REPORT ON THE AGRICULTURAL SITUATION AND FARM MACHINERY TEACHING IN VENEZUELA

By

Jeeus A. Sisco

An AE 811, Technical Problem, Report

Michigan State University

Agricultural Engineering Department

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Clarence M. Hansen
Major Professor
Agricultural Engineering Department
Michigan State University
East Lansing, Michigan

Dear Professor Hansen:

In compliance with the requirements of Technical Problems A.E. 811, I am submitting this "Report on the Agricultural Situation and Farm Machinery Teaching in Venezuela".

The objective is restricted to presenting a brief analysis of the agricultural situation in Venezuela along with some aspects of agricultural education, emphasizing the teaching of farm machinery as a university course.

Certain recommendations, such as proposed course work, teaching materials needed, buildings and applied research, are given at the end of this report. These proposals may be considered as a basis for future decisions in the reorganization of farm machinery courses at the faculty of Agronomy at the Central University of Venezuela.

I gratefully acknowledge all your valuable suggestions and help for the elaboration of this report.

Very truly yours,

Jesus A. Sisco
Graduate Agricultural
Mechanization Student

Approved C M Hansen
Major Professor

ACKNOWLEDGEMENTS

The author is indebted to many individuals for their suggestions and cooperation during the elaboration of this report. Particularly, he desires to acknowledge the valuable help received from Prof. H. F. Mc Colly, whose advise made the preceeding report a reality. Also, he acknowledges the effort made by Professor Clarence M. Hansen, his major advisor, in the revision of the report; the colaboration of Mr. Hugo Arellano, in the drawings of the building project, and finally, the moral support received from his wife, Maria Flor, to whom this report is dedicated.

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INTRODUCTION

As in most of the Latin American countries, Venezuela is facing the hard task of getting out of its condition as a developing country.

The complexity involved in reaching this goal is manifest by its multiple social, economical and political aspects. The country, government and population, has to fight a difficult battle in order to get the complete national economic liberation which has not been accomplished yet.

Included in this report is a brief annalysis of only one aspect of the Venezuelan situation, namely agriculture. The second part of this report deals with agricultural machinery teaching at the Faculty of Agronomy of the Central University of Venezuela.

Some recommendations are given which may be considered as a basis for future decissions in the reorganization of farm machinery courses in the mentioned faculty.

A. GEOGRAPHICAL CONDITIONS OF VENEZUELA.

1. Situation and Topography. Venezuela is located in the northern part of South America between 59° 45' and 73° 25' West longitude, and between 00° 45' and 12° 12' North latitude. Consequently, all the country is located in the Torrid Zone,

between the Equator an the Tropic of Cancer. It has a population of about 8,5 million inhabitants and has an area of 352,051 sq. mi.

In the time past, certain unfortunate political circumstances led to the seperation of Venezuela and Colombia thus forcing a natural, geographical and economical conformation. The lack of seaports on the Pacific coast leaves Venezuela out of the more important commercial traffic it could have had. So, the country does not have a strong cargo fleet and for this reason its commercial traffic is in the hands of American Lines, true freight trusts, which dominate the Caribbean Sea.

The country has four main topographical regions: the Andes Highlands and adjacent coastal areas, stretching from San Cristobal in the southwest on a long arc to the Paria peninsula in the northeast; the Maracaibo basin, composed of hot, humid lowlands bordering Lake Maracaibo; the Llanos, or tropical grasslands, gently sloping plains, flatlands and valleys, sometimes parched and sometimes flooded, extending from the Andes to the Orinoco River in the south and east; and the Guiana Highlands south and east of the Orinoco, a vast area of high plateaus and rolling planes.

2. Climatic Conditions. Temperature. In general, Venezuela has a warm climate. The Llanos has an average temperature of 26° C, (78.8° F), and maximum of 41° C (1o5.8° F); in the coastal region the average is 26.9° C (80.4° F),

and the maximum is 37° C (98.6° F); in the Maracaibo basin, average 28.3° C (82.9° F), and the maximum 38.9° C (102° F); in the Andes Highlands the temperature is mild and sometimes drops below 0° C (32° F), but because of the lack of winds in this zone, the immediate areas are not affected, on the contrary, the temperature is comparatively high.

Seasons: Venezuela, as a tropical country, does not have the the four characteristic seasons of the temperate countries. The changes in temperature are due to such factors as the rainfall, the winds, and the elevation above sea level.

There are two so called "seasons": a rainy season from middle April to middle November and a dry season during the other months.

In order to demonstrate the rainfall pattern, the following information is given: in Carora, State of Lara, (arid lands) the average rainfall is 632 mm (252.4 in.) and it rains during 49 days a year. On the other hand, in El Guapo, State of Miranda, (pluvial woodlands) the average rainfall is 2727 mm (1090 in.) and it rains during 187 days a year. (See appendix N° 2).

3. People. Venezuela is one of the least densely populated countries of the hemisphere. There are about 17 persons per square mile. Four fifths of the population is concentrated in the northwest quarter of the country: generally speaking, in the Andes, the coastal region and the Maracaibo basin.

The racial composition of the population is about 65% mestizo, 20% white, 8% Negro, and 7% Indian. Fortunatelly, Venezuela is a society with no great friction among racial groups, but foreign interests (read countries) lead Venezuelan people into a fraticidal political struggle. With this state of affairs they can continue the exploitation of the national richness for their exclusive benefit, without greater opposition from a divided people and a weakened government.

The rate of population growth exceeds 4%; the death rate had fallen to 10 per 1,000 by 1956. The birth rate has remainded high, 47 per 1,000 in 1956.

The urban population of Venezuela has been growing at even more rapid rate than the population as a whole. People living in localities with 2,500 inhabitants or more represented about 61% of the total population in 1959, compared with about 50% in 1950. Consequently, some 39% of the population is living in farms or in small rural settlements. (See Table N°1).

TABLE N°-1

ACTIVE POPULATION (1)

ACTIVITY (2)	NUMBER	PERCENT
TOTAL ACTIVE POPULATION...	2,507,390	100.00
Agriculture & Fishing.....	885,471	35.30
Mining.....	8,764	0.40
Petroleum.....	33,282	1.30
Manufacturing Industry....	314,563	12.50
Electricity Gas & Water...	14,831	0.60
Construction.....	170,305	6.80
Transportation & Comm.....	97,337	3.90
Commerce.....	297,584	11.90
Services.....	685,253	27.30

(1) Source: "Informe Economico, Año 1963". Banco Central de Venezuela, Caracas, 1964.

(2) Unoccupied people are not included. (Estimation; 10% of the active population).

4. Types of Terrain. The type of soils are still being studied. For this reason it is believed preferable to give a general description of the types of terrain instead of the types of soils. (See appendix N°-3).

a. High Mountainous Regions. Humid during 10 months per year; elevations from 1,700 to 4,000 meters; slopes up to 80%; temperatures from below 0° C(32° F) to 17° C(65° F), Valleys and terraces used in pastures, potatoes, wheat, and green beans. Very little population.

b. Mountains and Sloping Hills. Humid during 7 months a year; elevations from 500 to 1,700 meters; slopes up to 60%; temperatures from 17° C (65° F) to 22° C (71.6° F). They are used in annual crops. Very little population.

c. Hills and Terraces. Elevations from 100 to 600 meters; slopes from 5% to 30%; warm temperature, from 23° C (73.4° F). Most of the land without being used excepting small zones used in pastures.

d. Llanos (Plains) with natural drainage. Elevations lesser than 200 meters; warm temperature, from 23° C to 28° C. They are dry lands with very little use in agriculture.

e. Llanos (Plains) with forests. Humid during 8 months a year; elevations lesser than 200 meters, poor drainage, alluvial soils. They are used in crops such as sugar cane, bananas, corn, rice, etc. Most of them used in natural pastures.

f. Llanos (Plains) poorly drained savanna. Elevations lesser than 100 meters; warmer temperature, up to 41° C (105.8° F). Alluvial soils with poor drainage, consequently, they are periodically flooded. They are only used in natural pastures.

g. Llanos (Plains) swamps and marshes. Elevation lesser than 50 meters; warmer temperature, up

to 41° C; soils with salinity problems. They are used in wood production and in annual crops during the dry season.

5. Main Crops. About 3% of the total land area of Venezuela is now under crops, about 3% under artificial pasture and about 17% is under generally unimproved pasture.

Cropping has been limited largely to the Andes, the central region of the country, the coastal mountains and the Maracaibo basin. The Llanos (plains) have been used for open range production of cattle, even though ultimately, the high plains are used in agricultural production. So, the high plains of the States of Barinas, Cojedes, Portuguesa, and Guarico have about 14.7% of the country crop lands under agricultural production by 1950.

Corn. This crop constitutes the dietary base of the Venezuelan people. Its cultivation is extended all over the country but the main productors are the States of Portuguesa, Yaracuy, Lara, Aragua, Carabobo, Trujillo, Falcon, Anzoategui and Sucre. The area and national production was estimated in 366,761 hectares and 475,000 tons respectively, by 1964.

Rice. Rice production increased rapidly since 1950 reaching a peak in 1954, (102,343 tons), but had declined due to variety reasons and to the appearance of a virus disease known as White Leaf (unidentified virus) until

1963, when it began to increase again. The main productors are the States of Guarico, Portuguesa, Barinas, Cojedes, Yaracuy, Sucre, and Bolivar, and the Territory of Delta Amacuro. The area under crop and the national production were 90,721 hectares and 165,753 tons respectively, in 1964.

Sugar Cane. Although conditions are very favorable for growing sugar cane and this is one of the most mechanized crops, yields are rather low, 45 to 60 tons per hectare. The principal productors are the States of Aragua, Carabobo, Yaracuy, Lara, Sucre, Trujillo and Tachira. In 1964, there were 47,000 hectares under production and the total yield was 3,240,904 tons.

Cotton. Cotton is ecologically suitable, as a crop ripening in the dry season. Its production is located in the States of Aragua, Carabobo, Yaracuy, Guarico, Anzoategui, and Monagas. In 1964, Sowed area: 36,015 hectares; national production: 35,053 tons.

Coffee and Cacao. The production of coffee and cacao has been declining due to neglect or failure to replace deteriorating plants with new higher yielding varieties. Coffee production is limited to high lands such as the Andes and some mountains of the coastal system. Cacao production is located in the States of Sucre, Miranda and Aragua. The production was: coffee, 53,772 tons in 317,667 hectares; cacao, 14,513 tons in 87,616 hectares.

Sesame. Production of sesame has tripled in the last years in order to supply oil seeds for the domestic edible oil industry. The States of Portuguesa and Falcon are the principal productors, 68,357 hectares were sowed in 1964 with a total yield of 46,859 tons.

Potatoes. Potatoes are ecologically suitable for regions above 400 meters, but especially for greater altitudes. So, this crop is cultivated in the Andes and some central States as Aragua and Carabobo. In 1964, 121,000 tons were produced in a surface of 15,111 hectares.

Tobacco. Finally, the production of tobacco has been more or less stable since 1950. Main productors are the States of Portuguesa, Aragua, Guarico and Barinas. In 6,096 hectares were produced 8,529 tons by 1964.

B. AGRICULTURAL SITUATION IN VENEZUELA.

1. Land Tenure. As in many Latin American countries, the land ownership pattern in Venezuela is characterized by a number of large, extensively operated estates and a large number of small farmers complementing their precarious means of living on small plots. At the same time, however, there are vast areas of municipal and state-owned land which are underdeveloped and still in virgin forests. The inadequacy of land records makes it difficult to determine the extent and location of these lands, but the government estimates

that there are more than one million hectares of publicly owned land suitable for agriculture available for distribution to cultivators.

In the older developed areas, population pressures have resulted in fragmentation of holdings to such an extent that farmers must rely on share cropping arrangement with larger estates in order to acquire additional workable land. It is in this areas of population pressures where the government has been purchasing land for distribution. On the other hand, in the relatively underdeveloped areas plenty of land, publicly owned, is available for colonization.

The traditional family-sized farm is small and yields are low. This is caused partly by the tropical environment (rapid weed growth, leached poor soils, short days, etc), partly by the traditional farm systems, mostly dependent on human labor. The consequence of these two factors is general backwardness in agricultural development, productivity and income. In order to point out the distortion in the land tenure, in Table N^{o}2 is given the distribution of farm sizes. It is observed that about 2/3 of the farm families operate less than 5 hectares, and that only 445 families own 42.6% of the land under agricultural and livestock production.

TABLE N°2

DISTRIBUTION OF FARM SIZES (1)

	Farms		Surface	
Size in has.	Number	Percent	Hectares	Percent
0.1-4.9	125,990	53.7	267,250	1.3
5.00-19.9	69,565	29.6	638,962	2.9
20.0-49.9	18,900	8.0	548.495	2.5
50.0-99.9	7,123	3.0	463,678	2.1
100-499.9	7,886	3.4	1,584,182	7.1
500-999.9	1,864	0.8	1,220,952	5.5
1,000-2,499.9	1,669	0.7	2,467,531	11.1
2,500-9,999.9	1,308	0.6	5,512,582	24.9
10,000 or more	445	0.2	9,423,008	42.6
TOTALS	234,730	100.0	22,126,640	100.0

(1) Source: National Census of 1950. Part I Ministry of Development. Caracas, Cenezuela.

In Table N°3 is given the land use according to the number of hectares under agricultural production (22,076,635 has.), which represent about 24.3% of the total country surface. It is opportune to point out that there are 33,645 hectares under irrigation in spite of the fact that the total capacity of the 6 functioning irrigation systems is 231,040 hectares.

TABLE N^{O}3

LAND USE (1)

	Hectares	Percent
In permanent use.....	1,252,115	5.9
of which perennial crops....	542,919	
of which annual crops.....	709,196	
Recent shifting cultivation....	1,334,334	6.0
Artificial pastures.....	1,639,424	7.40
Natural pastures.....	11,861,537	53.6
Exploited forests.....	771,152	3.5
Non-exploited forests.....	3,663,828	16.6
Deforested.....	239,584	1.1
Not in use for agriculture.....	1,314,662	5.9
TOTALS	22,076,635	100.0

(1) Source: National Census of 1950, Part I. Ministry of Development, Caracas, Venezuela.

2. Rural People and the Agricultural Problem. In Venethere are two different sectors engaged in the agricultural production, that is, there is a commercialized sector constituted by medium and big farmers. This sector has quite enough resources and means of production, furthermore, it has shown itself to be relatively responsive to market incentives and government programs. It has also gained considerable experience in mechanized operation and some contact with use of fertilizers, improved seeds, pesticides, and other forms of technical improvement.

In contrast, there is a subsistence sector integrated by

the bulk of low-income cultivators which operate farms less than 5 hectares and have received very little benefit from recent economic development. Most of them cultivate less than 2 hectares and produce very little surplus for the market. Their problem is basically one of lack of know-how. Shortages of land is not generally an immediate limiting factor since they are already cultivating as much land as they can manage under systems of shifting or primitive permanent cultivation and with non-land resources they have in hand.

The agricultural problem thus has two quite separate aspects: the problem of increasing the production and efficiency of the commercialized sector and the problem of raising the income and living standard of the subsistence farmer. The latter is much more complex and the solution are relatively long-range.

3. Agricultural Policy of the Government. The government has been involved in the agricultural production through economical measures which can be briefly exposed: direct investments, credits to the farmers, price support policy, subsidies to certain products, and technical advise.

In 1960, the Agrarian Reform Law was promulgated. This Law provides the framework for a comprehensive program to deal with both low-income and commercial farmers. The Law calls for the establishment of adequate research and extension services, provision of farm credit, improvement of marketing facilities, and also sets forth new regulations controlling

land tenure. The total cost of one program designed to fulfill the objectives of the Law was estimated at Bs 23 billion (approximately $5.1 billion at the current change) by the "Subcomision Economica" of the "Comision de la Reforma Agraria" of which about one-half would be for preparatory costs such as adquisition of land, ittigation, drainage, electrification and tractor pools and one-half for the resettlement of about 350,000 farm families. Since the Government does not have the resources and the good intention to carry out a program of this magnitude in a relatively short period of time, it has not adopted this program. It has instead established an interim program aimed to the resettlement of small farmers in lands acquired in higher prices than they are really worth; the division and distribution of land from estates in crowded areas, as a measure to palliate the discontent of subsistence farmers and, in doing so, to avoid uprisings, and finally the expansion of loan operations.

The Government has not taken concrete measures to expand basic research, educational and extension services needed to support this program without the strong base given by the research and the educational and extension services.

4. Systems of Farming and Used Equipment. There are two principal systems of farming which characterize each agricultural sector.

The subsistence farmer has the handicap of low productivity, due to a combination of adverse tropical conditions,

poverty and lack of knowledge, and mainly to the use of primitive farming systems. With the primitive technique known to him he can manage one or two hectares. Few of them use animal power, a pair of oxen pulling a wooden plow, but most of them open up and work the soil with machete, hoe and digging stick. They saw by hand dropping the seeds in the opened holes. Many move their field from place to place each year or two, since production falls off rapidly after the first year under the primitive system. This situation has been cause of the acute problem of erosion and forests destruction, and their consequences of shortage of water and droughts.

The commercialized farmers know about modern techniques of production and modern farm machinery, even though they have been unable fully to exploit such a resources. For instance, the costs of mechanized operations have been high due to inexperience, lack of repair and maintenance facilities, purchase of excessive amount of machinery, the failure to develope a system for fuller utilization of machinery, and lags in other technical developments which normally should accompany mechanization. It is evident the lack of knowledge about the relationship between farm size and requited number of machineries.

Following, it is given in Table N°4 the common mechanized operations and the equipment employed.

TABLE N°4

OPERATION	MACHINES	REMARKS
Clearing forests.....	Track-type tractors, Angle-dozers, Ranks Chains, Clerain Blades, Cutter and Stumpers	This operation is done by the farmer or private companies.
Leveling land for irrigation.....	Rippers, Subsoilers, Land-planes, Graders. Scoops and Scrapers.	This operation is done by private companies for the commercialized sectors.
Tillage.....	Wheels tractors, Disk, molboard and rotary plows; Disk, Spike-tooth, and Spring-tooth harrows; Land rollers and pulverizers.	These operations are done by commercialized farmers. Subsistence farmers' land is tilled by Government's agencies.
Planting.....	Row-crop planters, Broadcast-crop planters and Grain drills.	
Control of weeds, pests and diseases....	Cultivators, Rotary hoes, Hydraulic sprayers, Blower sprayers, dusters.	The use of chemicals is of recent introduction.
Fertilizing.....	Manure spreaders and Granular fertilizer distributors.	
Hay Harvesting.....	Mowers, Hay conditioner, Hay balers, Hay rakes and silos.	These machines have a reduced use.
Grain Harvesting.....	Self-propelled combines and Corn pickers.	Self-propelled combines are of sacktype and occasionally used in harvesting sesame and corn.

TABLE N°4 (cont.)

OPERATION	MACHINES	REMARKS
Cotton Harvesting.....	Two-row self propelled, and one or two-row tractor mounted cotton pickers.	Tractor-mounted type is the most common.
Potato Harvesting.....	One-row power take off potato digger and self-propelled potato harvester.	Potato digger is used as peanut harvester. Self-propelled type is seldom used.
Forage Harvesting.....	Field chopper harvesters, self unloading wagons and Stationary choppers.	
Sugar cane Cropping...	Wheel and track tractors, Pailer loaders, wagons, tractor mounted field fertilizer applicators, Diggers and Big-Roman.	It is one of the best mechanized crops.
Crop Processing.....	Plants for rice benefit and cotton Gin.	

In 1956, a national agricultural survey was sone to evaluate the situation of the national agriculture as a whole. From this survey the data given in Table N°5 was taken.

TABLE N°5

ESTIMATED NUMBER OF FARM MACHINES (1)

TYPE	NUMBER
Tractors.....	10, 171
Plows (2).....	6,726

TABLE N°5 (cont.)

ESTIMATED NUMBER OF FARM MACHINES (1)

TYPE	NUMBER
Harrows.....	2,906
Planters.....	1,894
Others.....	3,720

(1) Source: National Survey, 1956
(2) Mainly Disks Plows

C. AGRICULTURAL EDUCATION.

While in other countries education is desired for its own sake, in Venezuela it is also a precondition for its economic development. A branch of the education, the agricultural education, deserves an special consideration for two main reasons: First of all about 39% of the total population are living in rural areas, and secondly the lack of education has been, and it still is an obstacle to the agricultural development.

The Ministry of Education currently has broad responsibility for the agricultural education at both its lowest and highest levels, while the Ministry of Agriculture deals with agricultural education at the intermediate level.

1. Rural Primary Schools. Agricultural courses are provided in the upper grades of these special primary schools. Nationwide enrollment in this type of school was only about 1,400 in 1959-60 and consequently has so far had limited impact. Agricultural education in such a level should not be limited to this type of school, on the contrary, it should be given

in all primary schools as a vocational course.

2. Agricultural Technical Schools. At this level, agricultural education is almost entirely the responsibility of the Ministry of Agriculture and it is not necessarily directed only at school age children. There are four of these schools training, during a period of three years, agricultural technical assistant. (peritos).

The Ministry of Agriculture also operates special schools for practical assistants (prácticos). These provide short courses of practical demonstration in specialized skills, such as coffee-growing, cacao-growing, and tractor operation.

3. Higher Agricultural Education. There are seven universities in Venezuela of which only three have agronomic studies. The curriculum is designed to be covered in a period of 5 years.

The need for agronomists in Venezuela is estimated at 1,000. If it is considered that there are about 400 trained agronomists, of whom 100 are foreign, and that only about 30 are produced annually, it will take a long time to cover this need, unless measures, such as opening of new schools or increasing the number of student entering university courses, were taken immediately.

Besides, the country faces the problems originated by the establishment of ittigation systems, rural electrification, construction of rural roads, crop processing, etc., which cannot be exclusively solved by agronomists. Some people trained

in agricultural engineering are required to solve these problems but the country does not have proper agricultural engineering schools to train them. There are agricultural engineering departments as a dependencies of agronomy schools, where some basic and major courses are given to students of agronomy seeking a major in agricultural engineering.

Undoubtedly, this ambiguous situation calls for the establishment of agricultural engineering schools as a full university career.

AGRICULTURAL MACHINERY TEACHING SITUATION

This second part deals with agricultural machinery teaching at the Faculty of Agronomy of the Central University of Venezuela, our nearest known experience. This reality, however, is not very far from those in other universities.

A. Present Situation. The first organized school of agronomy was founded in 1937. At the beginning the school was a dependency of the Ministry of Agriculture, and later became the Faculty of Agronomy within the Central University of Venezuela. (1942)

About 1950, the Faculty of Agronomy was transferred from Caracas to Maracay, the latter capital city of the State of Aragua one of the most outstanding agricultural productor. Since then, it continues functioning there.

A course in agricultural machinery was created since the beginning. It lasted one year and was divided in two parts,

the first part devoted to topics about engines and tractors, and the second one devoted to study implements and their applications.

In 1958, along with the establishment of semester and credit systems, the course was divided in two independent courses: Farm Machinery I and Farm Machinery II each one covering the content of the former first and second parts respectively. Each one has two hours of lecture and three hours of laboratory weekly, and 3 credit value.

B. Student Enrollment and Number of Instructors. At the present time, the average enrollment is 180 students. In order to assist them, there are 4 instructors and 1 teaching assistant.

A comprompise solution to the problem of large enrollment has been to gathering the students in one lecture group, and then split them in 6 laboratory groups which in time are sub-divided in 3 smaller groups. Each one of the laboratory groups is assisted by one instructor and one teaching assistant. Laboratory sessions are held from Monday to Saturday, and a report on the work done must be submitted weekly by the students.

C. Available Buildings and Equipments. Among other facilities, there is an engine and systems laboratory with 10 different types of engines. Some of them are not suitable to be directly used by the students due to their complexity.

The laboratory building is not appropiated to the kind of work to be done in it and to the number of students. So,

a new laboratory building should be built considering important factors, such as the number of students and instructors, the increasing enrollment, the existence of two quite different courses, engines and implements, and the need of a maintenance workshop.

Following, a brief inventory is given with the equipment the Faculty owns to be used in agricultural machinery courses.

2 wheel-type tractors

1 track-type tractor

2 disks plows

2 disks harrows

1 corn-cotton planter

1 grain drill

2 cultivators

1 rotary tiller

1 rotary-hoe

1 tractor-mounted sprayer

1 moldboard plow

2 sets of open end wrenches

1 set of instruments for engine testing and tune-up

1 set assorted sizes screw drivers

and some other technical aids such as charts, projectors, engine system displays etc.

It is rapidly seen that this equipment can not meet the teaching needs for 180 students. For this reason, it has

been necessary to borrow some equipment from other institutions adjacent to the Faculty and from farm machinery dealers.

D. Courses Time Scheduling. The present location of both courses in the scholar year has created a troublesome situation. The course Farm Machinery I almost does not need of field practices and it is given during the dry season under covered place. Conversely, the course Farm Machinery II does need of field practices and it is given outdoors during the rainy season. Consequently, there are losses of time and classes. Several times, the switching has been proposed, but equal number rejected by the Faculty's Authorities, allegedly, because of curriculum organization reasons.

Perhaps of more serious consequences is the location of the courses in the curriculum of agronomy. They are placed in third and fourth semesters and have as prerequisite a course on General Physics. This course is given in the first semester, so that, any student, after passing it can take the agricultural machinery courses without having the necessary background on agricultural practices, and without having a concious evaluation of the importance of mechanization as a base of agricultural production. Moreover, when the student gets through his studies four years later, he will have in mind very few ideas, if any, on the basic principles of mechanization.

E. Courses Outlines. Former outlines of these courses were simple enumeration of the main topics, without specifying

the courses objectives, teaching materials to be used, textbook and other course-work references, etc. Considering the situation, the instructors in charge of the courses agreed in doing some changes in the courses outlines. Those and new additions will be formlly expounded in the part corresponding to conclusions and recommendations.

F. Textbooks. There is not a complete textbook written in Spanish. For the time being, it has been used a translation into Spanish from the English of the book "Farm Machinery" by A. A. Stone and H. E. Gulvin. This translation has many mistakes, and it is too expensive.

In 1963, the University of La Molina Lima, Peru, edited a series of small books covering the following topics: Volume I, Elements and Mechanisms of Agricultural Machines; Voulme II, Tractors; Volume III, Machinery for Soil Preparation; Volume IV, Planting and Cultivating Machines; Volume V, Harvesting Machines; Volume VI, Machinery for Clearing Forests and Soil Movement; and Volume VII, Organization of Mechanization Projects.

This series seems to be a good one but it is not completly published yet.

G. Teaching Aids. These excellent teaching tools have been used in limited works. An effort should be done to supply the courses with the necessary material by means of purchase or preparation in the workshop. If during the corresponding lecture or laboratory charts, projection of motion pictures and slides,

and system displays are showed to the students, they will better understand what is explained to them.

H. Field Trips. Some agronomy schools take their students on field trips to the surrounding farms. But this is done in a very irregular way because of obstacles as the large enrollment, and the lack of opportune transportation. Some decission has to be made to overcome this situation as soon as possible in order to conduct effective field trips.

I. Tools for Maintenance Workshop and Laboratory. Acquisition of tools for maintenance workshop and Laboratory has not been a greater problem. But the way they are stored and the used procedure to furnish them to the students have certain inconveniences. That is, the tools are stored in shelves with several drawers and, of course, they are mixed up. The procedure followed to supply the tools consists in filling out a mimeographed blank sheet with number and type of tools furnished. With this procedure, losses of tools and confussions occur very often.

CONCLUSIONS AND RECOMMENDATIONS

With respect to the agricultural situation in Venezuela, it is very difficult to arrive to precise conclusions and recommendations, due to the complexity of the problem. Some general conclusions, however, will be given along with recommendations whose application might prove in an increase of crop production.

A. Conclusions on the agricultural situation.

1. There is a lack of realistic agricultural planning,

in terms of selection of area, size of farm, cropping pattern, soil and climatic conditions, capacity of the farmer, reliable statistics, etc.

2. Low educational and technical skills levels of the farmers.
3. Unfavorable agricultural policies of the National Government.
4. Lack of a meaningful mechanization.
5. Lack of sufficient productivity to pay for machinery.
6. There are not the number and satisfactory extension service agencies required by the size of rural population.
7. Technical research has been very limited. During the past ten years, the Venezuelan Government has devoted very little attention to agricultural research.
8. The country has unfavorable tropical conditions such as short days, high temperatures, poor lateritic soils, rapid weed growth, and prevalence of pests and diseases. Hilly lands, small farms and difficult rural roads for crop production transportation.

B. Recommendations on agricultural situation.

1. To increase the productivity by:
   a. Using a proper mechanization.
   b. Using fertilization and good soil management procedures.
   c. Using proper weed control.
   d. Adopting soil and water conservation practices:

irrigation, drainage, and erosion control.

e. Reducing losses by insects, diseases, rodents, and birds.

f. Using correct plant population of improved or adapted crop varieties.

2. The above exposed calls for:

a. Establishing of a competent and comprehensiye research plan.

b. Adapting machines made in other countries to the conditions of Venezuela.

c. **Amplification and improvements of extension services.**

d. Establishing of vocational agricultural education programs in primary and secondary schools.

3. The National Government should improve its agricultural policy in order to achieve in the shortest time the productivity levels of agricultural production required for the economical progress of the country.

C. Conclusions on Agricultural Machinery Teaching.

1. There are few agronomy schools in the country.

2. Consequently, the rate of production of agronomist trained in agricultural mechanization is very low.

3. The present agronomy schools are facing serious problems such as shortage of good instructors, lack of proper buildings and equipments, etc.

D. Recommendations on Agricultural Machinery Teaching.

1. It is recommended to improve and increase the capacity

of existent agronomy schools. Also, due to the need of people trained in this field, it is recommended to study the possibility of establishing agricultural engineering schools in the country.

2. Agronomy schools should improve and give special attention to their agricultural machinery courses. It is recommended to take measures such as:

   a. Capacitation of instructors by sending them abroad to take graduate courses in farm mechanization.

   b. Proper location of farm machinery courses considering the season of the year and the level within the curriculum in agriculture. In particular, the Faculty of Agronomy at the Central University of Venezuela should place these courses at 5th and 6th semesters respectively.

3. Courses should be up to date and certain flexibility maintained so that changes can be made according to new developments. Following, a project of course content is proposed which may be considered as a base for future decissions.

   TITLE: FARM MACHINERY I

   2 hours for lecture and 3 hours for laboratory weekly during one semester.

   PREREQUISITE:

   One course in General Physics and one course in Soils.

COURSE OBJECTIVES

1. To acquaint the student with the fundamental operation principles and management of agricultural engines and tractors.
2. To instruct the student in the proper maintenance and safe driving of tractors.
3. To give the student some economic and selection principles involved in the management of power units.
4. To develop special interest on the subject matter of this course among those students seeking to major in agricultural engineering.
5. To develop student understandings and attitudes, so that he will be able to do a better performance after completion of his studies.

TEXTBOOK: "Tractores y Maquinaria Agricola". Volumenes I y II Berlin, Johan D., y Ledgard, Reginald. Editorial de la Universidad Agraria la Molina, Lima, 1963.

SUPPLEMENTARY REFERENCES:

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Stone, Archie & Gulvin, Harold. Maquinaria Agricola. Mexico, Editorial Continental S.A., 1961.

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LECTURE TOPIC OUTLINE

1. Introduction to course.

a. History of development and introduction of farm machinery in the World and Venezuela.

b. Importance of farm mechanization on agricultural production and its influence on the national economy.

c. Makes and types of farm machines commonly used in Venezuela.

2. Materials of Construction.

a. Materials used in constructing farm machines.

b. Classification of these materials.

3. Elements and Mechanisms of Machines.

a. Lever

b. Belts and Pulleys

c. Inclined plane

d. Screw and Edge.

4. Power and Energy

a. Sources of power

b. Power measurement

c. The internal combustion engine

5. Systems of internal combustion engines

a. Valve system

b. Combustion system and fuels: spark engines, diesel engines; hydro-carbon fuels, octane and cetane numbers.

c. Electric system

d. Cooling system

e. Lubrication system. S.A.E. and A.P.I. classifications for oils and greases. Selection and storage of oils

and greases. Oil filters.

6. Power Transmission
   a. Clutches
   b. Gear transmission
   c. Fluid power transmission
7. Power Applications
   a. Draw-bars
   b. Hydraulic systems and hitches
   c. Power take off
   d. Pulleys
8. Nebraska Tractor Tests
   a. Purpose, value to public
   b. Discussion of tests
   c. Analysis of one or more specific test reports
9. Maintenance of Agricultural Tractors
   a. General maintenance principles
   b. Adquisition of parts
   c. Report of failures
10. Tractor Economics
   a. Factors affecting cost of operating farm tractors
   b. Cost analysis
   c. Comparison of gasoline vs diesel

LABORATORY OUTLINE

1. Engines and Materials of Construction
   a. Study of engine parts

b. Identification of material samples

2. Combustion System

a. Study of spark engine combustion system

b. Study of diesel engine combustion system

3. Ignition Timing

a. Remove spark plugs and distributor from engine

b. Time ignition and start

c. Use of timing lamps and other equipments

4. Cooling System

a. Study of different types of cooling systems

b. Maintenance. Clean-up. Washing solution preparation

5. Lubrication System

a. Selection of lubricants

b. Perform lubrication plan

6. Dynamometer tests

a. Measurement of h.p., fuel consumption, etc

b. Preparation of formal reports

7. Power transmission

a. Study of clutches and gear transmissions

b. Final drives. Brakes

8. Diesel Engines

a. Observe and start several typed of diesel engines

b. Study and use of injection nozzle tester

9. Analysis of Nebraska Tractor Test Reports

a. Choose several similar tractor models for comparison

b. Study and use of injection nozzle tester

c. Make calculations based on test results

10. Tractor Economics

a. Calculate cost of operating farm tractors

b. Compare cots for owning and operating several tractor models.

c. Compare owning cost vs custom work cost

NOTE: During each laboratory session, by rotating students, they may receive tractor driving practices and instruction on safety rules.

TITLE: FARM MACHINERY II

2 hours for lecture and 3 hours for laboratory weekly during one semester

PREREQUISITE:

Farm Machinery I

COURSE OBJECTIVES

1. To acquaint the student with the fundamental operation principles for production, weed and insect control, harvesting and processing of farm crops.
2. To instruct the student in the proper maintenance and safe operation practices with farm machinery.
3. To give the student knowledge of the most common used machines in Venezuela.
4. To make the student aware of selection principles, costs, expected life and other economic factors affecting farm machinery application.
5. To develop student understandings, and attitudes, so that he will be able to do a better performance

after completion of his studies.

TEXTBOOK: "Tractores y Maquinaria Agricola". Volumenes III, IV, V, VI and VII. Berlin, Johan D., y Ledgard, Reginald. Editorial de la Universidad Araria la Molina, Lima, 1963.

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LECTURE TOPIC OUTLINE

1. Introduction to course.
   a. Introduction to agricultural mechanization
   b. Objectives of agricultural mechanization
2. Measurements of Farm Machinery Capacity
   a. Field efficiency, concepts
   b. Calculation of theoretical and actual field capacity
3. Land Clearing
   a. Machines used for establishment and development of new farms.
   b. Land clearing operation and principles
4. Tillage Operation
   a. Classification, parts, and operation of disk and molboard plows.

b. Rotary tillers and chisel plows

c. Classification, parts, and operation of disk, spring-tooth and spike-tooth harrows.

d. Adjustment, graduations and maintenance of tillage machines.

5. Soil Surface Conditioning for Irrigation

a. Study of rippers and subsoilers

b. Study of landplanes, graders, scrapers and scoops.

6. Seed Planting Machines

a. Row-crop planters: corn-cotton, potatoes, etc

b. Small-grain planters: grain drill, planet jr., etc

c. Adjustment, maintenance and calibration. Typical problems.

7. Weed and Insect Control Machines

a. Cultivators

b. Sprayers

c. Dusters

d. Adjustment, maintenance, and calibration. Typical problems

8. Fertilizer Distributors

a. Dry and liquid distributors

b. Miscellaneous

c. Maintenance and calibration

9. Harvesting Machines

a. Combines

b. Corn harvesters

c. Cotton pickers

d. Potato harvesters

e. Peanut and sesame harvesters

f. Adjustment, maintenance and graduations

10. Hay and Forage Harvesting Machines

a. Mowers, conditioners and rakes

b. Operation with choppers and balers

c. Harvesting systems

11. Sugar Cane Equipment

a. Track and wheel tractors

b. Subsoiling, bedding and barring off equipments

c. Harvesters, piler-loaders and wagons.

d. Herbicide and fertilizer applicators

12. Labor Saving Machines

a. Loaders

b. Elevators

c. Conveyor unloaders

13. Crop Processing Equipment

a. Crop-residue disposal equipment

b. Corn shellers

c. Feed grinders and mills

d. Feed mixers

e. Crop dryers

14. Farm Machinery Economics

a. Bases and methods for calculating operation costs

b. Lease and hire

15. Machinery Selection and Planning

    a. Factors influencing farm machinery selection

    b. Machinery management and use planning.

LABORATORY OUTLINE

1. Machinery Performance Measurements

    a. Determine field efficiency

    b. Determine theoretical and actual field capacity

2. Primary Tillage

    a. Study of plows .

    b. Operate tractor with plow

    c. Perform adjustments, maintenance and graduations

3. Secondary Tillage

    a. Study of harrows

    b. Operate tractor with harrow

    c. Perform maintenance and graduations

4. Soil Surface Conditioning for Irrigation

    a. Study of subsoilers, scrapers and landplanes

    b. Field trip

5. Seed Planting Machines

    a. Corn-cotton planter

    b. Grain drill

    c. Potato planter

    d. Perform calibration on different planters

6. Weed and Insect Control

    a. Cultivators, sprayers and dusters

c. Perform adjustments and calibrations

7. Fertilizer Distributors

a. Study of fertilizer distributors

b. Perform adjustments and calibrations

8. Harvesting Machines

a. Study of combines

b. Study of corn harvesters

c. Perform adjustments and maintenance

d. Field trip

9. Hay and Forage Harvesting Machines

a. Mower adjustments and maintenance

b. Rake construction and selection

c. Study of balers

d. Field trip

10. Sugar Cane Equipment

a. Field trip to a sugar cane plantation

11. Labor Saving and Crop Processing Equipments

a. Application of loaders, elevators and conveyor unloaders.

b. Application of grinders, mixers and dryers

12. Cost Analysis

a. Perform owning cost calculation

b. Compare owning cost vs custom work cost

13. Farm Machinery Selection

a. Study of machinery selection

b. Typical problems.

A. Teaching Aids. Intelligent use of audio-visual aids will save instructor time and stimulate student interest Audio-visual aids increase the retention of knowledge and stimulate the development of understandings and attitudes. Most students remember what they see, hear, and read longer than what they only read. Aids which help students visualize abstract concept and processes are especially valuable. Visual aids are also valuable in teaching manipulative skills.

B. Charts. These aids are very helpful in demonstrations and they can advantageously substitute the drawings on the chalk= board. They are also valuable in recording results obtained in previous jobs, or in recording local agricultural data.

In selecting a chart, we have to consider very important factors: the information provided must be reliable, and the chart should be easily interpreted.

When the chart is to be prepared in the shop, various kinds of materials may be used in making it. Among them: sign cloth, unbleached muslin, vellum cloth, wrapping paper, stiff cardboard, and window shades. All of the preceding kinds of materials have their merits and can be used for certain types of charts.

Several manufacturers prepare charts which can be ob= tained from them upon requisition. The following are desirable:

cross-sectional engines

engine parts

electric and ignition systems

fuel systems and carburetors

lubrication systems

cooling systems

valve systems

types of tractors

plows and harrows

combines

other harvesters

planters, etc

C. Motion Pictures, Filmstrips, and Slides. These materials can be secured from machinery manufacturers. They are very helpful for showing some equipments which are not on hand. Color slides could be taken especially for teaching purpose during the performance of laboratory sessions or field trips. They afford a teacher an opportunity to project a picture for an appropriate period of time and to discuss it in detail.

D. Preparing Slides. The preparation of 2"x2" slides is very easy and requires little skill. The first essential is a good, clear negative. Following, a few suggestions regarding the preparation of slides:

1. Have a processing company prepare a positive film from the processed negative film. This job may be done by a local camera shop at a cost of a few cents a frame.
2. Secure the necessary slide binders. Slide binding kits provide binders, glasses for the front and back of each slide, and complete directions for binding.

3. Cut the positive frame to be mounted from the film and place it in a binder with the emulsion side up for black and white film and the shiny side up for colored film. be careful not to scratch or otherwise mar the positive.

4. Label slide for future use.

E. Motion pictures. Motion pictures are especially valuable in developing interest, in changing attitudes, in pointing up problems, and in developing generalizations. However, they are often not the best type of audio-visual aid for developing skills. Motion pictures are usually best adapted for use in introducing or summarizing discussions.

F. Overhead Projector. An overhead projector produces images from transparent plastic, acetate sheets, or celophane rolls. The overhead projector may be used in a lighted room. Materials may be prepared in advance for use, or the overhead projector may be used instead of chalkboard. The instructor may write on the cellophane roll as he instructs the students. What he puts on the roll will be projected on the screen in back of him.

The overhead projector is preferred as visual aid by many instructors because materials for projection may be prepared quickly, easily, and cheaply. The overhead projector allows the instructor to face the class or audience while using it.

G. Opaque Projector. An opaque projector will project the

image of opaque objects and pictures. It may be used to project typewritten data, photographs, or a picture in a book, bulletin, or magazine.

The divadvantage of this type of projector is that a room must be used effectively. Its initial and maintenance costs are relatively low, and the life of the projector is long.

H. Field Trips. Agricultural machinery teaching needs of field trips to places where the machines are being used. The purposes of field trip can be enumerated as the following: It provides opportunities for gaining new experiences and information, it provides opportunities for learning by doing-teaching on the job, it relieves the monotony of classroom instruction, it helps to develop understandings, and it develops student interest.

I. Planning a trip. A field trip needs to be carefully planned and suitable arrangements must be made in advance. The instructor should contact the farm, organization, or concern where the trip will be taken and make the necessary arrangements. This may mean personal trip by the instructor in advance to the date of the field trip, or it may be possible to make the arrangements by phone or letter.

J. Preparing the student. Before leaving on a trip, a discussion should be held with the students to consider the purposes of the trip and what will be expected of them: what they will see, what to do, what experiences they should gain, and what

should be the final outcome. This helps to create interest and understanding which should result in desirable outcomes.

K. Transportation. School buses should be available for field trips, they usually provides the most desirable type of transportation. In this way the students are kept together. This saves time and lessens the chance of discipline problems.

L. Evaluating a field trip. The students who participate in a field trip should discuss the trip as soon as possible after the trip should be summarized and appropriate conclusions developed. The students should also participate in evaluating the trip regarding its contribution to their purposes.

5. Equipment and Tools. Most of the schools do not have enough equipment as to meet their teaching needs. Some of the needed equipment and tools are listed below.

2 tractors for driving practices

2 plows (disk and moldboard plows)

2 harrows

1 corn picker

1 combine

1 cotton picker

1 prony brake

1 draw-bar dynamometer

1 set of engine parts mounted on a wood frame different types of used injection diesel pumps, nozzles and combustion chambers

2 cross sectioned batteries

1 display of different types of gears

1 cross sectioned transmission system

1 arc welder

1 oxyacetilene welder

1 heavy duty ½" portable electric drill with stand

5 vises

4 tire gauges

4 spark plug gauges

4 break point gauges

1 battery lifter, strap type

1 guard and sickle anvil

1 wire wheel brush

1 extractor set

1 electric bench grinder wheel size 6" to 8"

2 rpm speed indicators

1 safety hoist, chain differential cap. ½ to 1 ton

1 hydraulic jack, automatic type cap. 2 to 3 tons

1 trouble lamp

4 pans for parts

1 tank, parts washing 25 gal.

1 heavy duty gear puller

4 adjustable open end wrenches 8" and 12"

1 box type wrench set 5/16" to 1" by 16ths

2 box type comb. box and open wrench sets 1/4" to to 3/4 by 16ths

2 e.a. screw drivers 4", 6", 8", and 10"

1 socket wrench set, ½" square drive 3/8" to 1 1/8" by 32nds

4 pliers, long nose 6"

1 compression testing gauge

1 vacuum and fuel pump pressure gauge

NOTES: (1) Due to harvesting equipment is very expensive, arrangements should be done to obtain it as donation or loan from factories or other institutions.

(2) Tools for maintenance workshop and laboratory should be stored conveniently.

6. Buildings and other Facilities. It should be built as soon as possible a laboratory building with the following facilities:

1 engine and system laboratory

1 implement laboratory

areas for future expansion

areas for individual research projects

1 maintenance workshop

1 storage yard

1 auditorium with capacity for 30 students

2 storage depots

2 rest rooms

offices for instructors and majoring students

1 conference room and library

A. Workbenches. All workbenches which are placed along the wall should be approximately 24" wide and 32" high. It is desirable to use a 2" plank top. Benches should be well braced, sturdily constructed, and 6 to 8' ft. long.

If the benches are supported against a wall, the housekeeping under the benches is facilitated. A roll-

away rack that fits the angle under the bench may be used with a bench of this type. This rack may be used, for storing iron, steel beams, and certain tools.

B. Tool Storage. Cabinets which contain specific tools for a given kind of job and which are located in the work area in a shop are considered to be one of the best places to store tools. A tool room will not be needed when cabinets are used. Only those tools which are used occassionally and other teaching aids can be kept in storage room.

C. Tool Cabinets. The size of cabinets will depend upon the tools to be stored in them and the space available on the walls of a shop for hanging them. Shallow cabinets using 1" x 6" pieces for the top, bottom, and sides are satisfactory for storing most of the tools in a shop. They are attractive, require a minimum of space, and the doors do not sag easily. Several cabinets of medium depth and size are more desirable than a few large cabinets.

Portable cabinets are becoming popular. They may be rolled to the areas of the shop where the tools in the cabinets are needed, and they may be placed in a storage room when the tools in the cabinets are not in use. In appendix No 9, a workbench and cabinet wall detail is given.

D. First Aid Cabinet. A first aid cabinet is needed in a

shop. Certain amount of first aid supplies should be kept in reserve in order to insure that they will be available for an emergency when an item in the cabinet may be exhausted.

E. Exhaust Fans. Exhaust fans or other means are needed to eliminate smoke and fumes from the engine laboratory. Often the fans are installed at the time the laboratory is built, but if this is not done, to place them after is an easy job.

F. Electrical Facilities. Both 120 and 240 voltage should be available for lighting and power. This would include both single and three phase wiring. Two or more single phase receptacles should be installed in the welding area. Another receptacle should be near the large service door for welding in the outside work area. Convenience outlines should be installed along or just above the bench tops at 10 or 15'.intervals around the shop. Retractable convenience outlets installed in the ceiling are economical and facilitates changes in machinery locations.

G. Lighting. Some recommendations about lighting are the following:

a. Sufficient light for each type of job on which students may be working either day or night.

b. Absence of direct or reflected glare.

c. Absence of shadows during the day or night.

d. Pleasing appearance and ease of maintenance.

e. Artificial or natural lighting designed and controlled so that it does not dictate or limit the work activities at any time.

H. Acoustics. It is necessary to minimize disturbance in the lecture room caused by running engines or machines in the laboratory rooms. So, it is recommended:

a. Walls between shop and classroom fairly soundproof.

b. Locate storage, conference, or other small room between shop and classroom whenever possible.

c. Sound absorbent materials for walls are advisable.

I. Safety. One of the most important considerations in establishing a workshop is safety. Some recommendations are the following:

a. Arrange tools and work to give minimum obstruction.

b. Gasoline and other fuels should be stored outside the shop and kept in safety containers.

c. Safety areas should be indicated by painted lines.

d. Carbon dioxide fire extinguishers should be available in danger areas.

e. Provide safe storage for all inflammable material.

f. Store rags in metal containers with tight covers.

g. Ground all electrical outlets.

J. Arrangement of Tools and Equipments. Agricultural machinery instruction cannot be conducted successfully without enough equipment. Consequently, large amount of equipments are needed, and they should be properly arranged.

Proper arrangement produces an attractive shop which stimulates student interest and facilitates the development of desirable abilities. Proper arrangement is also essential so that all space may be utilized.

Following, a number of basic criteria for the arrangement of equipment in a shop are given:

a. The overall plan of arrangement should conform the uses to be made of the shop. (In our case, farm machinery maintenance and repair in the laboratory rooms, and maintenance workshop respectively).

b. Consider safety factors in the arrangement of the equipment.

c. Provide for "dirty" work to be done in an area of the shop near to a large doorway.

d. Provide the maximum amount of space for the repair and maintenance of large machines.

e. Have suitable tools for a given job located near the place where the work is to be done. This also means the proper location of tool cabinets.

f. Locate the equipment where adequate light is available.

g. Have the areas for sheet metal work and electrification adjoining since there will be jobs in electrificating which will involve soldering.

Appendices No. 10 and 11 show the distribution of some

equipment in the laboratory rooms.

In Appendics No. 6, 7, and 8 there are shown some drawings from the front, first floor and second floor respectively.

RESEARCH AND EXTENSION WORK

Due to the great importance of agricultural research and extension work, it is believed convenient to try them apart from the foregoing recommendations.

A. Research. This fundamental activity has been carried out in a very limited area, such as surveys to determine operation costs, essays about management and field machinery capacity, and study of mechanization on a specific crop. So, there are basic aspects in the machinery research which have remained untouchable. The results obtained from a good research plan could be of great benefit not only for the surrounding areas but for the entire country.

1. Selection, testing, and adaptation of farm machinery to the Venezuelan conditions.

   Importance: Most of the machines are imported from foreign countries with soils, climatic conditions and crops very different to those of Venezuela. So, research should be done in order to choose the proper machinery for the country.

2. Effect of use of different kinds of farm machines on crop yields.

   Importance: Results from this investigation could

help the extensionist's work. It proportions him with first hand information so that he can convince rural people of the increasing productivity and, consequently, more benefits they can get by using agricultural machines.

3. Effect of different types of tillage and other implement applications on soils.

Importance: From the stand-point of soil conservation, the result of this work could lead to establish the proper method of tillage and other implement application on each type of soil. In doing so, soil fertility and productivity will be kept in good stand.

4. Engine testing. Use of dynamometers.

Importance: This kind of research has great importance in engine selection according to the work to be developed, and in determining the h.p. requirements of each mechanized operation in accordance with physical characteristics of Venezuelan soils.

Undoubtedly, there are other investigations of relative importance, but the ones already mentioned are just enough to begin with. It is recommended to continue with the surveys and essays on costs and use of machines.

B. Extension Work.

1. Demonstration of farm machinery use. There is, practically, anything done on this aspect of the extension

services.

Farm machinery dealers are performing demonstration of farm machinery with commercial purposes. So, a reduced group of farmers receive the benefits of this policy.

It is proposed the establishment of a demostration service in agricultural machinery which can reach to both the commercialized and subsistence sectors.

2. Conferences for farmers. Agronomy schools have been isolated from the rural sector. A good plan of conferences on farm machinery management and maintenance could be the begining of a broader relationship between the school and the farmers.

3. Publication with information on farm machinery. As a part of the extension service, a publication department should be created in order to reach people living in farther areas. Pamphlets or bulletins should be edited regularly and in a very simple language.

Finally, it is oportune to repeat that the goal of this report is to give brief information about what is happening in Venezuela in the agricultural field, and that the recommendations given in it do not pretend to be unique or exclusive ones, just to be considered as a basis of discussion for future decissions.

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APPENDIX NO. 1

UNITS CONVERSION TABLE

Linear

1 meter= 39.37 inches

1 inch= 0.025 meters

1 meter= 3.280 feet

1 foot= 0.304 meters

1 kilomemeter= 0.621 miles

1 mile= 1.609 kilometers

Square

1 square meter= 10.763 square feet

1 square foot= 0.092 square meters

1 hectare= 2.471 acres

1 acre= 0.404 hectares

Weight

1 kilogram= 2.204 pounds

1 pound= 0.453 kilograms

1 metric ton= 1,000 kilograms

Capacity

1 liter= 1.056 quarts

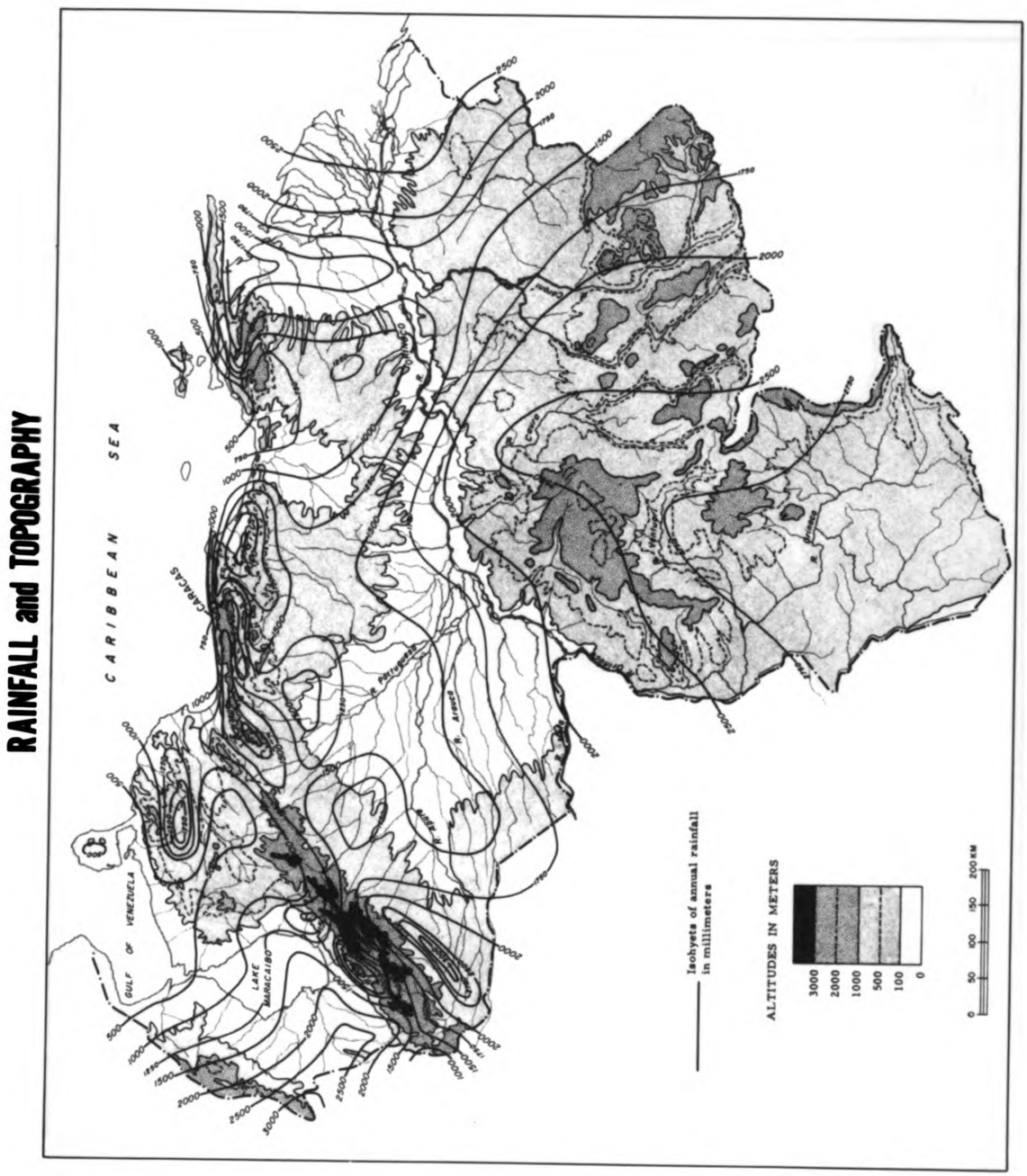
1 quart= 0.946 liters

1 liter= 0.264 gallons

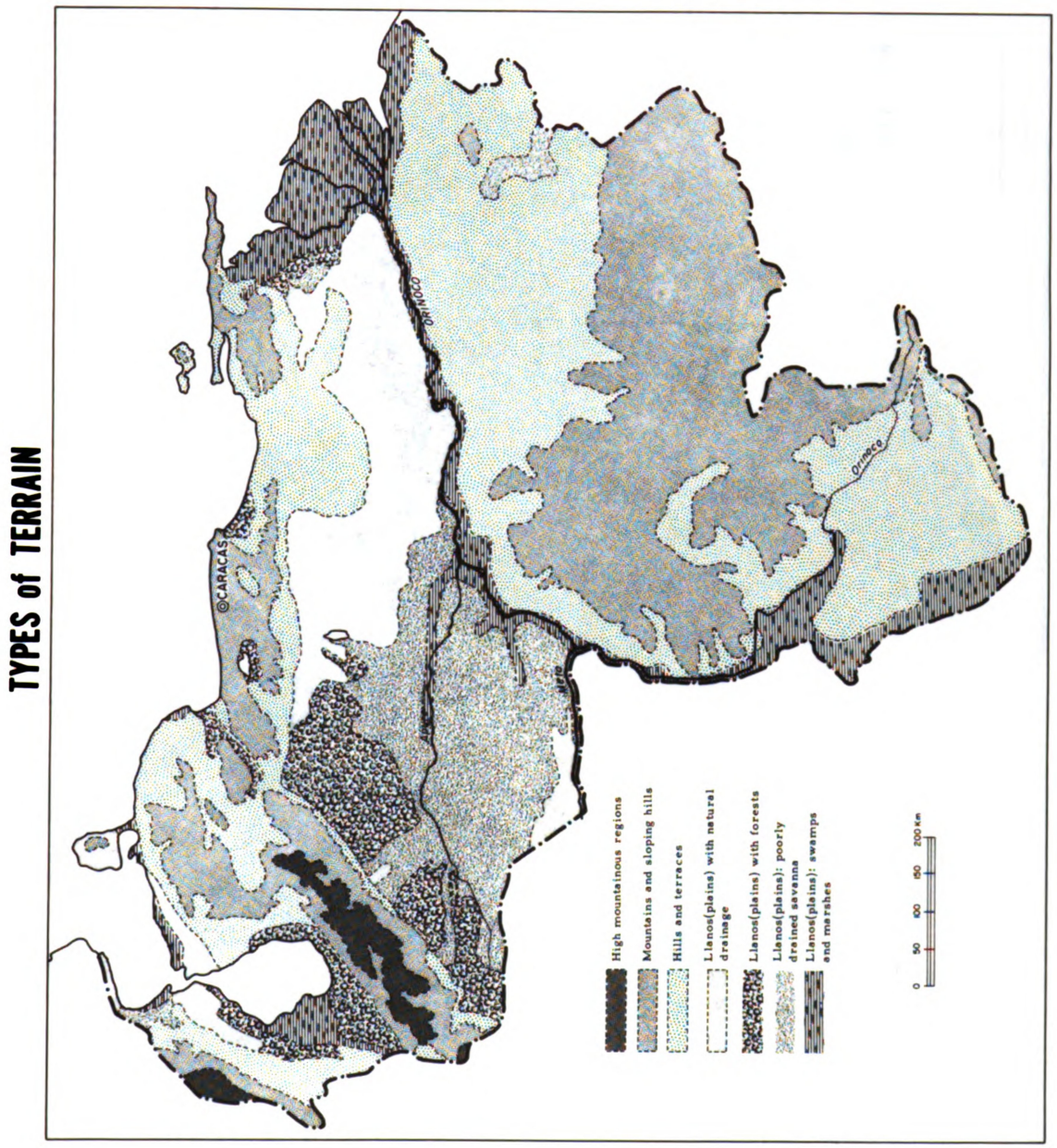
1 gallon= 3.785 liters

Temperature for conversion from °C to°F and viceversa, use the following formulas: °F= °C 9/5 plus 32 °C= (°F-32) 5/9

APPENDIX No 2.

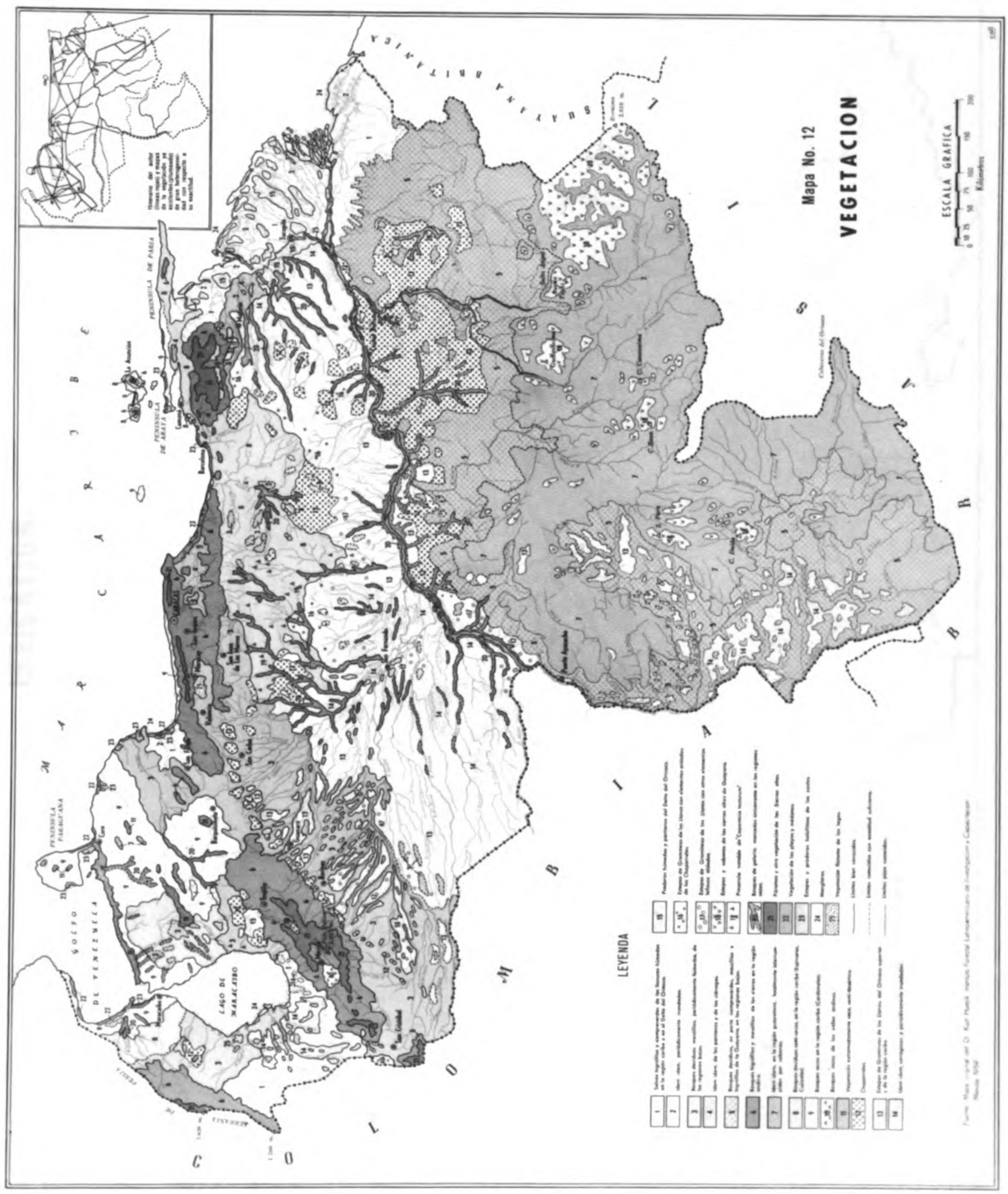


APPENDIX No 3.

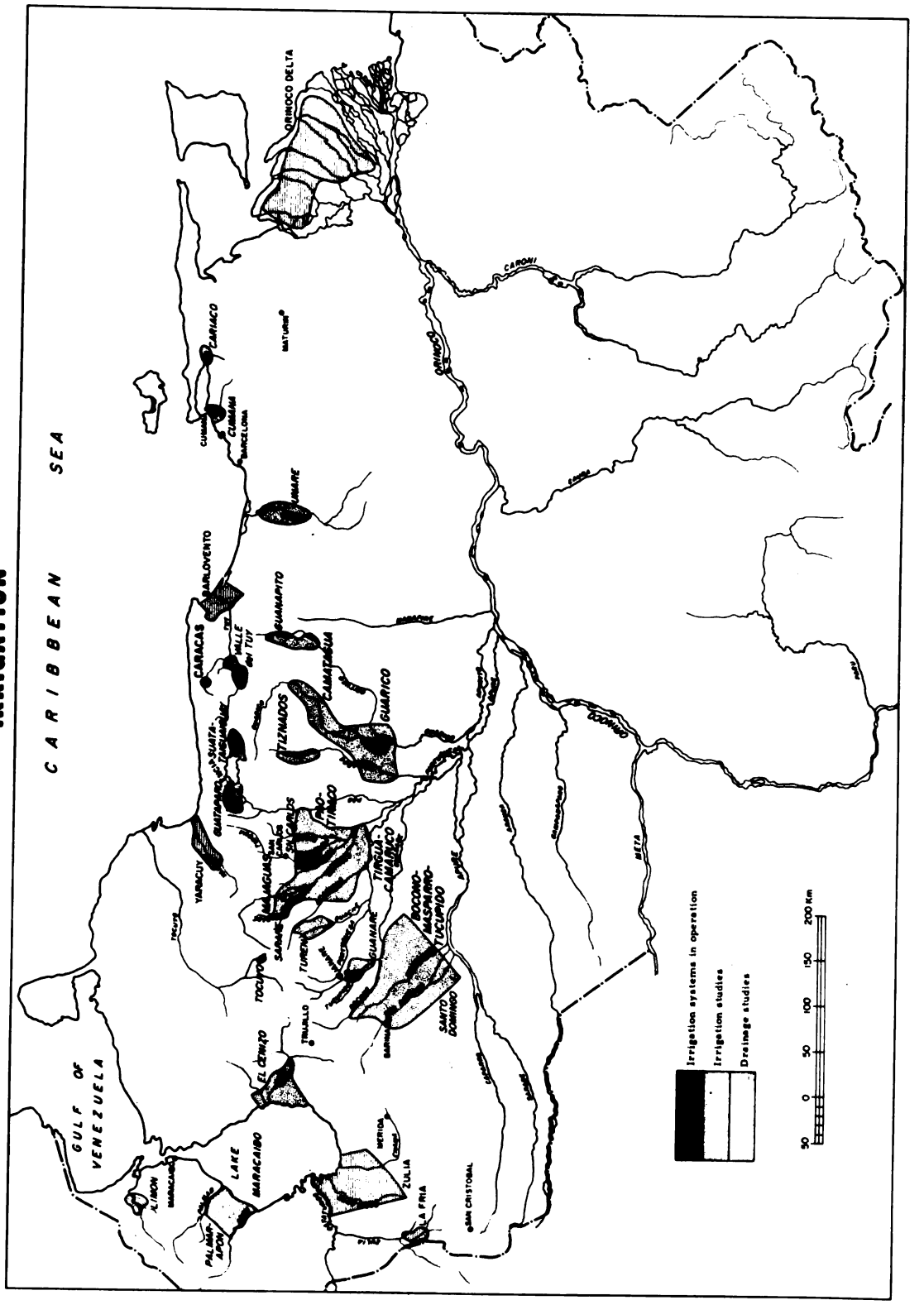


APPENDIX No 4.

FORESTS



APPENDIX No 5.



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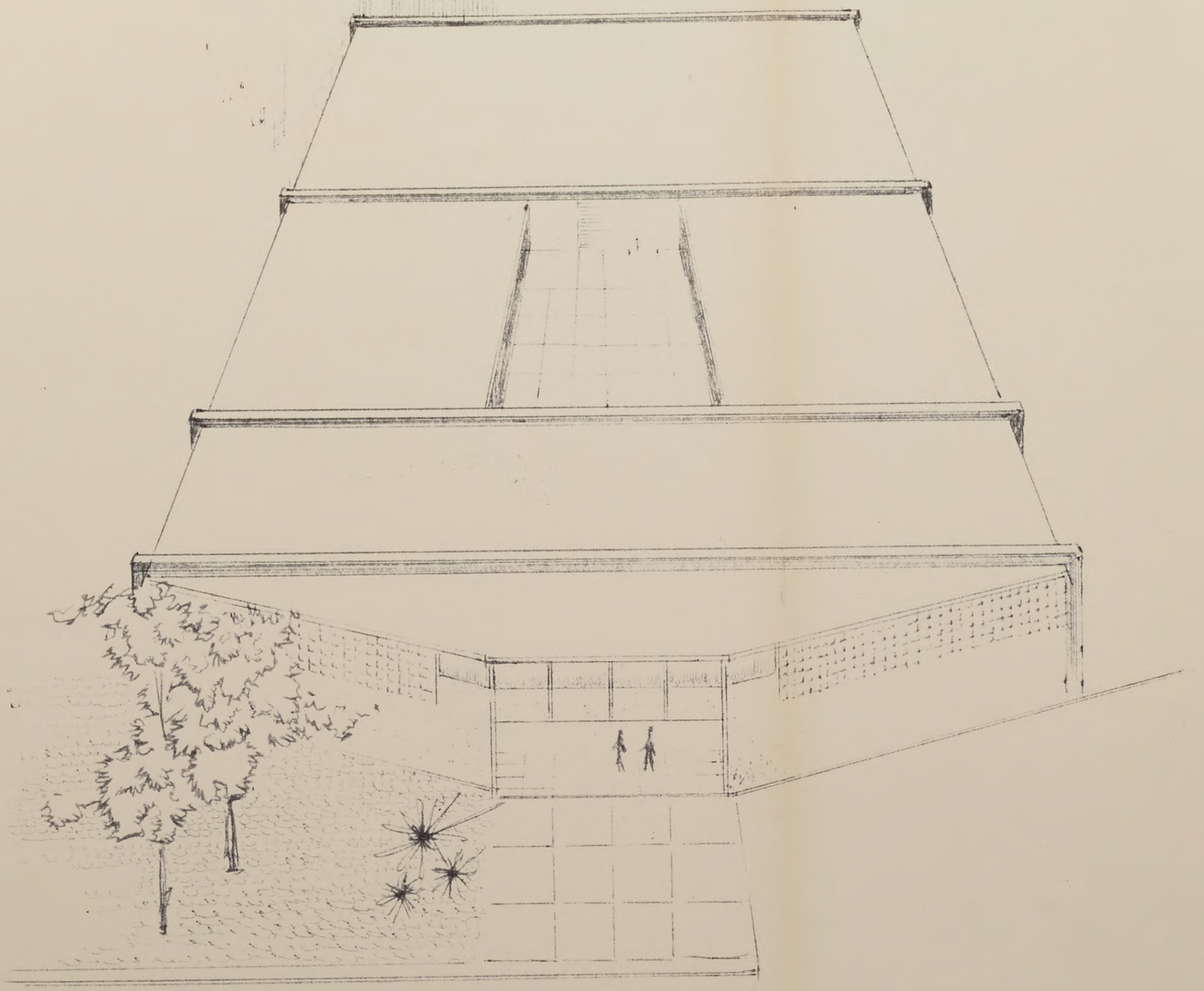
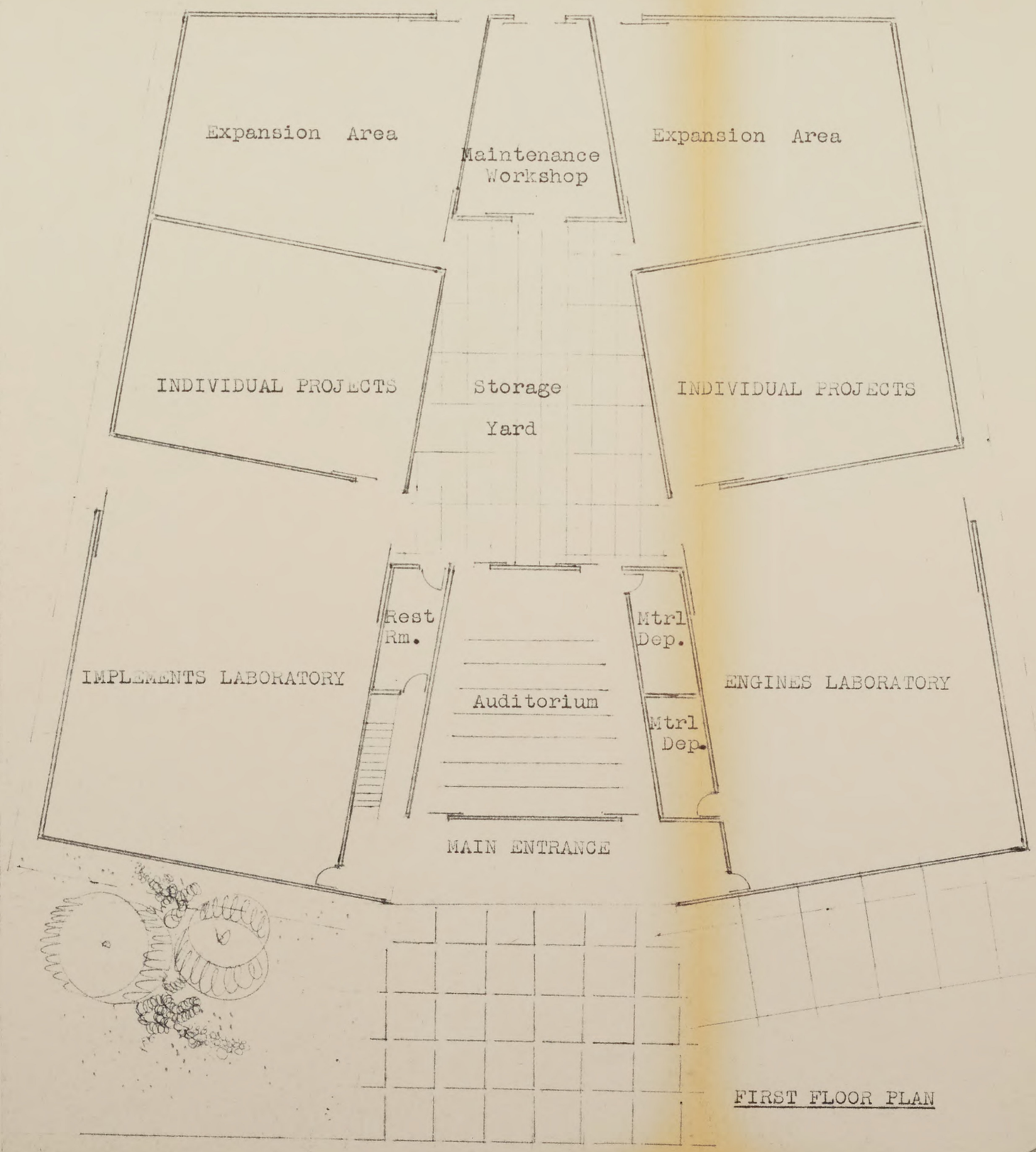


FRONT VIEW

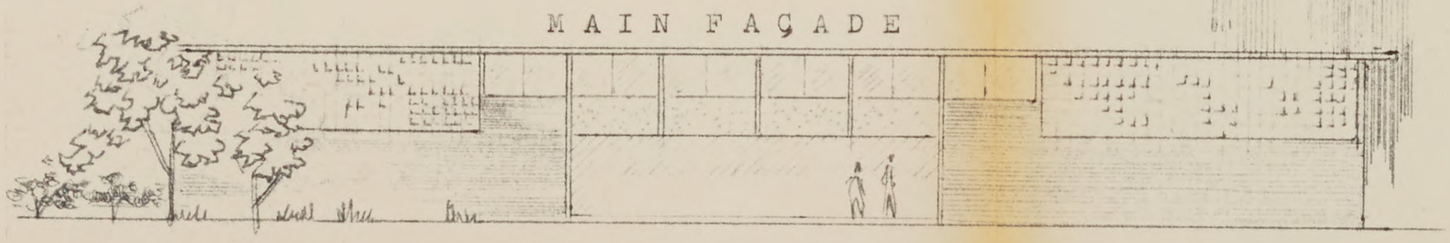
APPENDIX No 7.

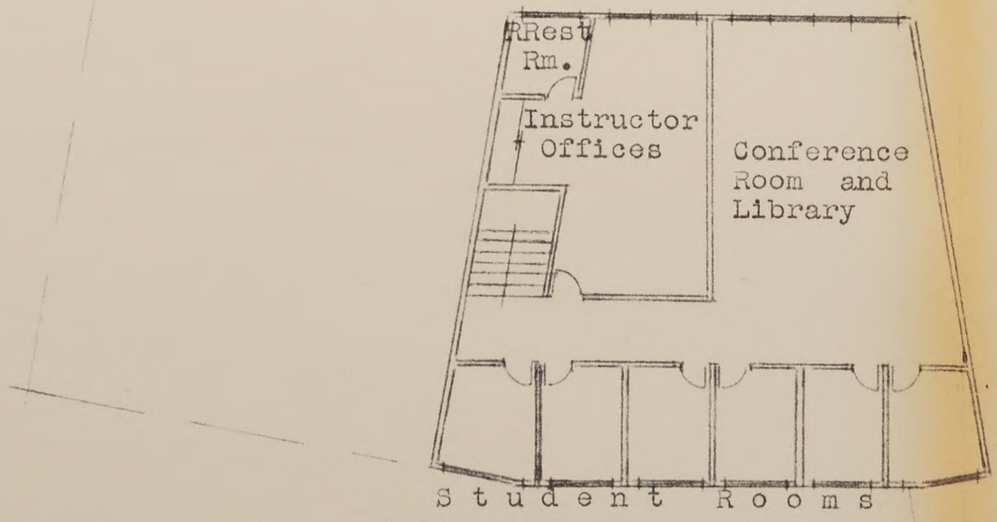


FIRST FLOOR PLAN

APPENDIX No 8.

MAIN FAÇADE

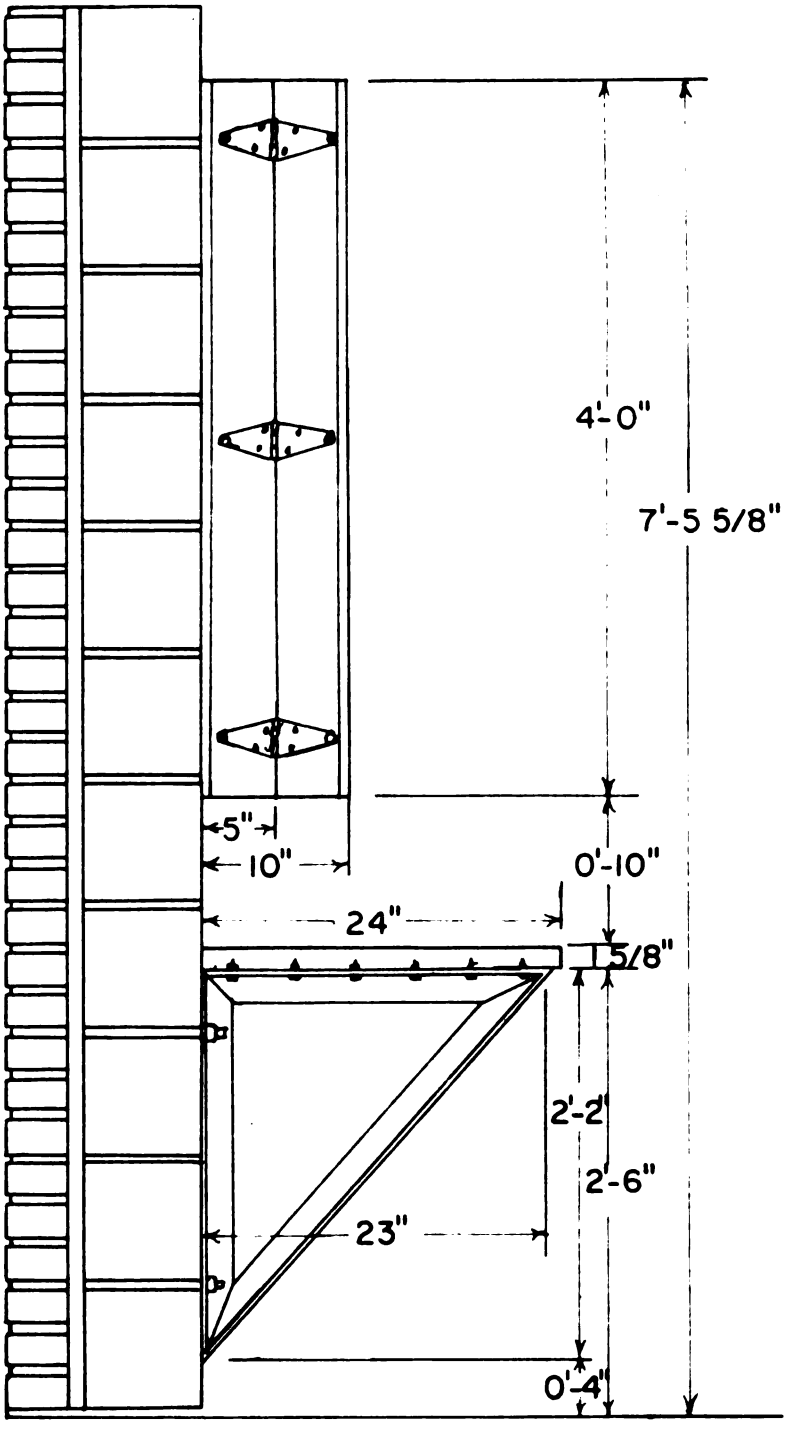


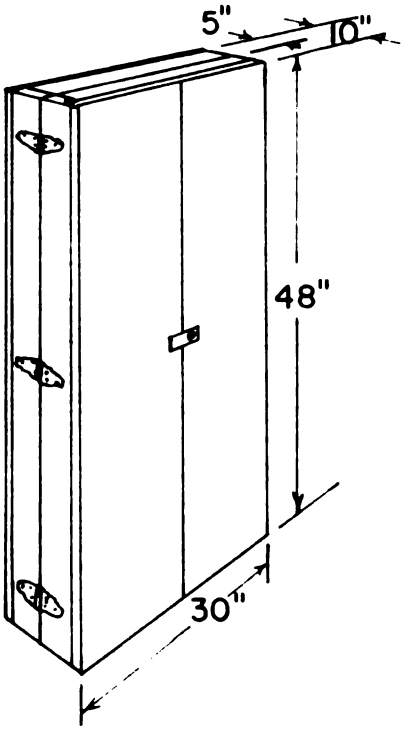


SECOND FLOOR PLAN

APPENDIX No. 9.

WORKBENCH AND CABINET WALL DETAIL

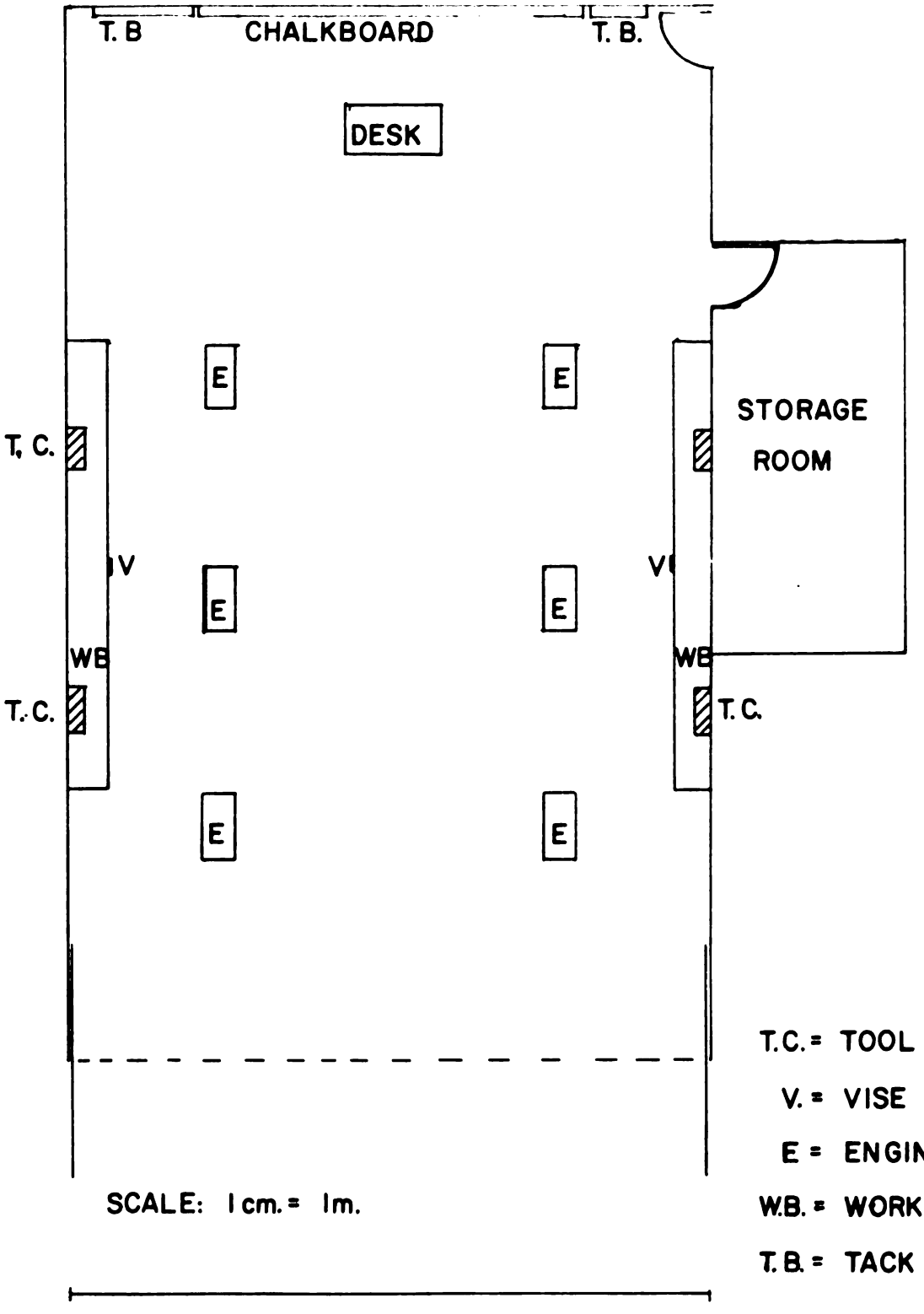




FOLDING TOOL CABINET

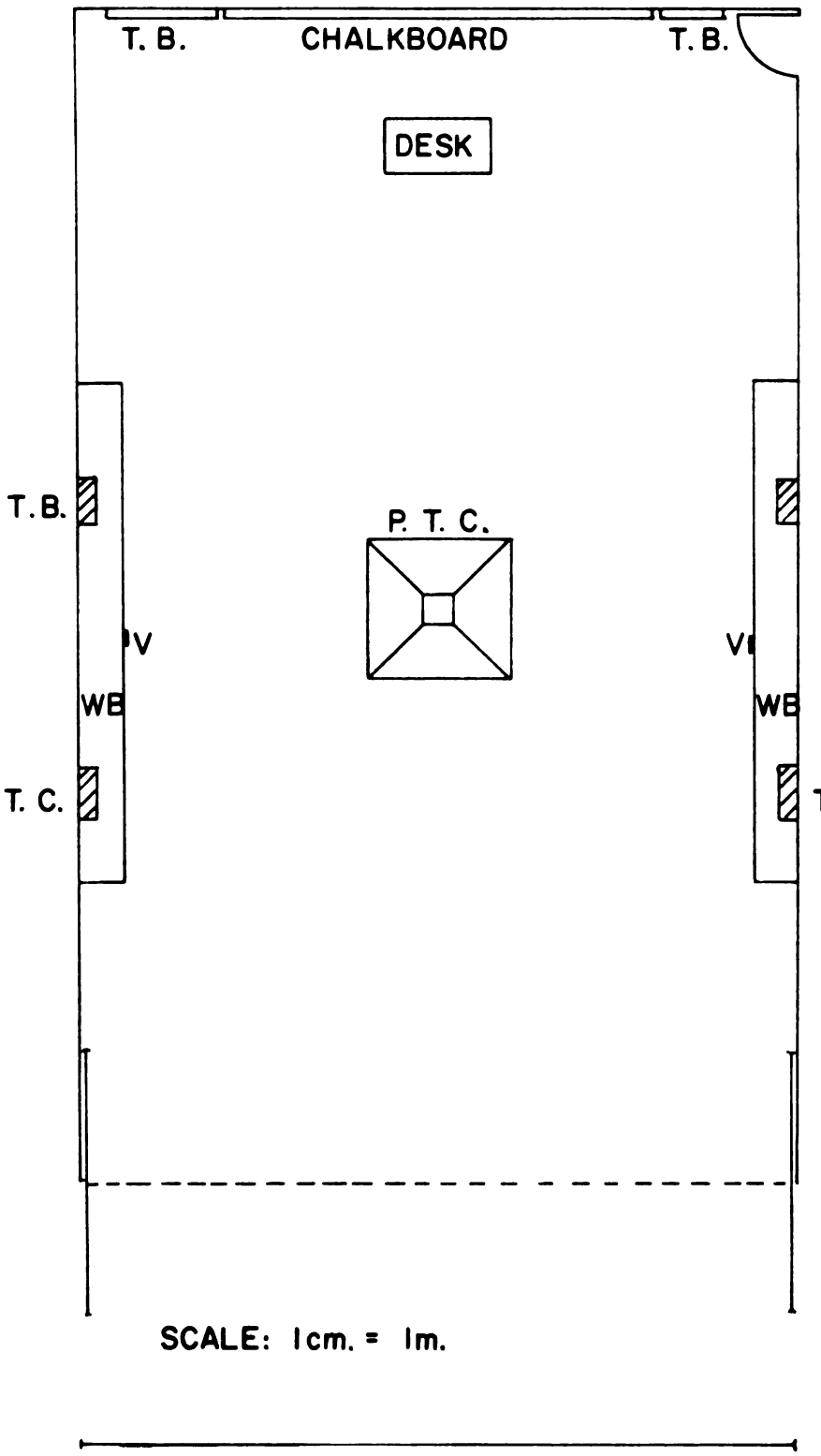
APPENDIX No. 10

ENGINES LABORATORY. EQUIPMENT DISTRIBUTION.



APPENDIX No. 11

IMPLEMENTS LABORATORY. EQUIPMENT DISTRIBUTION.



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