with new technologies and methods that require well trained personnel.

In case alternative (b) is choosen a comprehensive study on pure active principles market and to identify potential customers should also be carried out.

It is our opinion that, while waiting to solve the problems connected to the manufacturing and marketing of pure active principles any effort should be concentrated in the processing of those species which could be utilized in crude form as total extracts, as far as they are useful for the fulfilment of a specific pharma_ ceutical need.

The greatest attention has to be paid to the extraction techniques and to the quality control. As far as the extraction processes are concerned, some drugs can be processed by making use of alredy well know and tested methods, for istance the following ones:

.1. Essential Oil Plants: Pinus, Juniperus, Artemisia, Thymus;

.2. Glycyrrhiza, for production of the Ammonium Glycyrrhizinate;

.3. Valeriana;

.4. Alkaloids Plants: Hyosciamus, Ephedra

However, even the best tested methods need to be improved and also adjusted to new knowledge on the biological activity of the

extracts. For example, we can quote the case of the Valeriana: only recently the activity of its chloro-ethilenic fractions containing the valeopotriates has been discovered; the production of these valeopotriates is quite complicate because of their well-know instability.

Finally, for plants whose extraction method is unknow, full laboratory and pilot plant tests are required, with the support of chemical and pharmacological analysis.

We therefore recommend the following guidelines for the development of medicinal plants processing in Mongolia:

- Detailed market study in pure principles that could be made available
- Improve the present production of total extracts
- Install a pilot plant to carry-out test on local flora for both total extraction and production of pure principles.
- On the basis of the results of the pilot plant a final decision will be taken on further development.

6.4.6 Production subdivision in the ne< and old building

New Building

- Production of: Tablets
  Ampoules

Old building

- Production of: Capsules (in the former tablet production dept.)
  Ointments
  Gauze, bandages etc and related storehouse (now this production is carried out in a building that has to be destroyed to built the planned new one).
- Enlarged quality control laboratories

7. MEDICINAL FLORA OF THE MONGOLIA PEOPLE'S REPUBLIC

A list of medicinal plants existing in Mongolia is attached. The list has been drawn on the basis of published and unpublished data provided by the institute for botany in Ulan Bator and with the valuable assistance of its director and staff. Then we have revised the botanical (latin) names of all species according to the index kewensis (the former synonysm have been indicated in brackets).

SPECIES	FAMILY
Achillea sibirica (Ledeb.) Ledeb.	COMPOSITAE
Aconitum baicalense Turcz.	RANUNCULACEAE
" excelsum Reichb.	"
" lycoctorum L. (Syn. A. barbatum Patr.)	"
" volubile Koelle	"
Acorus calamus L.	ARACEAE
Adenophora denticulata Fisch.	CAMPANULACEAE
Adonis mongolica Simonovich	RANUNCULACEAE
Agriophyllum arenarium Bieb.	CHENOPODIACEAE
Allium fistulosum L. (Syn. A. altaicum Pall.)	LILIACEAE
" flavidum Ledeb. (Syn. A. leucocephalum Turcz.) ..	"
" mongolicum Rgel	"
" senescens L.	"
" tenuissimum L. (Syn. A. bidentatum Fisch.)	"
" victorialis L.	"
Alyssum biovulatum N. Busch.	CRUCIFERAE
" desertorum Stapf.	"
Amethystea coerulea L.	LABIATAE
Amygdalus mongolica Ricker	ROSACEAE
" pedunculata Pall.	"
Anabasis aphylla L.	CHENOPODIACEAE
Androsace villosa L. (Syn. A. incana Lam.)	PRIMULACEAE
Anemone albana Stev. (Syn. Pulsatilla ambigua Turcz.) ..	RANUNCULACEAE
" crinita Juzepczuk	"
" sibirica L.	"
Aneurolepidium angustum (Trin.) Nevski	GRAMINEAE
" pseudoagrophyrum (Griseb) Nevski	"
Antitoxicum sibiricum (L.) Pobedim.	ASCLEPIADACEAE
Aquilegia sibirica Lam.	RANUNCULACEAE

Arenaria asiatica Schischk.	CARYOPHYLLACEAE
" capillaris Poir.	"
Arnebia decumbens Coss. & Kralik	BORAGINACEAE
" guttata Bunge	"
Artemisia adamsii Bess.	COMPOSITAE
" davurica Vitm.	"
" frigida Willd.	"
" intricata Franch.	"
" sacrorum Ledeb.	"
" siversiana Ehrh. ex Willd.	"
Asparagus dovuricus Fisch.	LILIACEAE
Aster altaicus Willd.	COMPOSITAE
" hispidus Baker (Syn. A. biennis Ldb.)	"
" sibiricus Lam. (Syn. A. tataricus Turcz.)	"
Astragalus discolor Bunge	LEGUMINOSAE
" galactites Pall.	"
" mongholicus Bunge	"
" variabilis Bunge	"
Berberis sibirica Pall.	BERBERIDACEAE
Betula platyphylla Sukaczew	BETULACEAE
Bupleurum baldense Host. (Syn. B. bicaule Helm.)	UMBELIFERAE
Campanula glomerata L.	CAMPANULACEAE
" steveni Bieb. (Syn. C. altaica Ldle.)	"
Cannabis ruderalis Janisch.	MORACEAE
Capsella bursa-pastoris Medic.	CRUCIFERAE
Caragana leucophloea Pojark.	LEGUMINOSAE
Caryopteris mongholica Bunge	VERBENACEAE
Centaurea monantha Georgi	COMPOSITAE
Chamaerhodos erecta Bunge	ROSACEAE
Chelidonium majus L.	PAPAVERACEAE
Cimicifuga foetida L.	RANUNCULACEAE
Clematis alpina Mill. (Syn. Atragene sibirica L.)	RANUNCULACEAE
Cerastium arvense L.	CARYOPHYLLACEAE
Cnicus esculentus Sievers (Syn. Cirsium esculentum C.A.Mey)	COMPOSITAE

Convolvulus arvensis L.	CONVOLVULACEAE
Cotoneaster integerrima Medic. (Syn. C. melanocarpa Fisch.)	ROSACEAE
Cotyledon spinosa L. (Syn. Orostachys spinosa Sweet)	CRASSULACEAE
Crataegus sanguinea Pall.	ROSACEAE
Cuscuta chinensis Lam.	CONVOLVULACEAE
Cymbaria daurica L.	SCROPHULARIACEAE
Cynanchum acutum L. (Syn. C. sibiricum Willd.)	ASCLEPIADACEAE
Cynomorium songaricum Rupr.	BALANOPHORACEAE
Cypripedium guttatum Sw.	ORCHIDACEAE
Dasiphora fruticosa (L.) Rydb.	ROSACEAE
Delphinum grandiflorum L.	RANUNCULACEAE
Dianthus chinensis L. (Syn. D. versicolor Fisch.)	CARYOPHYLLACEAE
" superbus L.	"
Dentostemon integrifolius Ledeb.	CRUCIFERAE
Dracocephalum fruticulosum Steph.	LABIATAE
" moldavica L. (Syn. D. foetidum Bge.)	"
Echinops dahuricus Fish.	COMPOSITAE
Ephedra equisetina Bunge	EPHEDRACEAE
" glauca Regel	"
" monosperma S. G. Gmel.	"
" przewalskii Stapf	"
Epilobium dodanaei Vill. (Syn. Chamaenerion angustifolium Scop.)	ONAGRACEAE
Equisetum arvense L.	EQUISETACEAE
Erysimum altaicum C.A.Mey	CRUCIFERAE
Euphorbia esula L. (Syn. E. discolor Ldb.)	EUPHORBIACEAE
Fragaria orientalis Losinsk.	ROSACEAE
Galium verum L.	RUBIACEAE
Gentiana altaica Laxm.	GENTIANACEAE
" decumbens L.f.	"
" defensa Rottb. (Syn. G. barbata Froll.)	"
" frigida Haenke (Syn. G. algida Pall.)	"
" macrophylla Pall.	"
Geranium pratense L.	GERANIACEAE
" pseudo-sibiricum J. Myer	"

Glycyrrhiza uralensis Fisch.	LEGUMINOSAE
Gnaphalium uliginosum L.	COMPOSITAE
Haloxylon ammodendron Bunge	CHENOPODIACEAE
Helichrysum arenarium Moench	COMPOSITAE
Hemerocallis flava L.	LILIACEAE
Hippophae rhamnoides L.	ELAEAGNACEAE
Hyoscyamus niger L.	SOLANACEAE
Hypecoum erectum L. (Syn. Chiazospermum erectum Bernh.)	PAPAVERACEAE
Hypericum attenuatum Choisy	HYPERICACEAE
" perforatum L.	"
Inula britanica L.	COMPOSITAE
Iris ensata Thumb. (Syn. I. biglumis Vahl.)	IRIDACEAE
" flavissima Pall.	"
" sibirica L.	"
Juniperus communis L. (Syn. J. sibirica Burgsd.)	CUPRESSACEAE
" pseudo-sabina Fisch.	"
" sabina L.	"
Kobresia schoenoides Boeck. (Syn. Cobresia sibirica Turcz.)	CYPERACEAE
Lagotis altaica (Willd.) P. Smirn.	"
Lathyrus pratensis L.	LEGUMINOSAE
Ledum palustre L.	ERICACEAE
Leontopodium campestre Hand.	ERICACEAE
Leonurus cardiaca L.	LABIATAE
" lanatus Pers. (Syn. Pauzeria lanata(L.) Bge)	"
" mongolicus Krecz.	"
" sibiricus L.	"
Lilium tenuifolium Fisch.	LILIACEAE
Linaria buriatica Turcz.	SCROPHULARIACEAE
Linum baicalense Juzepczuk	LINACEAE
Lonicera caerula L. (Syn. L. altaica Pall.)	CAPRIFOLIACEAE
Lophanthus chinensis Benth.	LABIATAE
Malus pallasiana Juzepczuk	ROSACEAE

Malva rotundifolia L. (Syn. M. neglecta Wallr.)	MALVACEAE
Matricaria chamomilla L.	COMPOSITAE
Melilotus dentata Pers	LEGUMINOSAE
Menyanthes trifoliata L.	MENYANTACEAE
Myosotis asiatica (Vestergr.) Schischk.	BORAGINACEAE
Nepeta densiflora Kark.	LABIATAE
" macrantha Fisch. (Syn. N. sibirica Aschers.)	"
Oxytropis mongolica Komarov	LEGUMINOSAE
Paeonia anomala L.	RANUNCULACEAE
Papaver nudicaule L.	PAPAVERACEAE
" saichanense Grubov	"
Parnasia palustris L.	SAXIFRAGACEAE
Pedicularis altaica Steph.	SCROPHULARIACEAE
" flava Pall.	"
" longiflora Rud.	"
Peganum nigellastrum Bunge	RUTACEAE
Peurogyne carinthiaca G.Don. (Syn. Lomatogonium carianthicum A. Br.)	GENTIANACEAE
Phlonis agraria Bunge	LABIATAE
" tuberosa L.	"
Picea obovata Ledeb.	PINACEAE
Pinus sylvestris L.	PINACEAE
Plantago maritima L. (Syn. P. salsa Pall.)	PLANTAGINACEAE
" mongolica Decne.	"
Polygala sibirica L.	POLYGALACEAE
" vulgaris L. (Syn. P. hybrida DC.)	"
Polygonatum officinale All.	LILIACEAE
Polygonum alpinum All.	POLYGONACEAE
" hydropiper L.	"
Potentilla anserina L.	ROSACEAE
" subacaulis L.	"
Populus balsamifera L. (Syn. P. laurifolia Ldb.)	SALICACEAE
Poterium officinale A.Gray. (Syn. Sanguisorba officinalis L.)	ROSACEAE
Primula farinosa L.	PRIMULACEAE
Prunus sibirica L.	ROSACEAE

Pyrethrum altaicum (Herd.) O. et B.	COMPOSITAE
Pyrola rotundifolia L.	ERICACEAE
Ranunculus nivalis L. (Syn. R. altaicus Laxm.)	RANUNCULACEAE
" rigescens Turcz.	"
Rhamnus erythroxylon Pall.	RHAMNACEAE
Rheum undulatum L.	POLYGONACEAE
" uninerve Maxim.	"
Ribes diacantha Pall.	SAXIFRAGACEAE
" petraeum Wulf. (Syn. R. altissimum Turcz.)	"
Rosa acicularis Lindl.	ROSACEAE
" davurica Pall.	"
Rumex acetosa L.	POLYGONACEAE
" acetosella L.	"
" aquaticus L.	"
" gmelini Turcz.	"
Salix volgensis Anders. (Syn. S. caspica Pall.)	SALICACEAE
Salsola gemmascens Pall. (Syn. S. passerina Bunge)	CHENOPODIACEAE
Sambucus sibirica Nakai	CAPRIFOLIACEAE
Sanguisorba officinalis	RASACEAE
Saussurea salicifolia DC.	COMPOSITAE
Saxifraga crassifolia L.	SAXIFRAGACEAE
" hirculus L.	"
Scabiosa fischeri DC.	DIPSACACEAE
Scrophularia incisa Weinm.	SCROPHULARIACEAE
Scutellaria baicalensis Georgi	LABIATAE
Sedum aizoon L.	CRASSULACEAE
" telephium L. (Syn. S. purpureum Link)	"
" roseum Scop. (Syn. Rhodiola rosea L.)	"
Senecio mongolicus Sch.	COMPOSITAE
" sagittatus Sch. (Syn. Cacalia hastata L.)	"
Schizonepeta annua Schischk	LABIATAE
" multifida (L.) Brig.	"
Silene mongolica Maxim.	CARYOPHYLLACEAE
" repens Patrin.	"
Sisymbrium heteromallum C.A.Mey	CRUCIFERAE

Sophora alopecuroides L.	LEGUMINOSAE
Spiraea hypericifolia L. (Syn. S. aquilegifolia Pall.)	ROSACEAE
Statice speciosa L. (Syn. Goniolimon speciosum Boiss.)	PLUMBAGINACEAE
Stellaria dichotoma L.	CARYOPHYLLACEAE
Stellera chamaejasme L.	THYMELAEACEAE
Stipa splendens Trin. (Syn. Lasiagrostis splendens Kunth)	GRAMINEAE
Tanacetum vulgare L.	COMPOSITAE
Taraxacum officinale Wigg.	COMPOSITAE
Thalictrum minus L.	RANUNCULACEAE
Thermopsis lanceolata L.	LEGUMINOSAE
Thlaspi alpestre L. (Syn. T. cochleariforme DC.)	CRUCIFERAE
Thymus mongolicus (Ronniger) Ronniger	LABIATAE
" serpyllum L.	"
Tribulus terrestris L.	RANUNCULACEAE
Trollinus asiaticus L.	RANUNCULACEAE
Urtica cannabina L.	URTICACEAE
" dioica L. (Syn. U. angustifolia Fisch.)	"
Vaccinius vitis-idaea L.	VACCINIACEAE
Valeriana officinalis L.	VALERIANACEAE
Veratrum album L. (Syn. V. lobelianum Bernh.)	LILIACEAE
Veronica incana L.	SCROPHULARIACEAE
" longifolia L.	"
Viola biflora L.	VIOLACEAE
Zygophyllum brachypterum Kar.	ZYGOPHYLLACEAE
" pterocarpum Bunge	"
" xanthoxylum Engl.	"

7.1 Medecinal plants of potential interest for therapeutical use in PRM

The following tables show, for 33 medicinal plants existing in Mongolia, the following information:

- Botanic name
- Species belonging to the same family that have been already tested in other countries
- Part of the plant that can be used
- Main active ingredients
- Secondary ingredients
- Pharmacological properties

These information could be the basis for a through investigation activity on medicinal plants, their active ingredients content and their pharmacological activity.

Bot. name of the plant existing in MPR	Species tested	Part used	Main active ingredient	Secondary ingredients	Pharmacological properties
Achillea sibirica (Ledeb.)	A.millefolium L. (Syn.A setacea wold et K)	Inflorescence without stems	Essential oil containing -monoterpens -sesquiterpens -azulen derivatives	-Cyanogenic glycoside -Achillein -Ascorbic acid -Choline -Fatty acids	Stomachic tonic, carminative and anti-spasmodic. Os antihaemorragic useful in haemorrhaida haemorrhages. Ether extract of the flowers is antibiotic.
Aconitum Spp.	A.napellus L.	Tubers	Alkaloids: -aconitive -aconine -picroaconitive -other isomers	-L-sparteine -L-eohedrine ascorbic acid and several organic acids	Depressant for central Nervous System. External use against rheumatism. Caution: extremely poisonous
Acorus Calamus L.	A. Calamus L. Rhizomes		Essential oil cont: -Asarone, Asaryl-aldehyde -Terpens, pinene and Canfene	-Tannins -Vitamine B_1 -Acorine, bitter compound	Bitter-digestive, stomachic and carminative. Antispasmodic, antitussive.
Adonis mongolica Simonowich	A. Vernalis L.	Whole plant, without roots To be collected before flowering	Cardiotonic glicosyded -adonidine -adonidinic acid -adonidosides, from which was isol: cinnaring and adonitoxin	-Saponins -Choline -Phytosterols -Fatty acids	Pharmaceutical action similar to digitalis, but less strong Used in organic illinesses of heart, and sterosclerosis. Diuretic in pleuritis and peripheric edema.
Allium Spp.	A. Sativum L.	Bulbs	Essential oil cont.: -Sulfur organic compds, -allicine (derived from allin - allisatine I and II	-Vitamins: A, B_1, C -Biotine -Enzymes -Solfocianic acid	Antihypertensive Anti-infectious, mainly on respiratory and gastro-entheric apparatus. Choleretic and antibiotic Anti-neoplastic in transplanted tumors.
Anemone Spp.	A. hepatica L.	Fresh leaves	-Protoanemonine -Epatolobine	-Aemulsine(enzyme)	Used agains bronchytis and chronic tracheitis

Bot. name of the plant existing in MPR	Species tested	Part used	Main active ingredient	Secondary ingredients	Pharmacological properties
Artemisia Spp.	A. vulgaris L. A. maritima L.	Flowering tops	Essential oil cont. terpens: cineol methil-inositol; Santonin	- -	Bitter-tonic, eupeptic, cholagogue.
Astragalus mongholicus	A. gummifer L.	Gum	Bassorin, tragacanthin	starch ash	Demulcent and emulsifier; used also as adhesive for pills and tablets.
Berberis sibirica Pall.	B. vulgaris L.	Root and stem barks	Alkaloids: -Berberine -Berberrubine -Jatrorrizine -Columbamine	tannins and minor alkaloids	-Haemostatic, used in haemorrages -Bacteriostatic, useful against Leyshmaina tropica and Trypanosoma equiperdum. -Antibiotic
Crataegus sanguinea Pall.	C. oxyacantha L. C. monogyna Jacq. C. oxyacanthoides Thuill.	Flowers (with leaves accompanying the inflorescence)	Crategic acid (incl. Crategolic acid); Cratego-sapogenins Triterpenic compounds Ursolic and oleanlic acid	Flavonic glicosydes Quercitin Trimethylamine Chlorogenic and caffeic acid	Hypotensive , and cardiotonic when associated to digitalis; Indicated for treatment of several Heart diseases; Sedative
Ephedra Spp.	E. equisetina Bunge E. distachya L. E. flava Porter and others	Whole plant	Alkaloid Ephedrine, which can be present in six isomers	Cathechin Tannin Mucilage Resin	Chemically similar to adrenalin, Ephedrine differs for the pharmacological activity. Hypertensive and sympathomimetic, has a stimulating action on the myocardium. Extensively used in the treatment of asthma
Gentiana Spp.	G. lutea L. G. acaulis L.	Rhizome and roots	Glicosides: -Genziopicrine -Genziacauline -Genzianarine Xantonic pigments Alkaloid: gentianine	Olosides: -Genzionose -Genziobiose -Gentisic acid -Tianine -Mucilage	Bitter-tonic, eupeptic, antipyretic

Bot. name of the plant existing in MPR	Species tested	Part used	Main active ingredient	Secondary ingredients	Pharmacological properties
Glycyrrhiza uralensis Fisch.	G. glabra L.. G. uralensis	Roots	Glycyrrhetinic acid Glycyrrhizinic acid Glycyrrhetic acid	Bitter principles Resins Asparagine	Demulcent expectorant, used in cough mixtures. Antiulcers in gastric ulcers, acting as antispastic and anthistaminic.
Hippophae Rammoides L..	H. rhammoides	Fruits	Flavonic glucosides Vitamines Carotène	Organic acids Fatty oil	Rich source of vitamine C Syrup used in lung complaints
Hyoscyamus niger L.	H. niger L.	Leaves	Alkaloids: -l-hyoscyamine -Scopolamine -Tropine and Scopoline (traces)	hyoscypicrine Essential oil Fatty oil	Therapeutic value comparable to that of Belladonna. Sedative in nervous affections. Narcotic and mydriatic. Relieves spasms in the urinary tract.
Iris Spp.	I. germanica L	Rhizomes	Essential oil Iridin	Resin	Stimulant, cathartic and diuretic used in bronchitis. Flavouring agent .
Juniperus communis L.	J. communis L.	Fruits	Essential oil. cont..: camphene-pipene cadinenz and several terpenes	Aldehydes; B -pinene; Resin, juniperine	antiseptic and diuretic; stimulant, carminative, antitussive and expectorant.
Juniperus sabina L.	J. sabina L.	Leaves and twigs	Essential oil containing d-sabinol as main ingredient. d-sabinene α-pinene and other terpenes	Mircene, Limonene, Geraniol	Oxitocic and abortifacient - In veterinary used by injection of dilute extract in uterus to eliminate afterbirth

Bot. name of the plant existing in MPR	Species tested	Part used	Main active ingredient	Secondary ingredients	Pharmacological properties
Ledum palustre L.	L. palustre L.	Leaves and stems	Essential oil containing Ledol as a main ingred.	Arbutine, Ledotanic acid	Diuretic and diaphoretic. Useful in treatment of rheumatism and arthritis. Somewhere used as abortifacient.
Leonurus cardiaca L.	L. cardiaca L.	Whole plant	Essential oil. Alkaloid: stachydrine	Bitter principles, Tanninsvitamines	Sedative on central vegetative nervous system, and in cardiac nevrosis. In hyperthyroidism reduces the excitability and tachycardia.
Matricaria chamomilla	M. chamomilla l.	Flower Reads	Essential oil cont: chamazulene and other azulenic comp.ds; apigenin	Umbelliferon, Coumarines, Quercimeritrine	Antiphlogistic, antiallergic. Sedative, antinevralgic and spasmolitic.
Pinus sylvestris L.	P. sylvestris L.	Buds, leaves and twigs	Essential oil cont.: -terpens (α-pinene, limonene, fellandrene) -alcools -aldehyds, esters, chetons etc.	Caprilic, Sabinic, Juniperinic acids	Antiseptic for treatment of bronchitis infections urinary tract. Antiphlogistic and expectorant. Aromatic for antitussive preparations.
Plantago Spp.	P. major L.	Leaves	Aucubine Mucilage	Proteins Pectins Carotene	Mild diuretic, astringent, antiphlogistic and antihaemorrhagic (for internal use) Topical use as cicatrizer.
Rheum undulatum L.	R. officinale R. palmatum L.	Rhizomes and roots	Anthraquinone derivatives	Glucogalline Catechine Tannin Enzymes	Stomachic-tonic Laxative and purgative, but not indicated for chronic constipation.

Bot. name of the plant existing in MPR	Species tested	Part used	Main active ingredient	Secondary ingredient	Pharmacological properties
Rosa acicularis Lindl.	R. canina	Fruits (hips)	Vitamin C., P and carotine Tannin	Malic and citric acid; sugar	Stimulant and fortifying; Antidiarrhoeal and astringent.
Sanguisorba officinalis L. Rumex acetosa L.	R. acetosa L. S. officinalis L.	Leaves and stems Roots	Anthracenic compounds Tannin	Oxalic acid Potassium oxalate	Diuretic and mild laxative. Depurative Antidiarrhoeal and acemostatic.
Sedum roseum Scop. (Syn. Rhodiola rosea L.)	S. Roseum Scop.	Rootstock	Pyroyallol group of Tannis, Flavonoids	Essential oil (traces)	Refreshing, antiscorbutic, calmative
Sophora alopecuroides L..	S. Japonica	Flower buds: Stem and leaves Seeds Fruits	Rutin Cytisine, sophorine Agglutinins Flavonoids and Isoflavonoid glucosides	- - - -	Fruit are used in China as a remedy for haemorrhoids. Seeds and pods extract contain agglutinins anti A, anti B and anti H.
	S. tomentosa	Seeds and leaves	Cytisine, Matrine, Methylcytisine	- - - -	Action of cytisine is similar to nicotine as insecticide but is less toxic. Seeds and leaves are emetic and drastic alley purgative Decotion of seeds and roots are given in bilic disordes.
Thymus serpyllum L.	T. serpyllum L.	Flowering plant	Essential oil p-cimene Terpens Phenols (thymol)	Saponins Tannin Bitter comp.	Antiseptic, expectorant, antispasmodic, minative. Anthelmintic. Mild diuretic.

Bot. name of the plant existing in MPR	Species tested	Part used	Main active ingredient	Secondary ingredient	Pharmacological properties
Urtica dioica L.	U. dioica L. U. urens L.	Herb.	Aminoacids Amines β -Carotene and vitamines Hairs contain acetylcholine, histamine, 5-hydroxy-tryptamine.	Mucilages Essential oil Glicolic and glicuric acids	Diuretic, specifically antiuric and depurative, indicated in rheumatism. Preparation called ALCOHOL is used in USSR in therapy for chronic hepatitis, cholengitis, cholecystitis and habitual constipation.
Vaccinium vitis-idaea L..	V. vitis-idaea L..	Leaves Fruits	In the leaves: Arbutine Toarine Tannin	In fruits: Organic acids Vitamin C. Carotene	Extract leaves is used as a good disinfectant of urinary tract Antiseptic, astringent. The action is similar to that of Arctostaphylos uva-ursi (L) Sprengel. Fruits are edible .
Valeriana officinalis L..	V. officinalis L.	Rhizomes with roots	Essential oil containing sesquiterpens, alcools, esters, phenols, chetons. Alkaloids Glucoside	Isovalerianic, caffeic and chlorogenic acids.	Sedative, indicate for treatment of several having nervous or emotional origin. Carminative, hypotensive, spasmolitic.

7.2 Development policy for the medicinal plants in the MPR

It is a widely spread opinion in the MPR that the medicinal flora is one of the most valuable resources of the country and that a great effort should be made in order to widen the field of utilization of this commodity.

It has specifically been stated that it is a policy of the MPR that the manufacture of pharmaceuticals containing active principles of locally available plants should be given priority, while possible surplus of crude drugs should be chanelled toward foreign countries through the international trade circuit.

The above mentioned policy matches with the UNIDO attitude toward medicinal plants, which has been pointed out in several occasions (Some recommandations of UNIDO on the production of drugs from medicinal plants are provided in annex 4).

We recommend that the development of medicinal plants in Mongolia is according to the following main guidelines:

(1) Increasing and improving the existing extraction activity at the pharmaceutical factory through the rationalization of process, the improvement of personnel training of analytical control on raw-materials, on intermediates and on finished products.

The output of the factory should be used to satisfy domestic market needs.

(2) Strengthening of agricultural station and plants collection centres in order to provide sufficient quantities of crude drugs to keep the extraction facility running at full capacity. Possible surplus of crude drugs could be made available for export, untill an adequate demand for processed drugs would justify the installation of additional extraction capacity. We emphasize that the export of crude drugs should in no way be considered as a final solution, even if it could provide a beneficial income in foreign currency; it is commonly recognized that local processing of crude drugs, when technical and commercial conditions are favourable, does provide tangible benefits in terms of added value and of technical and scientifical progress.

(3) Setting up of a permanent strong marketing and commercial office to be well linked to the international market circuit. The aim of this organization should be the continuous analysis of the international market of natural extract, in order to find suitable outlets and to identify the plants to process (which extract can be better marketed).

We emphasize that any initiative aiming at an increase of the local production of crude drugs or of extracts for the international market needs to be supported by a previous marketing survey and, whenever possible, by specific agreements with buyers.

This marketing office should also collect scientific information on the trend of therapeutical applications of extracts from international literature and from contacts with buyers.

(In annex 5 we have provide some notes concerning the world market of medicinal plants.

(4) Stengthening of existing scientifical structure such as phytochemical and pharmaceutical laboratories and construction of a pilot extraction unit to be used to carry out experiments on new medicinal plants and in general reaearch and develoment work.

8. ADDITIONAL TECHNICAL ASSISTANCE

We recommend that the following additional technical assistance be provided:

(A) One man/month of one or two experts in pharmaceutical plants to assist the implementation of the extension program to meet 1983 requirements.
Visit should be paid in Summer 1982
Expected cost: 12,000 US Dollars

(B) Four man/months of two or three pharmacologists to help mongolian authorities in the revision of the existing pharmacopea and in the rationalization of imports and of local production.
Expected cost: 60,000 US Dollars.

Furthermore we recommend that a tour abroad be organized for manager and some assistants (for istance the head of the production departments, tablets, ampoules, plants extracts, as well as the head of the quality control laboratory.
Goal of the tour would be the visit to various pharmaceutical factories as well as raw materials producers.
The visit and subsequent exchange of information and experience would be of great help for the Mongolian experts in their work of equipment of the pharmaceutical production in Mongolia.

9. PERSONNEL TRAINING

Adequate training should be provided to key personnel of the pharmaceutical factory also in view of the important increase in production volume.
Training needs have been identified in the following major areas:

- quality control
- production depts
- maintenance

9.1 Training for quality control personnel

The following personnel should receive adequate training abroad as follows:

- quality control dept Director	: 6 months
- chemists (3)	: 3 months
- Microbiologist	: 3 months
- Instruments engineer	: 6 months

The training should be carried out in the quality control laboratories of pharmaceutical industries but the instrument engineer should receive training from the producers of the instrumentation that will be purchased, (at least for the most important instruments: chromatographs etc).

9.2 Training for production personnel

The head of each production department (tablets, ampoules etc) should visit similar production units in well organized pharmaceutical industries.
They should receive 1 - 2 months training.

9.3 Training for maintenance personnel

Maintenance engineer should visit the factories of the main production equipment manufactures and should receive at least 2 -3 months training.

Particular attention should be paid to routine and special maintenance procedures, trooble-shooting procedures and parts replacement.

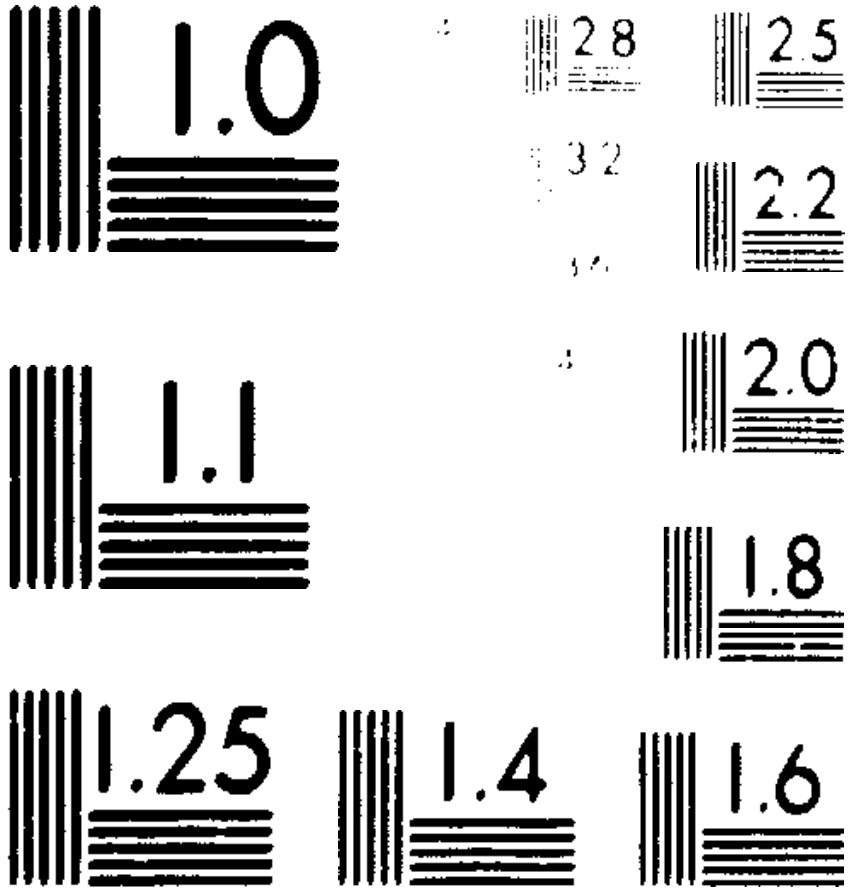
ANNEX 1

PRODUCTS PRESENTLY MANUFACTURED IN MONGOLIA

TABLETS (6 PIECES CONFECTIONS) (PRICES IN TUGRIK)

Product	Packing	Unit price (x 1,000)	Quantity (x 1,000)	Total cost (x 1,000)
Aspirin	0.5 g x 6	50	3,182.2	159.1
Analgina with piramidone	0.25 g x 6	135	927.2	125.2
Norsulfazole	0.5 g x 6	102	1,306.0	133.3
Phtalazole	0.5 g x 6	133	2,482.0	330.1
Ascorbic acid	0.5 g x 6	77	4,134.6	318.4
Streptocid Album	0.5 g x 6	55	1,034.6	56.9
Calcex	0.5 g x 6	57	2,759.3	157.3
Sulfadimezine	0.5 g x 6	154	1,880.0	289.5
Paraminosalicilic acid	-	78	1,252.5	97.7
Glutamic acid	0.3 g x 6	751	340.4	255.6
Pepsine-Pancrea tine	0.25 g x 6	243	1,269.5	308.5
Urotropine	0.5 g x 6	44	294.5	13
Demidrol	0.3 g x 6	184	660.3	121.5
Levomicetine	0.3 g x 6	1,194	164.7	196.7
Dimetine-Papave rine-dibazol-lu minal	0.3 g x 6	200	335	67.0
Aspirin-fenacetine caffeine-sodio ben zoate	0.5 g x 6	54	1,790.4	96.7

Product	Packing	Unit price (x 1,000)	Quantity (x 1,000)	Total cost (x 1,000)
Belladonna extract	0.3 g x 6	60	129.3	7.8
Dibazole		200	1,159.1	231.8
Sulgine	0.5 g x 6	71	205.5	14.6
Belladonna-salolo extract	0.3 g x 6	65	403.7	26.2
Calcium glicero phosphate	0.3 g x 6	120	480.5	57.7
Dionine 0.01 with sodium bi carbonate	0.3 g x 6	124	118.8	14.7
Furacicline	0.3 g x 6	400	236.5	94.6
Aspirin	0.3 g x 6	43	234.0	10.1
Sintomicine	0.5 g x 6	2,818	80.8	227.7
Piramidone-fenacetine-caffeine, so dium benzoate	0.5 g x 6	240	1,271.5	305.2
Herba thermopsis with sodium bi carbonate	0.3 g x 6	44	4,551.7	200.3
	T O T A L		32,684.6	3,917.2



AMPOULES (prices in Tugrik)

Product	Packing	Unit price (x 1,000)	Quantity (1,000)	Total cost (x 1,000)
Novocaine 0.25 %	2 ml	180	4,000	720
Vit. B 12	1 ml	200	1,500	300
Vit. B 1	1 ml	260	1,000	260
Vit. B 6 2 %	1 ml	200	500	100
Analgine	1 ml	167	100	16.7
Promedol		300	100	30
Distilled water			100	
			7,300	1,426.7

GALENICS (Price in Tugrik)

GALENICS SECTION

Product	Packing	Unit cost	Quantity (pieces)	Total cost (x 1,000)
Pertossine	100 ml	173.9	1,310	227.8
Pertossine	200 ml	61.2	2,000	122.4
Extract of Plantago Major	200 ml	14.6	2,900	42.3
Aloe Syrup	200 ml	2	2,100	4.2
Extract of Plantago Major with Honey		0.8	3,700	3
Cherries syrup	100 ml	0.9	704	0.6
Pantacrin (extract of deer horns)	30 ml	5 1	4,300	21.9
Cardiovalieno (belladonna extract + tincture of valerian + convallaria major)	25 ml	1.9	1,000	1.9
Extract of Radiolum rosa	50 ml	8.4	1,540	12.9
Dog-rose syrup	100 ml	0.1	1,700	0.2
Juice of calendula officinalis	200 ml	0.8	3,940	3.2
Dog-rose extracts	200 ml	0.5	1,628	0.8
			26,822	441,2

LIQUIDS IN LARGE CONTAINERS (Values are in Tugrik)

Product	Packing	Unit cost for ton	Quantity (in tons)	Total cost (x 1,000)
Liquor ammonium anisate		19,000	1.8	34.2
Ammonium hydrate		2,000	1.9	3.8
Iodine tincture		17,000	1	17.0
Denaturated alcohol		11,000	50.6	556.6
Alcohol 95 %		24,000	13.5	324,0
Calcium chloride 50 %		1,000	20.4	20.4
Novantin 60 %		3,000	0.2	0.6
Hydrogen chloride solution		1,000	1.2	1.2
Distilled water		500	5.6	2.8
			96.2	960.6

ALCOHOLIC EXTRACTS IN TINCTURES

Tincture of valerian		4,000	0.6	2.4
Extract of Juniper	100 g	1,000	90	90
Extract of absinthe	100 g	1,870	11,5	21,5
Plantago major + artemisia macrocefala + absinthe	25 g	680	1.6	..1
Dry cherries		1,800	2.5	4.5
			106.2	119.5

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OINTMENTS (Values are in Tugrik)

Product	Packing	Unit cost for ton	Quantity (in tons)	Total cost (x 1,000)
Streptocid 10 %		8,000	6.5	52
Ointment Bismieski		3,000	8.9	26.7
Vaseline Oil		4,300	2.9	12.5
Fish fat		2,500	4.0	10
			22.3	101.2

OINTMENTS IN SMALL CONFECTIONS

Oil hypofay Acamanades	100 cc.	15,150	0.34	5.1
			0.34	5.1

VITAMINS

Vit. C	25 g	860	762.5	655.8
Polivitamine	50 g	840	357.4	300.2
Polivitamine pills	250 g	1,360	37.7	51.3
			1,157.6	1,007.3

SMALL CONFECTIONS

	Paking	Unit cost per ton.	Quantity in ton.	Total cost (x 1,000 Tugrik)
Vitamins mixture with thin jelly	200 g	960	48.7	46.8
Sodium bicarbonate	25 g	144	64.6	9.3
Potassium permanganate	2 g	146	50.3	7.3
Dry Ringerlactate	27.5 g	300	20	6
			183.6	69.4

ANNEX 2

MAIN IMPORTS FROM USSR

ANTIBIOTICS

Product	Content per confection units or grams	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x 1,000 roubles)
Vicilline - 3 (mixture of penicillins)	600,000	500	123.75	61.87
Vicilline - 5	1,500,000	80	247.50	19.80
Tetracycline tablets	0.1 g x 10	200	400	80
Monomicine	500,000	40	610	24.4
Neomicine sulphate	400,000	40	1,850	74
Penicillin G	250,000	9	30,60	275.4
Streptomicine sulphate	500,000	1,500	40	60
Oxytetracycline	125,000 x 25	40	2,000	80
Oleandomicine sulphate	125,000 x 25	35	2,350	82.25
Eritromicine	250,000 x 10	140	1,150	161,7

Penicillin V	250,000 x 10	300	150	45
Chlorotetra cycline	100,000 x 20	200	272	194.4
Oxacyeline	250,000	100	245	24.5
Penicillin G Sodium Salt	1	500	69.2	34.6
Penicillin G Sodium salt	0.5	350	49.9	17.46
Nistatine	500,000 x 20	7	2,340	18.38
Streptomicine	1	400	45	18
			TOTAI	1,271.76

MISCELLANEOUS PRODUCTS

Product	Content per confection	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x1,000 Roubles)
Aminazine (chlorpromazine HCl)	2.5 % - 1 ml ampoules	200	45	9
Glucose solution	40 % - 20 ml	3,500	12,50	43.75
Gemodesa (blood substitute)	400 ml	55	3,650	200.75
Calcium gluconate	10 pieces	250	40	10
Calcium chloride	10 % - 10 ml	550	20.25	11.14
Lever extract	0.025 N x 100 ml	2,000	9	18
Poliglukin (blood substitute)	400 ml	12 tons	9,000	108
Poliglukin	400 ml	3 tons	9,000	27
Saiodin		100 vials	337.50	33.75
Sulfadimidine	0.5 g x 500	10	3,050	35
Fitoperolactol	30	1 vial	122.65	12
Extract of Aloe	1	1,600 ampoules	24.75	39.5
			TOTAL	547.89

VITAMINES

Product	Content per confection	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x 1,000 Roubles)
Vitamine C	5 % - 1 ml	3,000	15,75	47.25
Vitamine B1	5 % - 100 ml	10 vials	2,410	24.1
Vitamine B6	2.5 % - 1 ml	500	37	18.5
Vitamine B1	3 % - 1 ml	1,000	22.80	22.80
Vitamine B12	200 g	1,000	76.20	76.20
Multivitaminic	20 pieces	20	580	11.6
Multivitaminic pills	50 pieces	80	580	46.4
			TOTAL	246.85

SUMMARY IMPORTS FROM U.S.S.R.

	Number of products	Value (x 1,000 Roubles)
Antibiotics	31	1,293.21
Miscellaneous products	105	704.31
Vitamines	22	263.13
TOTAL	158	2,260.65

A total of 158 products are imported from USSR for a total value of 2,260.650 roubles.
The main 36 products account for 91.4% of the total value.

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MAIN IMPORTS FROM HUNGARY

Product	Content per Confection	Confections (x 1000)	Price (for (1000 pieces)	Total cost (x1000 roubles)
Anatossine	20	100	450	45
Gastripon	20 1	40	550	22
Gastribomat	20 1	60	610	36.6
Idrocortisone ointment	2.5 %	60	180	10.8
Idrocortisone ointment	5 %	25	380	9.5
Dopekid	50 pieces	10	3,500	35
Krimosiftil	10 "	50	480	24
Kilion	20 "	10	950	9.5
Kilion supp.	10 "	10	950	9.5
Corontin	100 "	15	730	10.95
Metacilline	10 "	3,000 (units,	14	70
Nafazoline	20 "	80	150	12
Nerobol	20 "	35	740	25.9
Nuredal	100 "	20	840	16.8
Prednisolone	100 cpr.	16	1,620	25.92
Prednisolone ointment	20.0/10 x 2	15	1,800	27
Prednisolone injections	3 pieces	20	1,760	35.2

Pirazinamide	500	pieces	1,000	15	15
Oxacilline	6	"	50	3.300	165
Supracillin	300,000	units	20	720	14.4
Salvosiftil	24	pieces	125	340	42.5
Suprastin	20	"	20	580	11.6
Tetran A	25	"	2	9.800	19.6
Triexazina	20	"	50	360	18
Clorzit syrup	50 ml		70	500	35
Enterosiptol	20	pieces	80	270	21.6
Isoniazide	50	"	90	250	22.5
Protiomamide	50	"	6	2,600	15.6
Reopirin	500	" (units)	5,000	11.60	58
Reosolon	20	"	45	5.80	26.1
					890.57

A total for 82 different products are imported from Hungary for a total value of 971,550 roubles. The main 30 products account for 91.7% of the total value.

MAIN IMPORTS FROM BULGARIA

Product	Content per confection	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x 1000 roubles)
Analgin	10 pieces	200	120	24
Bellergamin	50 "	50 pieces	300	15
Tetracycline	16 "	450 pieces	500	270
Tetraden	250 mg	10	960	9.60
Tetracycline syrup	60 ml	70	590	41.3
Oxytetracycline	16 pieces	150	750	112.5
Oleandomicine	250 mg	30	810	24.3
				496.70

A total of 12 different products are imported from Bulgaria for a total value of 511,760 roubles.
A total of 7 products account for 97.1 % of the total value.

MAIN IMPORTS FROM CZECHOSLOVAKIA

Product	Content per confection	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x 1000 roubles)
Pirabutol	40 pieces	30	540	16.2
Reserpin	50 "	100	190	19
				35.2

A total of 15 products are imported from Czechoslovakia for a total of 73,040 roubles. The main 2 products account for 48% of the total value.

MAIN IMPORTS FROM DDR

Product	Content per confection	Confections (x 1,000)	Price (for 1,000pieces)	Total cost (x 1000 roubles)
Summavit	10 pieces	120	230	27.6
Travitin	200 "	100	800	80
				107.6

A total of 25 different products are imported from DDR for a total value of 130,420 roubles. The main 2 products account for 82.5% of the total value.

MAIN IMPORTS FROM POLAND

Product	Content per confection	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x 1000 roubles)
Cocarbossilasi	3 pieces	120	1,000	120
Elenium	50 "	25	930	23.25
				143.25

A total of 19 products are imported from Poland for a total value of 180,850 roubles. The main 2 products account for 79,2% of the total value.

MAIN IMPORTS FROM ROMANIA

Product	Content per confection	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x 1000 roubles)
Chloramfenicol	12 pieces	100	330	33
Calcium gluconate injections 10 %	10 ml	250	55	13.75
Calcium gluconate 0.5	20 pieces	200	110	22
				68.75

A total of 9 products are imported from Romania for a total value of 88,810 roubles. The main 3 products account for 77.4% of the total value.

MAIN IMPORTS FROM SWITZERLAND

Product	Content per confection	Confections (x 1,000)	Price (for 1,000 pieces)	Total cost (x 1000 roubles)
Ismelin	40 pieces	7	4,500	31.5
Adelfon	50 "	4	2,650	14.5
Ripazon	10 "	2	7,150	14.3
Tegretol	50 "	1	12,000	12.0
				72.30

A total of 14 products are imported from Switzerland for a total value of 81,440 roubles. The main 4 products account for 88.8% of the total value.

ANNEX 3

Notes on the drugs used in the P.R.M.

More than 1,000 drugs are registered and/or permitted in the PRM, some of which under different pharmaceutical forms and composition.

From the data we collected (1979 local production and 1981 import forecast) we infer that the number of actually used products is 450 approximately, some of them in different pharmaceutical forms and dosage.

We have compared the list of these drugs with the "Essential drug list" recommended by the World Health Organization.

We have thus been able to find out which pharmaceuticals on the "Essential Drugs List" are being utilized in Mongolia.

The pharmaceuticals products used in Mongolia and also included in the "The selection of essential drugs", second report of the WHO Expert Committee - WHO Geneva 1979, are shown in the following list divided by therapeutical categories.

LIST OF DRUGS USED IN MONGOLIA INCLUDED IN THE 'ESSENTIAL DRUG LIST'

1. Anaesthetics

   Ether, anaesthetic

   Lidocaine

2. Analgesics, Antipyretics, non steroidal antiinflammatory drugs.

   Morphine

4. Antiallergics

   None

5. Antidotes

   Charcoal, activated

6. Antiepileptics

   Diazepam

7. Antiinfective drugs

   Ampicillin

   Benzylpenicillin

   Benzate-benylpenicillin

   Chloramphenicol

   Erytromycin

   Phenoxymethylpenicillin

Sulfadimidine

Tetracycline

Ethambutol

Isoniazid

Streptomycin

Griseofulvin

Nystatin

8. Antimigraine drugs

None

9. Antineoplastics

Cyclophosphamide

Fluorouracil

10. Antiparkinsonism Drugs

None

11. Blood, drugs affecting the

Folic acid

12. Blood products and blood substitutes

None

13. Cardiovascular drugs

Lidocaine

Propranolol

Reserpine

Digoxin

Epinefrine

14. Dermatological drugs

Hydrocortisone

Nystatin

15. Diagnostic agents

Fluorescein

Adipiodone meglumine

16. Diuretics

Furosemide

17. Gastrointestinal drugs

Codeine

Sodium bicarbonate

18. Hormones

Hydrocortisone

Prednisolone

Insulin

19. Immunologicals

None

20. Muscle relaxants

None

21. Ophtalmological Preparations

Hydrocortisone

22. Oxytocics

Oxytocin

24. Psycotherapeutic drugs

Amitriptyline

Chloropramazine

Diazepam

Haloperidol

Lithium Carbonate

25. Respiratory tract, Drugs acting on the

Codeine

Ephedrine

26. Solutions correcting water

None

27. Surgical disinfectants

None

28. Vitamins and minerals

Ascorbic acid

Nicotinamide

Pyridoxine

Riboflavin

Thiamine

Calcium Gluconate

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We have revised the list of drugs used in Mongolia with a number of Medecine doctors and pharmacists. Some comments are given here below:

1. More than 50 products recommended in the WHO essential drugs list are not used in Mongolia.
2. It would be advisable to adopt pharmaceutical dosages and pharmaceutical forms as recommended by WHO essential drugs list
3. We recommend the substitution of some pharmaceuticals with others included in the WHO essential drug list. Some rationalization, for istance could be achieved in the antibiotics field, where both chlorotetracicline and oxytetracicline could more conveniently be replaced by tetracycline which is easily available in bulk at lower price.
4. Many of the presently used products are obsolete and scarcely efficacious. Consequently, we would like to stress the necessity of improving the list of drugs used in Mongolia to modern therapeutical and pharmacological standards, eliminating the ineffectual drugs and replacing them with more effective ones.
5. Many pharmaceutical formulations should be up-dated (we have noticed that oral forms are used for drugs that are highly effective only given as injection).

On the basis of these few comments we would recommend a through re-examination of the drugs used in Mongolia, aiming at an improvement in the terapeutical field, both from the qualitative and from the quantitative point of view.

The above mentioned re-examination will have the following goals:

- eliminate scarcely effective drugs and, eventually, substitute them with more efficient ones.
- suggest the use of new drugs, presently not used in Mongolia
- analyse every single pharmaceutical form, verify dosage and, if necessary, suggest their improvement
- propose new formulation and pharmaceutical forms.

We belive the mentioned analysis can be carried out by a group of experts (pharmacologists, doctors and pharmacists) in a position to review all the above aspects (product, pharmaceutical form, activity, cost, raw materials etc).

Some examples can be given to better explain the present situation:

A. Several sulfa drugs are produced locally, such as the streptosil album (sulfamilamide), the norsulfazole (sulfathiazole), the stalazole and the sulgine These are "short acting" sulfa drugs, no longer used in most of the countries and replaced by the new "long acting" sulfa drugs.

   The World Health Organization has recommended (in 1977) the following sulfa drugs: SULFAMETHOXY PYRIDAZINE, SULFALENE, SULFADOXINE.

B. The ascorbic acid is presently used with 0.5 gr. dose; the WHO recommends doses of 0.05 gr. because it has been proven that the acid in excess is eliminated with no effect.

C. The Salol (phenil salicilate) is considered obsolete because new highly active drugs can replce it.

D. Progesterone is imported under the form of tablets but this drug is active only when given as injection.

These few examples should stress the need of a comprehensive revision of the drugs presently used in MOngolia.

As a first approach we have prepared the following list of drugs that are useful against the most common diseases (refer to page 5 and 6 of the report).

(Pharmaceutical forms and doses are as per 'the selection of essential drugs' WHO, Geneva, 1979).

1. RESPIRATORY DISEASES

- Ampicillin capsule or tablet, 250 mg, 500 mg anhydrous
- Benzylpenicillin powder for injection, 0,6 g (= 1 million i u), 3 g (= 5 million i u) (as sodium or potassium salt) in vial.
- Benzathine penicillin Injection, 1,44 gr benzylpenicillin (= 2,4 million i u)/ 5 mil in vial
- Chloramphenicol capsule 250 mg
- Gentamicin injection, 10 mg, 40 mg (as sulfate), 1 ml in 2 ml vial
- Dihydrostreptomicin injection 1 g (as sulfate)
- Eritromycin capsule or tablet, 250 mg (as stearate or ethyl-succinate) oral suspension, 125 mg (as stearate or ethylsuccinate)/ 5 ml
  Powder for injection, 500 mg (as lactobionate) in vial
- Tetracycline capsule or tablet, 250 mg (hydrochloride)
- Sulfadimidine tablet 500 mg
  Oral suspension 500 mg/5ml injection, 1 g (sodium salt) iu 3 - ml ampoule
- Sulfamethoxypyridazine tablet 0,5 g
- Sulfamethoxazole + trimetoprim tablet 100 mg + 20 mg, 400 mg + 80 mg.
- Salazosulfapyridine tablet 500 mg
- Aminophylline tablet 200 mg
  injection 25 mg/ml in 10 ml ampoule

- Epimephirine Injection 1 mg (ashydrochloride) in 1 ml ampoule
- Codeine tablet 10 mg (phosphate).

2. DISEASES OF THE DIGESTIVE SYSTEM

- Aluminium hydroxide tablet 500 mg oral suspension 320 mg/5 ml
- Magnesium hydroxide oral suspension, equivalent to 550 mg magnesium oxide/10ml
- Charcoal activated powder
- Furazolidone tablet 0,1 g
- Codeine tablet, 30 mg (phosphate)
- Metronidazole tablet 200 - 500 mg
- Tetracycline capsule or tablet 250 mg (hydrochloride)
- Sodium-bicarbonate powder
- Kanomycin syrup 2 g/100 ml (as sulfate)
- Paramomycin capsule 250 mg (as sulfate) syrup 125 mg (as sulfate) 5 ml
- Prometazine tablet, 10 mg, 25 mg (hydrochloride) syrup 5 mg (hydrochloride)/5 ml injection, 25 mg (hydrochloride), 5 ml in 2 - ml ampoule

3. DISEASES OF THE NERVOUS SYTEM ANS SENSORY ORGANS

- Phenobarbital tablet 50 mg, 100 mg
- Diazepam tablet 5 mg
  Injection 5 mg/ml in 2 - ml ampoule,
- Phenytoin capsule or tablet 25 mg, 100 mg (sodium salt)

- Chlorpromazine tablet 100 mg (hydrochloride) syrup, 25 mg (hydrochloride)/ 5 ml injection, 25 mg (hypochloride)/ ml in 2 - ml ampoule
- Amitryptiline tablet, 25 mg (hydrochloride)
- Haloperidol tablet, 2 mg

4. INFECTIONS AND PARASYTIC DISEASES

- Metroridazole tablet 200 - 500 mg
- Piperazine tablet 500 mg (citrate or adipzate) syrup (as citrate) equivalent to 500 mg hydrate/ 5 ml
- Niclosamide tablet, 500 mg
- Mebendazole tablet, 100 mg

5. CARDIOVASCULAR DISEASES

- Glyceril trinitrate tablet (sublingual) 0,5 mg
- Propranolol tablet 10 mg, 40 mg (as hyprchloride) injection, 1 mg (hypochloride) in 1 - ml ampoule
- Procainamide tablet 500 mg (hypochloride), injection, 100 mg (hypochloride)/ml in 10 - ml ampoule
- Hydralazine tablet 50 mg (hypochloride)
- Hydrochlorotiazide tablet 50 mg
- Sodium nitroprusside injection 10 mg/ml in 5 - ml vial
- Digoxin tablet 0.0625 mg; 0,25 oral, solution 0,05 mg/ml injection 0.25 mg/ml in 2 - ml ampoule
- Furosemide ampoule, tablet 40 mg, injection 10 mg/ml in 2 ml ampoule

- Epimephirine injection 1 mg (as bitartrate) in 1 -ml ampoule
- Spironolactone tablet, 25 mg

6. DISEASES OF THE SKIN

- Neomycin + Bacitracin ointment 5 mg neomycin + 500 in bacitracinzine/gr
- Hydrocortisone ointment or cream 6% + 3%
- Miconazole ointment or cream 2% (nitrate)
- Nystatin ointment cream 100.000 iu/g
- Salicilic-acid solution, topical 5%
- Zinc undecilinate ointment
- Chloramphenicol capsule 250 mg
- Benzylpenicilline powder for injection, 0,6 (= 1 million i u), 2.0 g (= 5 million i u) (as sodium or potassium salt), in vial.

7. NEOPHASIES

- Cyclophoshpamide tablet 25 mg, powder for injection 500 mg in vial
- Fluorouracile injection 50 mg/ml in 5-ml ampoule
- Doxorubicin powder for injection, 10 mg, 20 mg (hypochloride) in vial
- Methotrexate tablet 2.5 mg (as sodium salt), injection 50 mg (as sodium salt) in vial.

The local production of the above listed drugs will be decided time by time according to the market requirements and to the available equipment.

As mentioned in other part of the report the machinery that is, or that will be available within 1990, is suitable to produce:

- tablets (with the exception of the ones requiring pre compression)
- ampoules (the ones that can be heat- sterilized)
- capsules
- heat sterilizing injectable solutions
- ointments

A first list of products listed in the previous pages and which local production is recommended and possible with the present or planned equipment is proposed here below:

1. TABLETS

Sulfadimidine

Sulfamethoxypyridazine

Sulfamethoxazole + trimetoprim

Salazosulfapyridine

Animopilline

Codeine

Aluminium hydroxide

Furazolidone

Metronidazole

Prometazine

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Phenobarbital

Diazepam

Chloropromazine

Metroridazole

Piperazine

Niclosamide

Procainamide

Hyphochlorotiazide

Furosemide

2. AMPOULES

Procainamide

Na-Amidopyrin methansulfonat (sodium)

Furosemide

Vitamin B1

Vitamin B6

Some other products to be determined

3. CAPSULES

Chlorammphenicol

Ampicillin

Tetracyclin

Eritromycin

4. INJECTABLE SOLUTIONS

Oral reidratation salt

Sodium Chloride

Sodium bicarbonate

Potassium chloride

Glucose

Sodium lactate

Glucose

Glucose with sodium chloride

Potassium chloride

Sodium bicarbonate

Sodium chloride

Water for injection

5. OINTMENTS

Benzoic acid + salicilic-acid

Miconazole

Zinc undecilinate

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ANNEX 4

UNIDO RECOMMENDATIONS ON THE PRODUCTION OF DRUGS FROM MEDICINAL PLANTS

1) Priority in the production of drugs derived from medicinal plants should be given to those well accepted and widely used.

2) In the cultivation of medicinal plants, priority should be given to the plants identified by Unido.

3) Countries having no phytochemical industry could make a start by setting up units for the preparation of crude extracts for domestic use and export.

4) Efforts should be made in order to include traditional remedies in health care programs, within the following Boundaries:

   - The production of established traditional remedies should be taken up by centralized agencies, with proper quality control of the product;
   - Studies should be made of their sub-acute and chronic toxicities in order to ensure the safety of drugs that are going to be used for long periods.
   - Drugs whose use is not yet well established should be subjected to clinical tests to establish their efficacy.
   - As far as the scientific production of traditional drugs is concerned, suitable standard procedures must be established for the cultivation, storage, and processing of plants.
   - Medecine doctors should be made aware of the use of these phytopharmaceutical products by means of scientific articles and specific training.

For your immediate information the list of the biologically active plants and of the main ones which production is recommended by Unido is attached.

BIOLOGICALLY ACTIVE PLANTS (Re.: UNIDO ID/222)

Name of plant	Part of the plant used	Product	Availability		Region			Method of production a/	Market potential		Trend
			Cultivated	Wild	Africa	Latin America	Asia		Local	Export	
Acacia arabica/ Acacia senegal	Stem	Gum		+	+				+	++	Steady
Aconitum sp.	Root	Total extract		+			+	C	+	+	Down
Acorus calamus	Rhizome	Essential oil and crude drug		+			+	A	+	++	Steady
Aesculus hippocastanum	Seeds	Aescin and total extract	+	+			+	C	+	++	Up
Agave sisalana	Juice	Hecogenin	+		+	+	+	D	+	++	Steady
Aloe sp.	Leaf juice	Aloin	+	+	+	+	-		+	++	Steady
Ammi majus	Seeds	Xanthotoxin	+	+	+		+	D	+	++	Up
Ammi visnaga	Fruits	Visnagin, khellin		+	+	+		C	+	++	Steady
Amomum subulatum	Fruits	Essential oil	+	+	+		+	A	+	++	Up
Amomum xanthioides	Fruits	Essential oil	+	+	+		+	A	+	++	Up
Andira araroba	Stem wood	Total extract		+	+	+		C		+	Steady
Anethum sp.	Fruit	Essential oil	+			+	+	A	+	+	Steady
Anise	Fruits	Essential oil	+		+		+	A	++	++	Steady
Artemisia maritima	Flowering tops	Santonin		+	+		+	D	+	+	Steady
Atropa belladonna	Leaf and roots	Total alkaloids	+				+	C	++	++	Steady
Berberis aristata	Root, stem bark	Berberine		+			+	B	+	++	Steady
Berberis asiatica	Root, stem bark	Berberine		+			+	B	+	++	Steady
Berberis lycium	Root, stem bark	Berberine		+			+	B	+	++	Steady
Betula alnoides	Stem bark	Crude drug		+			+		+	+	Steady
Capsicum annum	Fruits	Capsaicin oleoresin	+		+	+	+	D	+	+	Steady
Carica papaya	Fruit juice	Papain	+		+	+	+	B,C	+	+	Up
Carum carvi	Fruit	Essential oil	+		+		+	A	+	++	Steady
Cassia acutifolia	Leaves and pods	Sennosides		+	+	+	+	C	+	++	Up
Cassia angustifolia	Leaves and pods	Sennosides	+				+	C	+	++	Up
Cassia italica	Leaves and pods	Sennosides		+	+			C	+		
Catharanthus roseus	Leaves and roots	Vinblastine, vincristine, raubasine	+	+	+	+	+	D	+	++	Steady
Centella asiatica	Whole plant	Asiaticoside	+	+	+		+	C	+	++	Steady
Centella acuminata	Roots	Emetine	+			+	+	D	+	++	Up
Cephaëlis ipecacuanha	Roots	Emetine	+			+	+	D	+	++	Up
Ceratonia siliqua	Fruit	Total extract	+	+	+			C	+	++	Steady
Chenopodium ambrosioides	Flowering top and whole plant	Essential oil	+	+	+	+	+	A	+		Steady
Cinchona sp.	Stem and root bark	Quinine, quinidine	+	+	+	+	+	D	++	++	Up
Claviceps purpurea		Ergotamine, ergotoxine, ergometrine	+			+	+	D	++	++	Steady
Cola nitida	Seeds	Total extract	+	+	+	+		B	++	++	Up
Combretum micranthum	Leaves	Total extract		+	+		+	C	+	++	Up

a/ A = steam distillation; B = water extraction; C = Alcohol extraction; D = extraction with other solvents.

Name of plant	Part of the plant used	Product	Availability: Cultivated	Availability: Wild	Region: Africa	Region: Latin America	Region: Asia	Method of production a/	Market potential: Local	Market potential: Export	Trend
Commiphora mukul	Resin	Gum		+			+	D	++		
Costus speciosus) Costus citratus)	Rhizome	Diosgenin		+		+	+	D			
Cymbopogon flexuosus	Leaves	Essential oil, citral	+		+	+	+	A	+	++	Steady
Datura sp.	Leaves	Atropine									
Derris elliptica	Root	Rotenone	+	+	+		+	D	+	++	Up
Digitalis lanata	Leaves	Digoxin and lanatosides	+		+			C,D	++	++	Steady
Dioscorea sp.) Dioscorea) leichartii)	Tubers	Diosgenin	+	+	+	+	+	D	++	++	Steady
Duboisia myoporoides	Stem	Hyoscyamine, hyoscine	+	+	+	+	+	D	++	++	Steady
Ephedra gerardiana	Whole plant	l-Ephedrine		+			+	D	++	++	Steady
Ephedra vulgaris	Whole plant	l-Ephedrine		+			+	D	++	++	Steady
Ephedra nebrodensis	Whole plant	l-Ephedrine		+			+	D	++	++	Steady
Eucalyptus globulus	Leaves	Essential oil	+		+	+	+	A	++	++	Steady
Glaucum flavum	Leaves	Glaucine		+	+		+	C	++	++	Steady
Glaucum simplex	Rhizome	Colchicine		+	+		+	D	++		
Gloriosa superba	Rhizome	Colchicine		+	+		+	D	++	+	Steady
Glycyrrhiza	Rhizome	Total extract		+			+	B	++	++	Steady
Heracleum candicans	Roots	Xanthotoxin		+	+		+	D	+	++	Steady
Hibiscus sabdariffa	Flower	Dried flowers	+		+	+	+		+	++	Up
Holarrhena floribunda	Stem bark	Conessine and total alkaloid	+	+			+	D	+		
Hydnocarpus kurzii	Seeds	Fixed oil, hydnocarpic acid		+			+		+		
Hydnocarpus wightiana	Seeds	Chaulmoogric acid									
Hyoscyamus sp.	Root	Hyoscyamine and other alkaloids		+	+				+		
Linnia chevalieri	Whole plant	Camphor and essential oil		+	+			A	+	+	Steady
Lobelia pyramidalis	Leaf, flowering top	Lobeline and total extract		+			+	D	+		
Mentha sp. (Japanese mint) Mentha piperita)	Whole plant	Essential oil	+		+	+	+	A	++	++	Up
Mucuna pruriens	Beans	l-Dopa	+	+	+	+	+	B	+	+	Steady
Oncoba echinata	Seeds	Fixed oil			+				+		
Papaver somniferum	Capsule and latex	Morphine, codeine moscapine papaverine	+			+	+	D	++	++	Up
Passiflora sp.	Whole plant	Total extract	+	+	+	+	+	C	+	+	Steady
Pausinystalia yohimbe	Stem bark	Yohimbine and total extract		+	+			D	+	+	Steady
Physostigma venenosus	Seeds	Physostigmine, stigmasterol		+	+			D	+	++	Steady
Physochlaina praelta								C,D			
Pilocarpus sp.	Leaves	Pilocarpine		+		+		D	+	+	Steady

Name of plant	Part of the plant used	Product	Availability: Cultivated	Availability: Wild	Region: Africa	Region: Latin America	Region: Asia	Method of production a/	Market potential: Local	Market potential: Export	Trend
Plantago ovata	Seeds, husks	Ispaghula, psyllium	+				+		++	++	Up
Podophyllum hexandrum (P.emodi)	Tubers	Podophyllin, podophyllotoxin		+			+	D	+	++	
Polygala senega	Roots	Resin		+	+				+	+	Up
Prunus africana	Stem bark	Total extract		+	+			C	+	++	Steady
Psoralea corylifolia	Seeds	Psoralen		+			+	D	+	+	Steady
Rauwolfia heterophylla Rauwolfia serpentina Rauwolfia vomitoria	Roots	Reserpine, ajmaline, deserpidine, rescinnamine, reserpiline		+	+			D	+	+	Up
Rhamnus purshiana	Bark	Crude extract		+		+		C	+	+	Steady
Rheum emodi	Rhizome	Total extract	+	+	+		+	C	+	+	Steady
Rheum palmatum	Rhizome	Total extract	+	+	+		+	C	+	+	Steady
Ricinus communis	Seeds	Fixed oil	+	+	+	+	+		+	++	Steady
Solanum sp.	Berries	Solasodine	+	+	+	+	+	D	+	+	
Sterculia setigera	Bark exudate	Gum		+	+		+		+	+	Steady
Strophanthus gratus	Seeds	Strophanthine, strophanthidine		+	+			D	+	+	Up
Strophanthus kombe											
Strychnos nux vomica	Seeds	Strychnine		+	+		+	D	+	+	Steady
Tabernanth iboga	Stem bark	Ibogaine		+	+			D		+	
Taraxacum officinale	Root	Resin and total extract		+		+	+	D	+	+	Steady
Thevetia neriifolia	Seeds	Peruvoside	+		+	+	+	D	+	+	Steady
Urginea indica Urginea scilla	Bulbs	Proscillaridine		+	+	.	+	C	+	+	Steady
Valeriana officinalis Valeriana wallichii	Rhizome	Total extract	+	+		+	+	C	+	+	Steady
Voacanga thoursii Voacanga africana	Seed	Tabersonine		+	+			D		+	Up
Vinca minor	Leaves	Vincamine	+	+	+	+	+	D	+	+	Up

IMPORTANT PLANT DRUGS SUITABLE FOR
PRODUCTION BY DEVELOPING COUNTRIES

Therapeutic Group	Essential		Second category	
	Plant	Active constituent	Plant	Active constituent
Anaesthetics	-	-	-	-
Analgesics, antipyretics,	Papaver somniferum	Morphine Codeine	Aesculus Hippocastanum Aesculus indica	Aescine and total extract
Nonsteroidal anti-inflammatory drugs and antigout drugs	Gloriosa superba	Colchicine		
Antiallergics	-	-	-	-
Antidotes, chelating agents, cholagogue			Combretum micranthum	Extract
Anti-epileptics	-	-	-	-
Anti-infective				
Antiprotozoal	Cephaëlis ipecacuanha Cinchona sp.	Emetine Quinine	- -	- -
Anthelmintic	-	-	Chenopodium ambrosioides	Ascaridol, total extract
	-	-	Artemisia maritima	Santonin
Antimigraine	Claviceps purpurea	Ergotamine	-	-
Antineoplastic	Catharanthus roseus Catharanthus lanceus	Vinblastine Vincristine	Podophyllum hexandrum (P.emodi) Prunus africana	Podophyllotoxin and total extract Total extract (specific for prostate enlargement)

Antiparkinsonism	Mucuna pruriens
Blood and haematopoietic system	-
Cardiovascular	
Antihypertensive	Rauwolfia serpentina
	Rauwolfia vomitoria
	Rauwolfia confertifloratum
	Catharanthus roseus
	Catharanthus lamceis
	Vinca minor
	Voacanga africana a/
	Voacanga thoursii a/
Anti-arrhythmic	Cinchona sp.
	Rauwolfia serpentina and other species
Cardiotonic	Digitalis lanata
	-
Dermatological preparations	Ammi majus
	Centella asiatica
Diagnostic agents	-
Diuretics	Theobroma cacao
Gastointestinal drugs	
Antispasmodics	Duboisia myoporoides
	Duboisia leichartii
	Atropa belladonna
	Atropa acuminata
	Datura sanguinea
	Datura stramonium
	Datura metel
	Hyoscyamus muticus
	Hyoscyamus niger
	Physoohlaina prealta

a/ Provides raw material for drug production.

l-Dopa		
-	-	-
Reserpine	Rauwolfia sp.	Deserpidine
Raubasine	Ammi visnaga	Visnagin
Vincamine		
Quinidine		
Ajmaline		
Digoxin and lanatosides	Strophanthus gratus	Strophanthin
	Thevetia narifolia	Peruvoside
-	Urginea scilla (Scilla maritima)	Proscillaridine Rutin or bioflavanoids
Xanthotoxin	Psoralea corylifolia	Psoralen
Asiaticoside	-	-
-	-	-
Theophylline		
Total alkaloids atropine or hyoscyamine		

Cathartics	Cassia angustifolia Cassia italica Cassia acutifolia
Laxatives	Plantago ovata
Anti-ulcer	Glycyrrhiza glabra
Antidiarrhoeal	Berberis aristata
Hormones	Dioscorea deltoidea Dioscorea floribunda Dioscorea composita Costus speciosus Solanum laciniatum Solanum khasianum Solanum xanthocarpum Agave sisalana
Immunologicals	-
Muscle Relaxants (peripherally acting) and antagonists	Physostigma venenosum Chondrodendron tomentosum
Ophthalmological preparations	Pilocarpus sp. Physostigma venenosum Duboisia myoporoides
Oxytocics	Claviceps purpurea
Psychotherapeutic	

a/ Provides raw material for drug production.

Sennosides mixture or sennosides A,B as such and products glycyrrhetic acid and extract a/	Rheum sp.	Total extract
	Alloe sp.	Aloin
Berberine	Ceratonia siliqua	Total extract
Diosgenin a/		
Solasodine a/		
Hecoginin a/		
-	-	-
Physostigmine		
d-Tubocurarine		
Pilocarpine		
Physostigmine Atropine a/ (as homotropine)		
Ergometrine		
	Rauwolfia serpentina	Reserpine and crude extract
	Rauwolfia confertifloratum	
	Rauwolfia vomitoria	
	Valeriana wallichii	Valepotriate and total extract
	Valeriana officinalis	

Drugs acting on the respiratory tract	Ephedra gerardiana (Ephedra vulgaria)	Ephedrine	Glycyrrhiza glabra Glycyrrhiza uralensis Glycyrrhiza violacea	Total extract
	Ephedra nebrodensis			
	Theobroma cacao	Theophylline a/ (as aminophylline)	Glaucum flavum	Glaucine
			Polygala senega	Total extract
	Papaver sommiferum	Codeine		
Solutions correcting water, electrolyte, and acid-base disturbances	-	-	-	-
Vitamins and minerals	-	-	-	-

a/ Provides raw materials for drug production.

ANNEX 5

The world market of medicinal plants

1 Scientific aspect

As a consequence of the steady increase of the amount of work being done all over the world in the field of medicinal plants, new active principles and the relevant possible applications are continuously discovered, thus putting forward the great interest of this matter from both the scientific and the social point of view.

The results of this research activity are - indeed - of great importance not only in terms of new treatment possibilities but also for the consequent involvement of economical, technical and human resources.

Suffice it to say that over 2/3 of the drugs currently on the market (app. 100 species) originate from plantations, among which about thirty of large size, established mainly in developing countries and involving the employment of large quantities of manpower.

Nowadays, the research activity on the medicinal plants is mainly finalized to the discovery of new substances having some therapeutic action; in several occasions, the starting point of these researches is to be found in the indications of popular or folk medicine (on which the discipline of ethnobotany is based).

In a growing number of cases folk medicine has shown a real correlation between the vegetable and the human organism, to the point that it would be possible to talk of symbiosis.

Within the phytochemistry field, a particular discipline known as systematic biochemistry or chemiotaxonomy, which is a hybrid of chemistry and taxonomy, has grown considerably in the last few years.

This science, which mainly studies the distribution of the secondary components of the plants in the vegetable kingdom, is based on the general principle that there are high probabilities to find similar secondary components in plants which are near from a taxonomic point of view.

This principle is basic for the research of new plants containing secondary components responsible for certain activities, which have already been found in similar species.
It will therefore be necessary to apply this principle to the study of those species existing in the MPR, which have not yet been subjected to full phytochemical and pharmacological screenings.
These species have been included in the list of plants having a potential pharmacological interest.

2 Industrial utilization

The extraction industry tends to isolate from the plants their active components in a pure state, with the aim of determining with absolute precision the respective biological and pharmacological activity and the limits of employment due to possible toxicity.
Very often, starting from molecules of natural origin, a real chemistry of natural substances is developed as a result of the work of applied research, aiming at forming up some semisynthetic derivatives from those substances which have a better bioavailability, a more specific application and a higher effectiveness together with a lower toxicity with regard to the original active substances.
In these cases the vegetable becomes a real synthesis laboratory, where the largest possible quantity of a certain active principle is produced.
The agronomy side of the work is also based on the same principle, when a species is to be cultivated : from the cultivation technique to the selection of varieties having an always higher content of the substance which is requested, possibly concentrated in a given organ (leaf, root, seed, etc.).
The most significant example of this evolution is the chemistry of steroids, which utilizes some relatively simple substances (diosgenine, solasodine, solanidine) for the preparation of hundreds of derivatives whose applications are indispensable in some therapeutical field, such as those requiring anti-inflammatory and contraceptivedrugs.
We are therefore going to talk about medicinal plants, even when the vegetable item does not produce an active principle to be employed as such

in a medicinal speciality, but it produces a precursor of it; this, according to the OMS definition of medicinal plant which sounds as follows: "Medicinal plant is any vegetable which contains, in one or more of its organs, some substance usable for therapeutic purposes or as precursors of chemio-pharmaceutical hemisynthesis".

3 Use of natural substances as drugs

One of the most exhaustive investigations on the employment of medicinal plants as drugs, was carried out by Farnworth in the USA, using data from the National Prescription Audit. This report shows that just in the year 1967 a quantity of 243 million specialities prescribed in the USA contained one or more natural products as active principles.
At the present moment, it is possible to give for each therapeutic category the percentage of drugs containing vegetable components as:

HORMONES	: 100 % of progestogens and corticosteroids
	98.6 % of anabolizants
	79.6 % of androgens
CARDIOVASCULAR	: 89.5 % of hypotensives
	85 % of drugs of combined activity
ANALGESIC	: 40 % of all drugs
ANTI-COUGH AND DECONGESTIVE	: 57.8 % of all drugs
ANTISPASMODIC	: 44.8 % of all drugs
BRONCODILATOR	: 44.7 % of all drugs
ANTIDIARRHOEAL	: 96.6 % of all drugs
LAXATIVE	: 44 % of all drugs
ENZYMES	: 41 % of all drugs
ANTIMALARIAL	: 80 % of all drugs

The above-listed categories cover by themselves nearly 30 % of the whole drug consumption; another fraction of approximatively 35 % does contain medicinal plants in a percentage varying from 8 % to 30 %.

However, the contents in medicinal plants are negligible for some categories such as antibiotics, diuretics, antiobesity, antihistamines, sulfonamides, antithyroidics, fungicides.

4 Trade of medicinal plants (excluding flavouring agents)

4.1 Industrial medicinal plants

These are the plants used in the pharmaceutical industry for the preparation of pure products or of total extracts having their own pharmacological activity or being precursors of active principles used in the preparation of medicines.

Most of these plants are grown in proper plantations, while some of them are cropped wild.

Main species which supply crude drugs in quantity of hundreds of tons/year are:

- Aesculus hippocastanum L. (fruits)
- Atropa belladonna L. (leaves)
- Catharanthus roseus G.Don. (roots and leaves)
- Cassia angustifolia Vahl. (leaves and pods)
- Cinchona Spp. (stem barks and branches)
- Citrus Spp. (fruit peels)
- Cola Spp. (seeds)
- Cynara scolymus L. (plant)
- Datura metel L. (leaves)
- Digitalis lanata Ehrh. (stem and leaves)
- Dioscorea Spp. (rhizomes)
- Duboisia Spp. (leaves)
- Ephedra Spp. (plant)
- Glycyrrhiza Spp. (roots)

- Matricaria chamomilla L. (inflorescences)
- Mentha piperita L. (parte aerea)
- Mucuna pruriens Dl (seeds)
- Panax gingens C.A. Meyer (roots)
- Papaver Spp.
- Physostigma venenosum Balf. (seeds)
- Pygeum (= Prunus) africanum Hook (stem barks)
- Rauvolfia vomitoria Afz. and others Spp. (root barks)
- Rauvolfia serpentina Benth. (root)
- Rauvolfia canescens L. (root)
- Rhamnus Spp. (branch bark and stem)
- Silybum marianum Gaertn. (seed)
- Solanum Spp. (fruits, leaves)
- Strychmos nux-vomica L. (seeds)
- Vaccinium myrtillus L. (fruits)
- Valeriana Spp. (rhizomes)
- Voacanga Spp. (seeds)

Main species which supply crude drugs in quantities of dozen of tons/year are:

- Ammi Spp. (roots)
- Cephaelis ipecacuanha (Brot.) A. Rich. (roots)
- Colchicum autumnale L. (bulbs - seeds)
- Crataegus Spp. (flowers)
- Datura stramonium L. (leaves)
- Gentiana Spp. (rhizome)
- Gingko biloba L. (leaves)
- Gloriosa Spp. (rhizomes - seeds)
- Hamamelis virginiana L. (leaves - bark)
- Hyosciamus niger L. (leaves)
- Passiflora incarnata L. (parte aerea)
- Pausinystalia yohimbe (K. Schum) Pierre (stem bark)
- Peumus boldus molina (bark)
- Pilocarpus Spp. (leaves)
- Podophyllum peltatum L. (rhizome)
- Polygala senega L. (roots)
- Rheum Spp. (rhizome)
- Ruscus aculeatus L. (root)
- Sophora japonica L. (flowers)
- Scilla Spp. (bulbs)
- Strophanthus Spp. (seeds)
- Thevetia neriifolia Juss (seeds)

4.2 Officinal plants for use in "toto"

This category consists of plants employed for the production of drugs to be marketed in the form of teas, infusions, tisanes and various galenics.

The drugs of this kind currently on the market come from over 100 species; we list hereinafter only those being marketed in quantities of at least a few dozens of tons:

Althaea officinalis L., Artemisia Spp., Betula Spp., Cymbopogon citratus Stapf., Citrus Spp., Combretum micranthum G. Don., Crataegus oxycantha L., Cynodon dactylon Pers., Drosera Spp., Gentiana Spp., Harpagophytum procumbens Dl., Matricaria chamomilla L., Mentha Spp., Plantago ovata Forsk., Tilia cordata Miller.

4.3 Officinal plants for cosmetic use

The market of these plants is rather unstable as far as both qauntity and price are concerned, with the exception of some items among which we can list the following:

Aloe Spp., Arnica montana L., Betula Spp., Calendula officinalis L., Centella asiatica Urb., Citrus Spp., Hamamelis virginiana L., Hedera helix L., Helicrysum Spp., Juglans regia L., Krameria Spp., Lavandula Spp., Malva Spp., Panax Spp., Rosmarinus officinalis L., Salvia officinalis L., Thymus Spp. .

ANNEX 6

Main equipment needed for the extension of the factory

A. Equipment needed for the extension foreseen by 1983

A.1 Tablets production

no. 2 Mixers (kneading machine)
120 liters capacity.

no. 3 Scale 50 kgs range

no. 2 Scale 5 kgs range

no. 4 Containers, stainless steel,
100 liters capacity

no. 1 Steam heated kettle,
50 liters capacity

no. 2 Granulating machines with
Sieves (Frewitt model
MGI 624 or equivalent)

no. 1 Static dryer,
300 - 400 kg capacity

no. 1 Fluid bed dryer, 80-100 kg capacity,
Glatt mod. WSG or Calmic Cisa
model ERC 12 KK or equivalent

no. 2 Mills

no. 4 Tabletting machines, 60,000
tablets/hour
Ronchi model MP/33 or KILIAN mod.
Pharma I - H or equivalent

no. 1 Set of laboratory equipment for:
tablets testing, including:
- tablet thickness tester
- tablet hardness tester
- scale

A.2 Ampoules production

no. 1 Distillation unit complete with demineralizer and heating system.
Capacity not less than 30 - 50 liters/hour
(8 hours per day operation)

no. 3 Ampoules producing machines,
Tungsram model 4019 or equivalent

no. 2 Over pressure sterilization furnaces,
15,000 ampoules capacity,
Colussi model FS 101P or equivalent

no. 1 Furnace for glass pipes drying

no. 2 Machines for filling and sealing of ampoules,
Cioni model AZ/FA or Tungsram or equivalent

no. 1 Steam heated reactor with stirrer,
100 liters capacity

no. 4 Vessels for filtered sterile solutions

no. 4 SEITZ type filters

no. 1 Pump for filtration of sterile solutions

no. 1 Steam autoclave, 20,000 ampoules capacity,

Fedegari model FOF2 or Calmic

Cisa model R 7612 or equivalent

no. 1 Ampoules inspection machine

no. 2 Printing machines for ampoules,
Markem model 165 BMK II or equivalent

A.3 Injectable solutions production

no. 2 SEITZ type filter

no. 1 Pump for sterile solutions

filtration system

A.4 Equipment for quality control laboratory

no. 1 Gas chromatograph

no. 1 U.V. spectrophotometer

The total value of the above listed equipment is 800,000 US Dollars approximately plus shipping and start-up costs.

B. Equipment needed for the extension foreseen by 1990

In addition to the equipment listed in paragraph A, the following items are needed to attain the production levels foreseens in 1990:

B.1 Tablets production

no. 1 Fluid bed dryer, 80 - 100 kgs capacity

Glatt model WSG or

Calmic Cisa model ERC 12 HK or equivalent

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no. 1 Granulating machines with sieves,
Frewitt model MGI 624 or equivalent

no. 1 Tabletting machine, 60,000 tablets/hour output, Ronchi model MP/33 or Kilian model Pharma I - H or equivalent

no. 1 Mixer, 60 liters capacity

no. 1 Scale 20 kgs range

no. 1 Steam heated kettle, 20 liters capacity

no. 1 Granulating machine, Frewitt or equivalent

no. 1 Static dryer

no. 1 Mill

no. 1 Alternative tabletting machine, Ronchi model CT 20 or equivalent

no. 1 Scale 1 kg range

B.2 Ampoules production

no. 1 Steam heated reactor with stirrer, 100 liters capacity

B.3 Capsules production

no. 1 Scale 30 kgs range

no. 1 Mixer, 30 kgs capacity

no. 2 Capsules filling unit, Bonapace Co. model A/B-1/S and B/B-6/S or equivalent

no. 2 Manual sieves

no. 1 Machine for capsule inspection
with conveyor belt

The total value of the above listed equipment is 300,000 US dollars approximately plus shipping and start-up costs.

ANNEXE 7

In this annexe we shall provide some information on the equipment that should be added to the laboratory and the training that would be required for the personnel.

As basis of our suggestions we have taken the production program forecasted for the end of the decade with relevant requirements (see points 5.6.2. and 6.4.4. of the report).

By that date the laboratory should be suitable to carry out the following types of analysis:

- chemical analysis
- chemical physical analysis
- microbiological analysis

} on active ingredients, on the production and on extracts.

The following rooms will be needed:

no. 2 chemical analysis laboratories, 30 sq.mt. each

no. 2 chemical - physical laboratories, 20 sq.mt. each

no. 1 microbiology laboratory, 30 sq.mt.

Total space needed = 130 sq.mt.

The two chemical analysis laboratories will be also used to prepare the samples for the subsequent chemical-physical analysis.

.A. The chemical laboratory is in need of the following main equipment:

- no. 2 electronic balances, range 0 - 200 gr, with 0.1 mg. accuracy
- no. 1 analytical balance

- no. 3 Karl Fisher apparatus for water - counted determination
- no. 1 melting point determination instrument
- no. 2 thermostatic water - bath
- no. 2 rotatory evaporators under vacuum (Buchi type)
- no. 2 heated stirrers
- no. 1 thermostatic oven

.B. The chemo-physical laboratory is in need of the following main equipment:

- no. 1 U.V. spectrophotometer
- no. 1 U.V. - IR spectophotometer with registration apparatus
- no. 1 colorimeter
- no. 2 complete set for thin layer chromatography
- no. 1 U.V. lamp for detection of spots on thin layer chromatography
- no. 1 centrifuge
- no. 1 microscope
- no. 2 gas chromatographs
- no. 1 high pressure liquid chromatograph
- no. 1 polarimeter
- no. 1 refractometer
- no. 1 thermostatic oven

All these equipment should be complete with several spare parts considering their sophistication.

.C. The microbiological laboratory should be suitable to carry out at least the following three essays:

. sterility

. bacteria activity

. bacteria quantity

The following equipment are needed:

no. 1 laminar-flow hood class 100

no. 1 refrigerator

no. 1 water bath

no. 1 thermostatic ovens

no. 2 autoclaves

no. 1 water distillation apparatus.

.D. For all above listed laboratories is also recommended to improve the documentation; for each product a dossier of analytical documentation should be prepared.

Each dossier should include also the description of the product, the specifications and the methods of analysis.

For raw materials physical specifications (apparent density, granulometry etc) should be added too.

.E. Routine analysis should be performed on raw materials: from the batches of the various products entering the storehouse, samples must be drawn and carefully analyzed.

Approval label with lot identification should be issued by laboratory.

.F. In process control

Quality control specialists should carefully verify the production process, in order to:

- to carry out identification tests on used raw materials
- to carry out in process tests. In particular we suggest the following ones:

. Granulate: chemical analysis should be carried out before compression in order to check the exact content of the active ingredient.

. Tablets : the following analysis must be carried out every hour, type identification, weight, disintegration time, hardness, diameter, thickness.

. Ampoules : identification essay

. Capsules : Identification, weight control

.G. Analysis on finished products

The following analysis must be performed on the finished products before packing;

. Tablets : as in process control plus the complete chemical analysis

. Ampoules : the complete chemical analysis and the sterility tests.

Pirogenicity and toxicity must also be performed when requested.

We suggest to collect a sample of 10 ampoules for analysis from each production batch.

. Ointments: quantitative analysis of the ointment after the addition of the active ingredients is needed.

. Capsules : complete chemical analysis (10 capsules to be collected from each production batch)

. Extracts : Complete analysis for the accurate determination of the active ingredient quantity.

The following personnel is needed for the above mentioned laboratories:

no. 1 Director of the quality control to supervise the operation of all three laboratories

For the chemical analysis laboratories:

no. 2 Specialists, analytical chemistry

no. 1 Assistant

no. 2 Laboratory workers

For the chemical - physical analysis laboratory:

no. 1 Specialist, chemist

no. 1 Engineer for instrumentation maintenance and for the samples preparation

no. 1 Laboratory workers

For the microbiological laboratory:

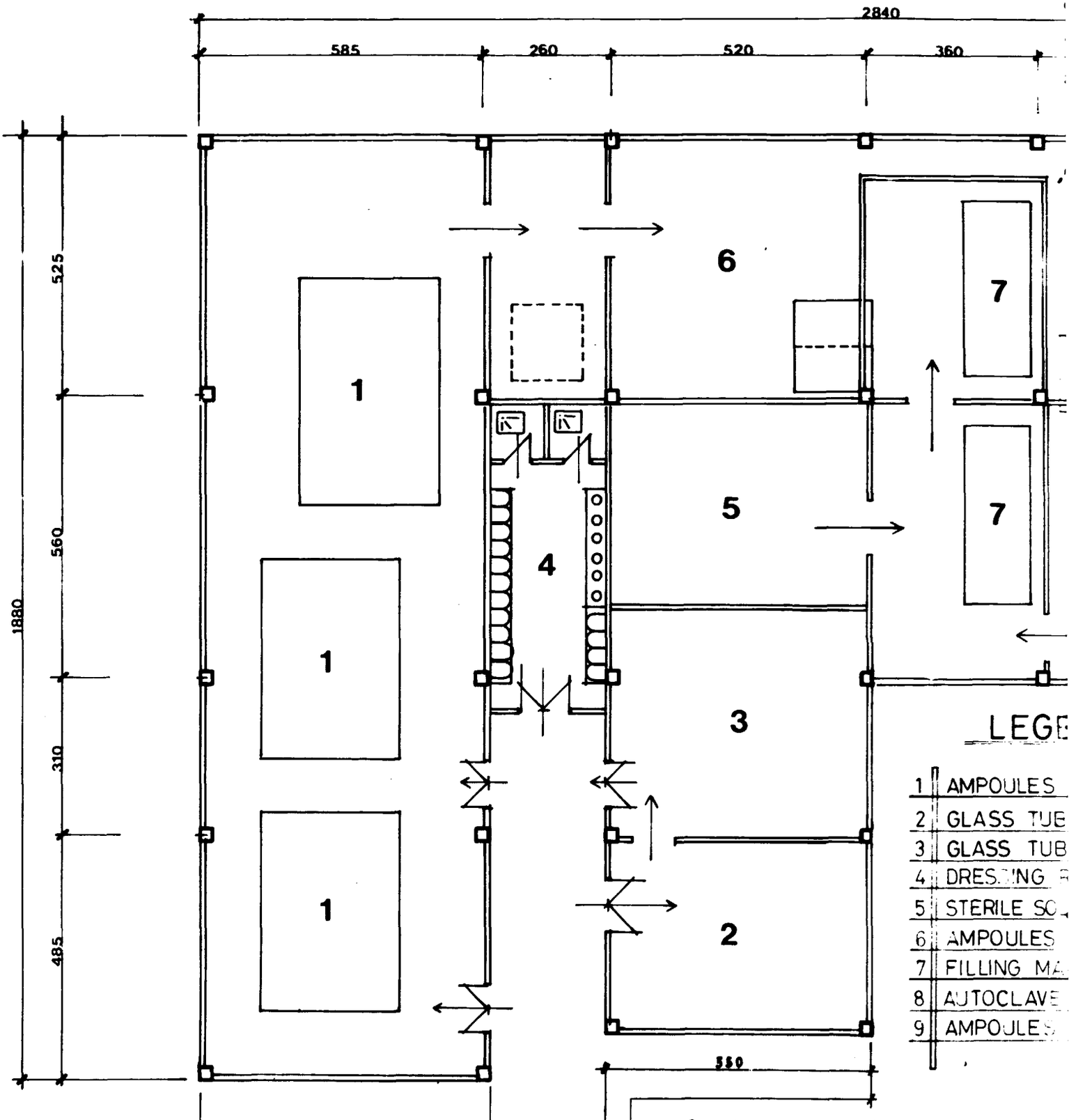
no. 1 microbiologist

no. 1 laboratory workers

We recommend that training be given to the following personnel:

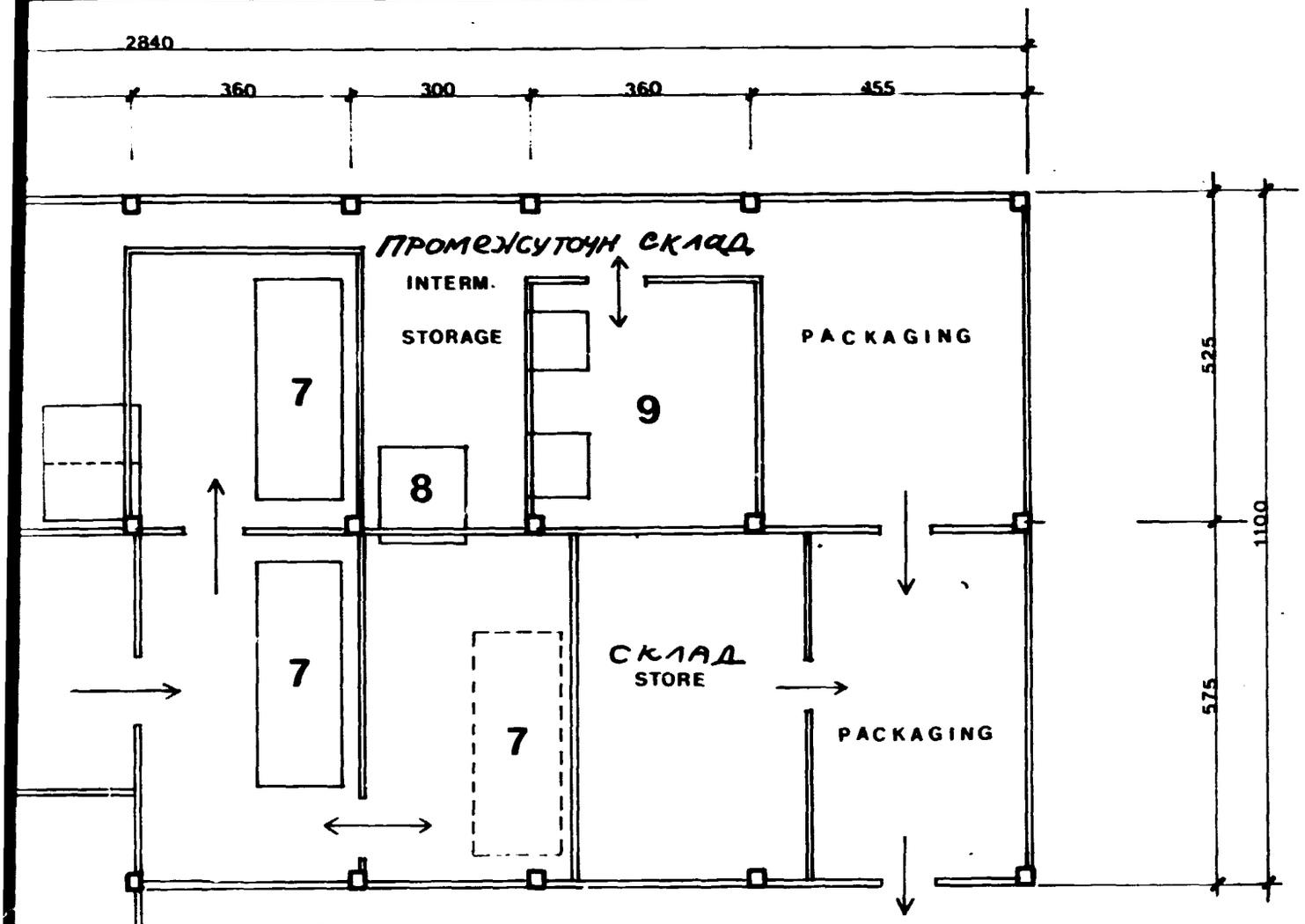
- Director of the quality control : 6 months
- Microbiologist : 3 months
- Engineer for instrumentation maintenance: 6 months

Training should be given in large laboratories in Soviet Union, Japan, America or Europe.



1 · машины, изготовляющие
2 · хранение стеклянных тр
3 · мойка стеклянных трубо
4 · раздевалка для персонал
стерильной зоны
5 · приготовление стерильн. р
6 · мойка ампул
7 · машины, заполняющие
8 · автоклав
9 · контроль и проверка а

SECTION 1



LEGEND :

1 AMPOULES MAKING MACHINES
2 GLASS TUBES STORAGE
3 GLASS TUBES WASHING
4 DRESSING ROOM FOR STERIL AREA PERSONNEL
5 STERILE SOLUTIONS PREPARATION
6 AMPOULES WASHING
7 FILLING MACHINES
8 AUTOCLAVE
9 AMPOULES INSPECTION

SECTION 2

ины, изготовляющие ампулы
чение стеклянных трубок
ка стеклянных трубок
девалка для персонала
ильной зоны
отбление стерильн. растворов
ка ампул
ины, заполняющие ампулы
оклав
троль и проверка ампул

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SUGGESTED LAYOUT FOR
THE AMPOULES DEPARTMENT

DRAWING A

scale 1:100

Предлагаемая планировка
цеха ампул Чертёж А.

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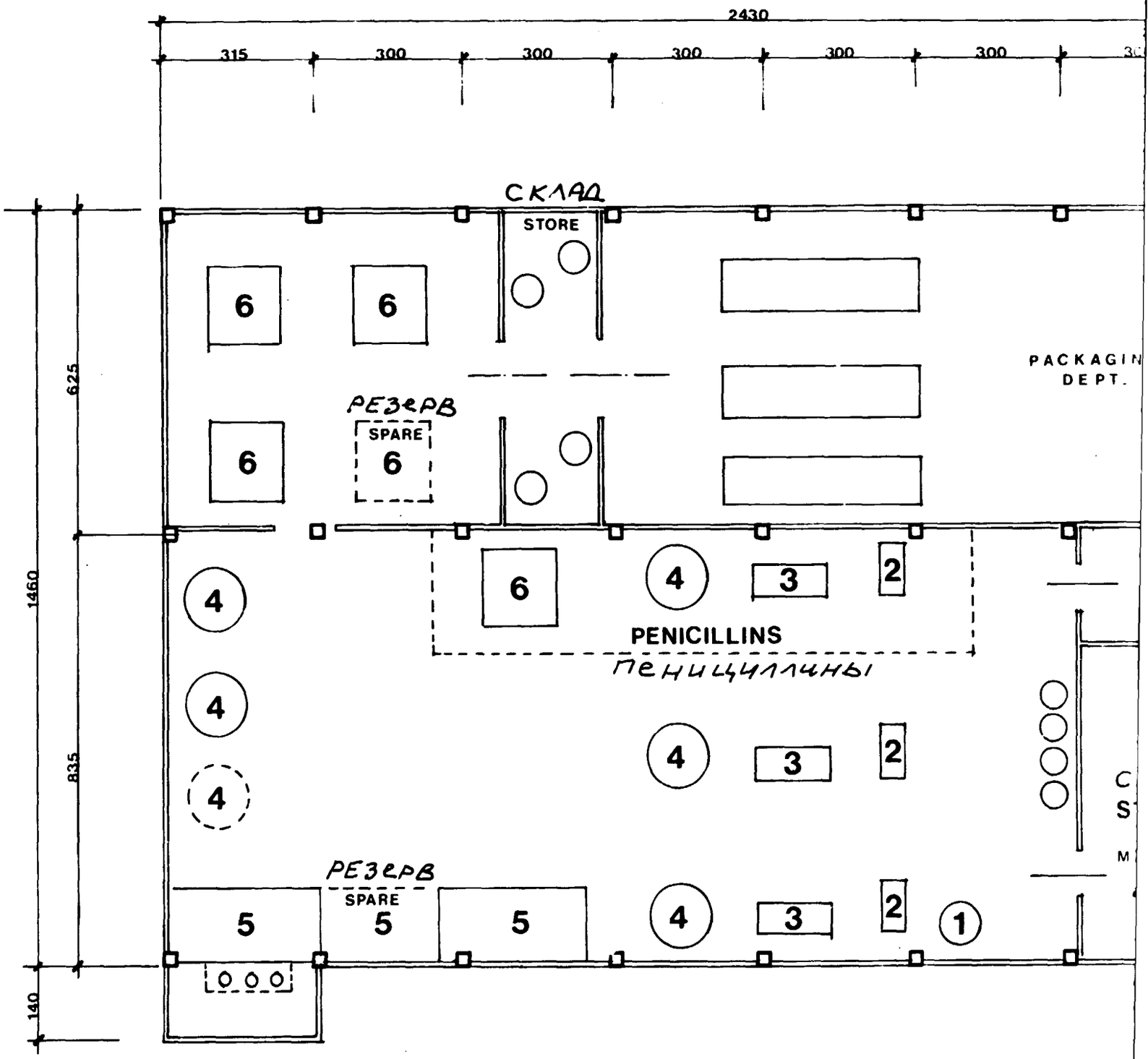
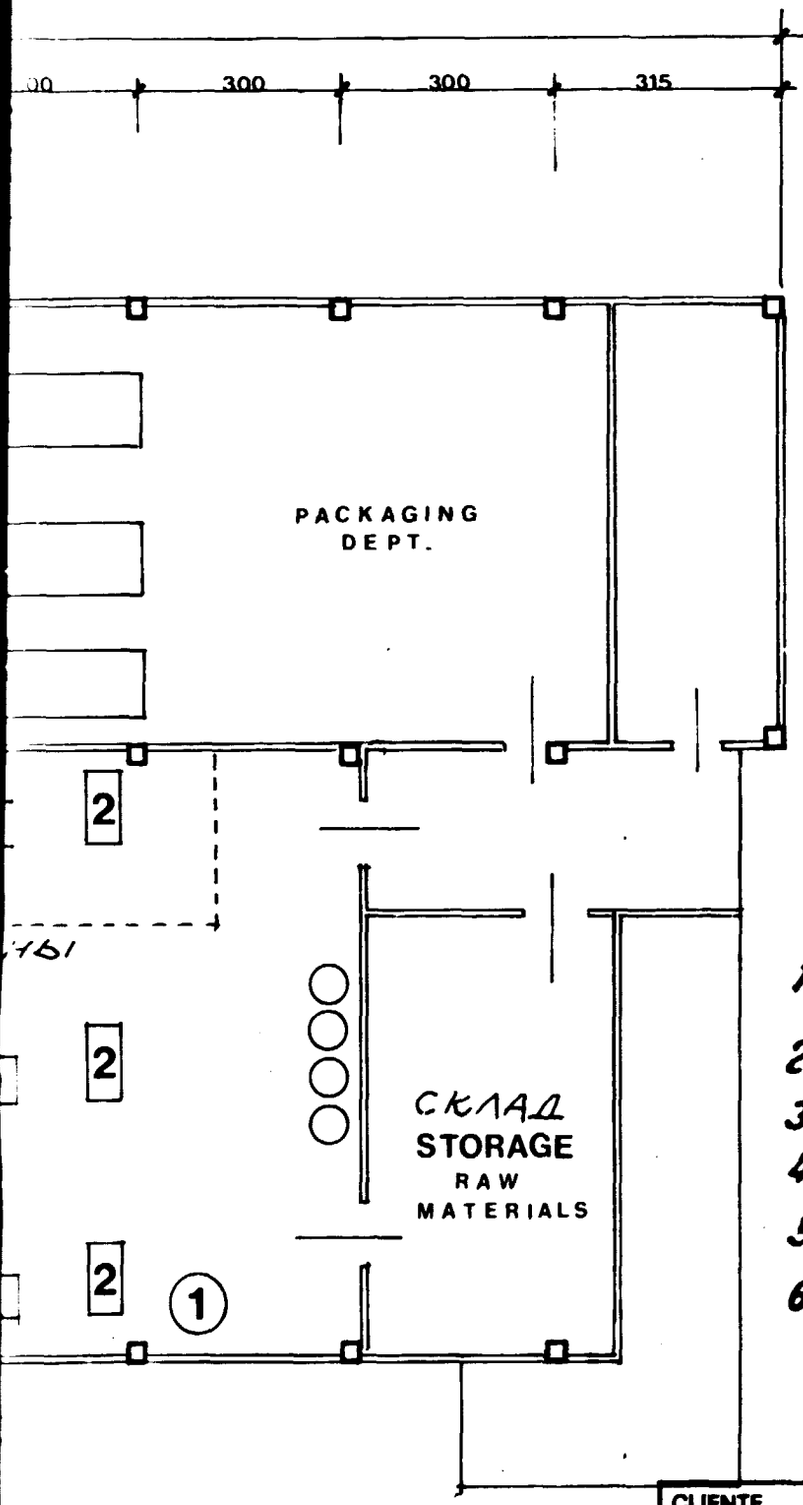
Ph. N. 3102 Tlx N. 330229


2430
315
300
300
300
300
300
СКЛАД
STORE
6
6
6
6
РЕЗЕРВ
SPARE
PACKAGIN
DEPT.
625
1460
835
140
4
4
4
6
4
3
2
PENICILLINS
ПЕНИЦИЛЛИНЫ
4
3
2
РЕЗЕРВ
SPARE
5
5
5
4
3
2
1

SECTION 1



LEGEND :

1 PAN - STEAM HEATED

2 WEHIGHING

3 MIXER

4 MILL

5 DRYERS

6 COMPRESSING MACHINE

Обозначения:

1 Лоток, подогреваемый паром

2 Мойка

3 Смеситель

4 Мельница (дробилка)

5 Сушилки

6 Прессовочная машина

SECTION 2

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SUGGESTED LAY-OUT FOR

TABLETS PRODUCTION DEPARTMENT

DRAWING -B- scale 1:100

Предлагаемая планировка
цеха таблеток Масштаб 1:100

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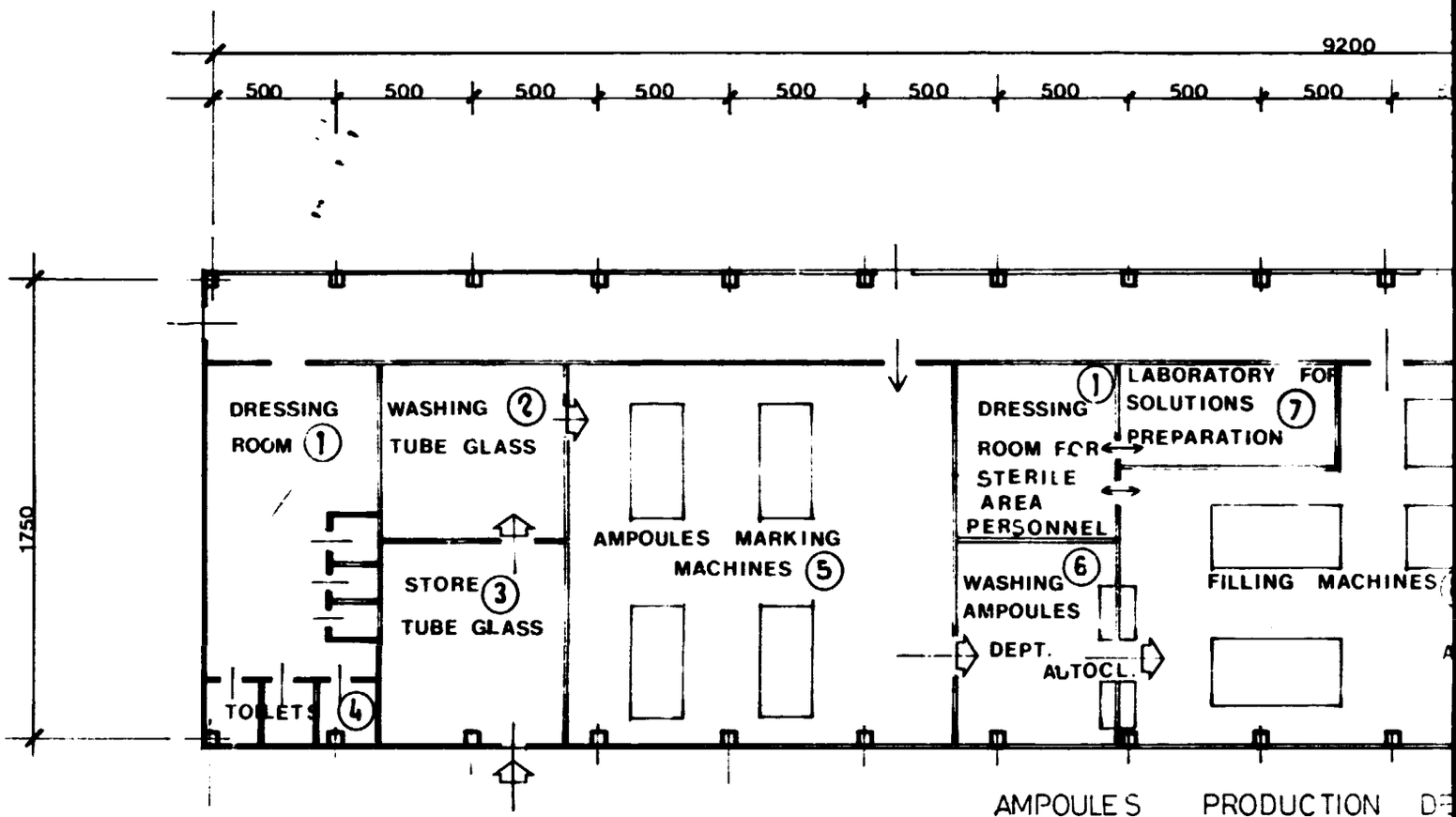
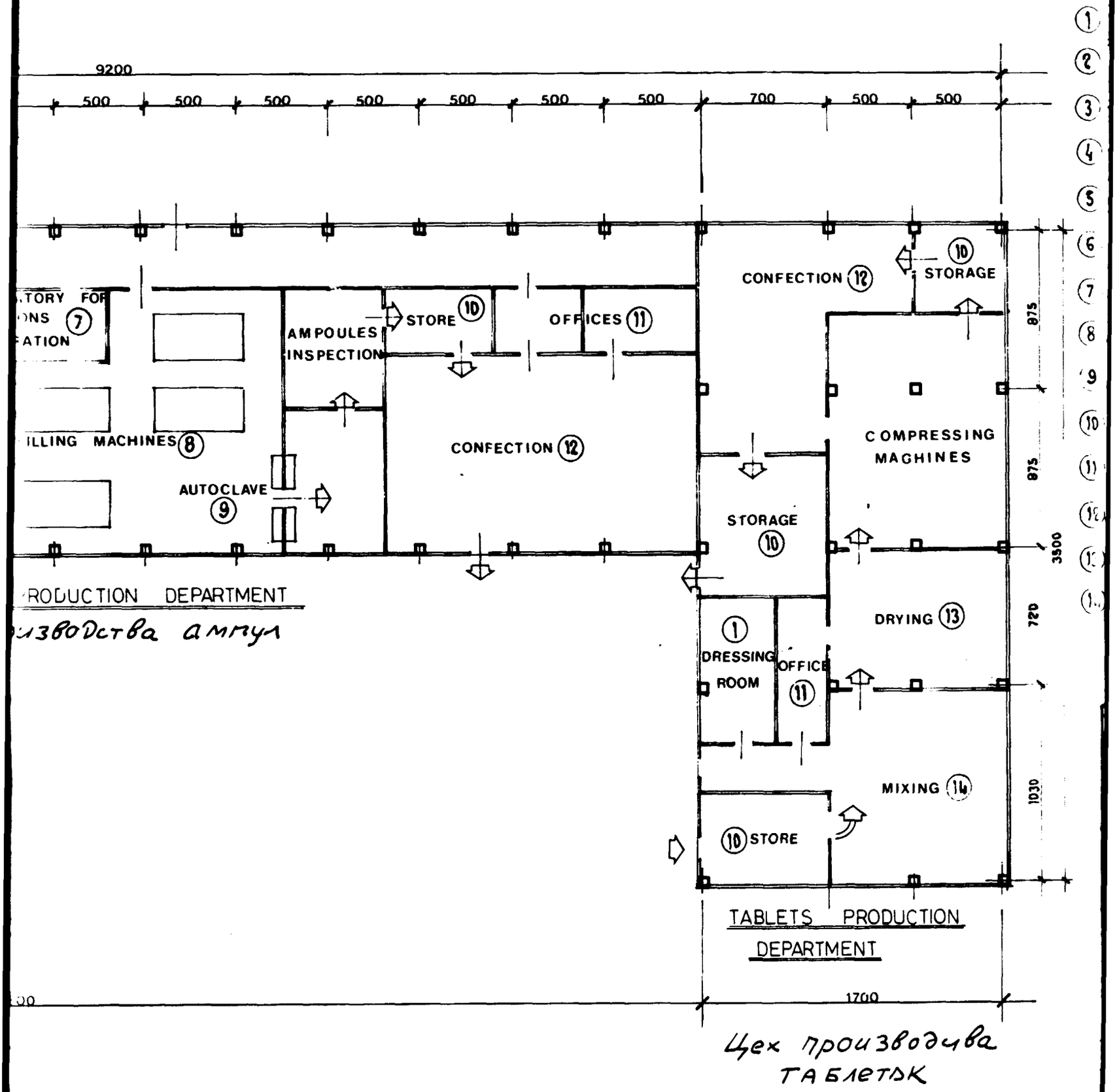

9200
500
500
500
500
500
500
500
500
500
1750
DRESSING ROOM (1)
WASHING (2) TUBE GLASS
STORE (3) TUBE GLASS
TOILETS (4)
AMPOULES MARKING MACHINES (5)
DRESSING (1)
LABORATORY FOR SOLUTIONS (7) PREPARATION
ROOM FOR STERILE AREA PERSONNEL
WASHING (6) AMPOULES
DEPT. AUTOCL.
FILLING MACHINES
AMPOULES PRODUCTION
Цех производства
7500

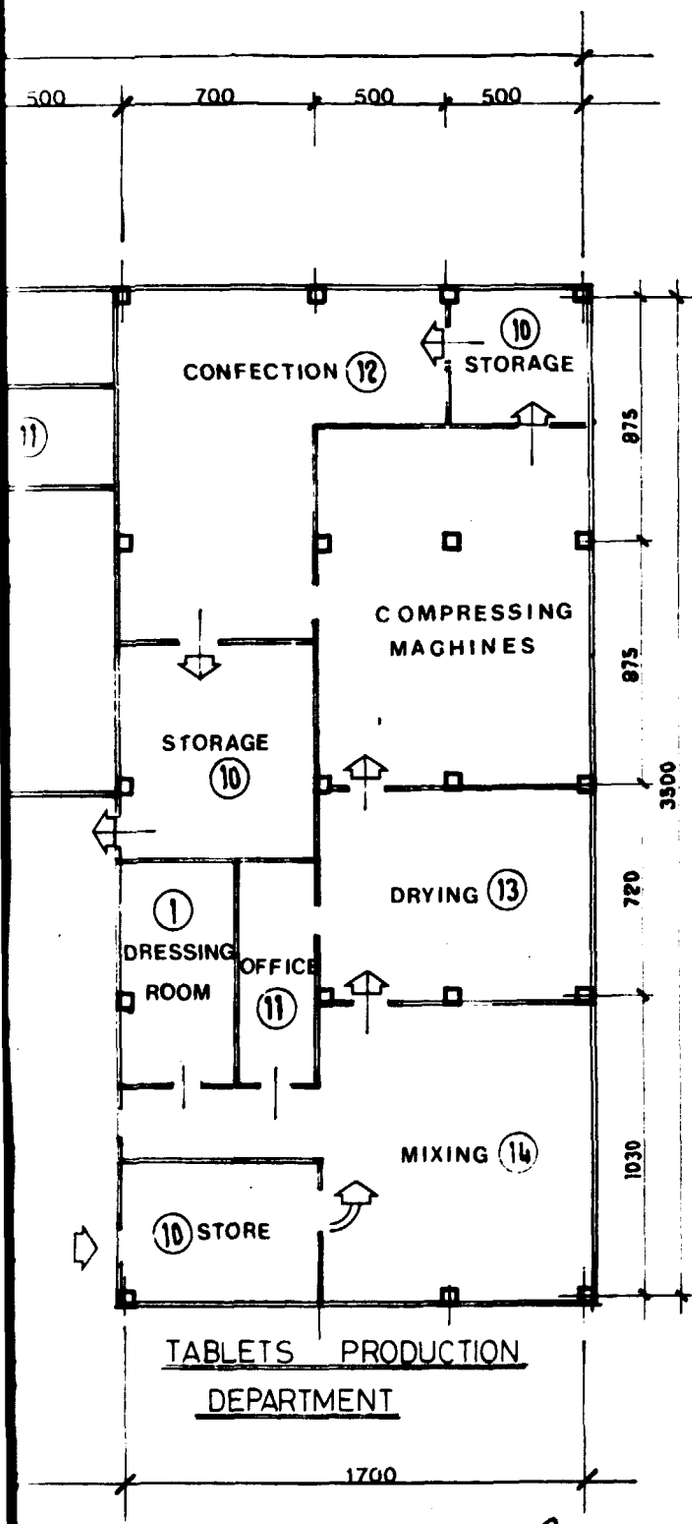
SECTION 1



изводства ампул

Цех производства таблеток

SECTION 2



TABLETS PRODUCTION DEPARTMENT

Цех производства таблеток

(1) Раздевалка
(2) Мойка стеклянных трубок
(3) Хранение стеклянных
(4) Туалеты
(5) Машины, изготавливающие ампулы
(6) Мойка ампул
(7) Лаборатория приготовления растворов
(8) Машины, заполняющие ампулы
(9) Автоклавы
(10) Склад
(11) Административные помещения
(12) Упаковка
(13) Сушка
(14) Образование смеси

Предлагаемая планировка нового корпуса для производства таблеток и ампул (в объёмах программы 1990 года)

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SUGGESTED NEW BUILDING FOR AMPOULES AND TABLETS PRODUCTION — 1990 PROGRAM —

scale 1:100

SECTION 3

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