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PROPOSED BAALBECK SLAUGHTERHOUSE

A Model For Rural Lebanon

BY

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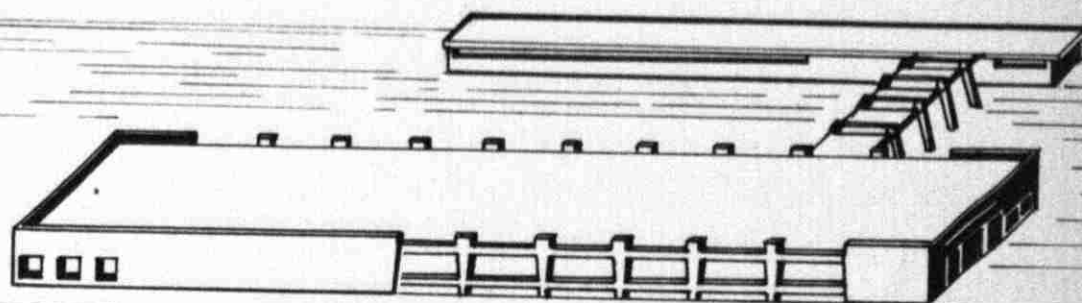
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## SYNOPSIS

This project is a study of the operation, management, and control of slaughterhouses in general, and includes a description of the major processes. It emphasizes local Lebanese practices in relation to faith and meat control.

The main object of this project is the design of a communal slaughterhouse to serve Baalbeck and its neighboring villages, with a population estimated to be about 60,000 and 180,000 in 1970 and 2010, respectively.

A slaughterhouse serving several small communities is recommended as a feasible solution to the need of slaughterhouses in Lebanon.

It is anticipated that the proposed slaughterhouse will derive an income which, if accumulated at interest over a period of forty years, should be enough to cover the construction cost of a new project.

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## INTRODUCTION

### A. Purpose and Scope

The hygienic production of meat is one of the aspects of a public health program that should not be neglected. Meat is a perishable food capable of transmitting disease unless appropriate precautions are taken throughout the production process, marketing and storage.

In Lebanon, as in many other developing countries, modern slaughterhouses and slaughtering facilities are greatly needed particularly in rural areas. Typically, the Lebanese rural population inhabits small closely associated villages, a situation that is ideal for the establishment of a slaughterhouse to serve a number of villages, thus avoiding duplication of facilities, effort and costs.

In the light of the current situation in Lebanon, an attempt has been made in this study to design a modern slaughterhouse to serve Baalbeck and a few neighboring villages. It is hoped that the proposed slaughterhouse will serve as a model to be adapted in other rural areas throughout the country.

### B. Historical Background

Meat hygiene<sup>(1)</sup> began with the earliest civilizations of the Mediterranean area. In ancient Egypt, the food edicts proclaimed the pig unclean and the cow sacred, and banned their flesh as food for man. The butchering of the ox, goose and gazelle which were in demand was governed by elaborate rules many of which were linked to religious taboos and rituals as much as to sanitation. While



The Israelites, in 2000 B.C. adopted these edicts with certain extensions; the Moosaic food laws are still faithfully observed by orthodox Jews, and also - with some modification - by strict Mohammedans.

Several of the classical Greek and Roman writers, like Aristotle and Virgil, noted the similarity of disease processes in man and animals; while in the Middle Ages this was not a worthy thought and was rejected by the Church. Nevertheless, meat inspection was practiced in France in 1162, while in what is now Germany, special inspectors of pigs were appointed in Aachen in 1385. The slaughter and sale of calves under three weeks of age was prohibited in Bavaria; and ante- and post-mortem inspection was established in 1615.

In England early in the 14th century, civic records showed that the mayor and his officers in large cities had, as one of their duties, to inspect meat markets. Toward the end of the 14th century a sanitary act was passed by the parliament of King Richard II to this effect. Regulations dating from the fourteenth and fifteenth centuries forbade the use of tainted meat in the public cookshops. The present law in England and Wales governing the hygienic manufacture, storage and wholesomeness of meat products is based on the Food and Drugs Act of 1938. Slaughterhouses<sup>(2)</sup> are governed by the 1958 Act which came into operation on August 1, 1958. It deals with the licensing of slaughterhouses; it gives effect to the principle aims urged by the Interdepartmental Committee on Slaughterhouses. Regulations about the construction of slaughterhouses, and provision for the safety,

health and welfare of workers in slaughterhouses form the frame work of the opportunities by this Act.

In North America<sup>(1)</sup> despite the fact that at present slaughterhouses operate on a large scale under the scrutiny of government employed inspectors, only rudimentary meat inspection was carried out in few cities of the U.S.A. before 1884, when the Federal Bureau of Animal Industry was formed. A meat inspection department was established within this bureau in 1892, and inspection of meat was made compulsory. By 1949, although Federal Officials were inspecting meat, still one third of all animals slaughtered for food in the U.S.A. was not subjected to inspection. Until now, a good deal of small scale slaughtering and processing occurs in some areas with no kind of meat inspection.

In Canada and France meat hygiene legislation started two centuries ago, exactly 100 years before Napoleon founded the "Public Abattoir System" in Paris.

In Lebanon, meat hygiene legislation was actually initiated in 1932. The existing laws are adequate but enforcement is poor.

It is generally assumed that in earlier civilizations meat was eaten more than in successive generations<sup>(3)</sup>. There are indications showing that the average consumption per person tends to decrease when a larger variety of food is available.

Meat transmits various bacterial and parasitic infections to man and, therefore, the term meat-borne diseases has been given to all damages caused to man by meat. Meyer<sup>(4)</sup> has given the following classification of meat-borne diseases:

1. Diseases of chemical and toxicological origin.
2. Diseases transmitted from animal to man by meat.
3. Diseases transmitted from environmental or human contamination of meat and meat products.

Examples of meat-borne diseases occurring in Lebanon and other countries are numerous.



## Chapter I

### SLAUGHTERHOUSES

#### A. Ante-Mortem Care

Ante-mortem veterinary inspection of animals intended for slaughter should be regarded as an essential procedure in any meat inspection service specially in a good slaughterhouse; it includes: Transportation and ante-mortem care and the ante-mortem inspection.

##### 1. Transportation and Ante-Mortem Care of Slaughter Animals

The ante-mortem care of slaughter animals involves the care during transportation of animals between the farm and the lairage of the slaughterhouse.

Transportation of animals to the slaughterhouses is accomplished in several ways: by sea, road, rail, and "driving on the hoofs" through variable stretches of road - a common practice in Lebanon.

Transportation may induce physical conditions such as transport sickness, muscle bleeding and loss of weight which are always evident in the quality of meat. Normally cattle lose up to 10% of their weight in 24 hours journey; in hot weather this loss is increased by 2 to 3%<sup>(5)</sup>. Investigations carried out by the United States Bureau of Animal Industry show that the weight loss or shrink<sup>age</sup> may be recovered by a good supply of food, water and comfort during transportation and after arrival to the lairage of the slaughterhouse. This kind of care may reduce the above

mentioned values by an amount varying from 50 to 75%<sup>(6)</sup>.

In view of these facts, animal dealers had recognized the importance of rest after transportation, and the preparation of the animal has shown a direct influence on the kind of meat product as well as on the weight of the animal. Therefore, it is always advisable that the animal should rest, with as little upset as possible, in dry and clean accommodations with sufficient space and comfort for a duration that varies from 24 hours to three days. Investigations<sup>(6)</sup> have shown that blood coming out from the animals while slaughtering, is decreased when the animal is tired. The decrease in bleeding leads to the reduction of the amount of blood recovered and also render the meat unsatisfactory for canning and salting. Excessive muscular fatigue means that the reserve of glycogen in some of the muscles have been used up. Glycogen changes to lactic acid after killing and the rate of setting of the meat is greatly influenced by the formation of this acid<sup>(5)</sup>. Bongert and Ficker (quoted by Lebbin<sup>(7)</sup>) have also shown that when cattle, calves and sheep are in a state of fatigue, organisms like *E. coli* are absorbed through the mucous membrane of the intestines into the blood circulation, kidneys, liver and lymph-glands of the intestines. A live animal has sufficient resistance to combat such organisms, but when slaughtered the body's resistance is cancelled and, therefore, the carcass will be harboring organisms which reduce the quality of meat by putrefaction. The fatigued animal's meat appears, when slaughtered, dark and fiery and gives

the impression that bleeding has been incomplete. This change in color is due to changes of a chemical nature which take place in meat of fatigued animals. There is also decreased oxygenation of the blood hemoglobin and muscle myoglobin with a consequent darkening of the muscle pigments. For these reasons no slaughtering should be allowed until the animal has been rested and has entirely recovered from the effect of transportation. This will enable the meat dealer to get better quality of meat and the consumer a safer supply of meat.

Regulations<sup>(2)</sup> concerning transport of livestock are laid down in England by the Transit of Animal Order, 1927. This order specifies the way of transporting animals in wagons. No specific requirements for floor space in the vehicle are put down. American regulations<sup>(8)</sup> specify a minimum floor space during transportation as  $4 \frac{1}{3}$  sq. ft. for pigs,  $2 \frac{3}{4}$  sq. ft. for sheep, and  $3 \frac{1}{2}$  sq. ft. for calves. Cattle placed crosswise require 22 to 26 inches of the car length. German regulations<sup>(8)</sup> specify a minimum floor area of 1 sq. meter for two calves, 1 sq. meter for 3 sheep and 2 sq. meters for 3 pigs, and also require the separation of different kinds of animals. Most regulations specify the necessity of watering and feeding the animals during transportation. The main difference being the minimum period of transportation requiring no feeding which commonly ranges between 24 to 36 hours.

2. Ante-Mortem Veterinary Inspection

The ante-mortem veterinary inspection is the most important aspect of inspection which, if neglected, will render post-mortem inspection inadequate and sometimes impossible. The purposes of such inspection performed on livestock prior to slaughtering are:-

- a. Detecting animals infected with contagious diseases that can be directly transmitted to those engaged in slaughterhouses, such as anthrax.
- b. Detecting diseased animals requiring isolation in order to prevent the hazard involved in consuming their meat.
- c. Simplifying post-mortem examination of the carcass and meat of slaughtered animals.

Several hours of rest should be given to animals to recover from the journey before the ante-mortem inspection is done because in many instances, transport of animals may give rise to symptoms which may be interpreted as signs of diseases.

The importance given to ante-mortem inspection varies from one country to another. In the Netherlands<sup>(6)</sup>, animals are not condemned immediately on the basis of the findings of ante-mortem inspection alone, while in the U.S.A.<sup>(6)</sup>, animals showing ante-mortem inspection symptoms of rabies, tetanus, milk fever and transit fever are directly condemned without resort to post-mortem inspection. Two examples of extreme practices are: one aims at conserving meat, and the other aims at strict safety measures.

Immediate slaughtering is sometimes necessary where the animal is so injured or sick that death is inevitable. Such animals should be slaughtered at the earliest possible moment in order to save the meat for human consumption. In this case, the post-mortem inspection is done to ensure the safety of meat.

Animal diseases such as rabies, tetanus, milk fever, transit fever, black quarter, braxy and sheep pox, if detected during ante-mortem inspection necessitate that the animal be definitely condemned regardless of any other consideration. One exception<sup>(8)</sup> in this relation is that cattle affected with milk or transit fever may be detained for treatment under official supervision.

Animals condemned for such a reason in a manner and a place described in the text are used for the production of by-products. On the other hand, if ante-mortem inspection indicates that the animal is infected with diseases other than those listed above, final decision on the condemnation of meat should be reserved until the findings of the post-mortem examination are obtained.

### 3. Qualifications and Duties of Meat Inspectors

Inspection ought to be carried out only by inspectors who preferably should have had a long experience of general clinical practice before taking up this type of work. Judging suspect animals in ante-mortem inspections is difficult even for scientifically trained men and, it proves a hard test of their knowledge and skill. These inspectors should be qualified, licensed and should have a veterinary degree for this kind of job. Both, ante-

mortem and post-mortem inspections should be performed by the same inspector in order to follow up the diagnosis.

## B. The Lairage

### 1. Purpose and Advantage

The lairage or stockyard is the part of the slaughterhouse that serves as a guest house for the animals to rest prior to their slaughter. Animals should be lairaged or rested before being slaughtered because without a certain period of rest, animals show a reduction in the keeping quality of the meat due to the development of acidity in the muscles. It is evident, therefore, that rest of the slaughter animals after transportation is extremely essential for the production of a better meat. This is why the keeping quality of the meat of animals slaughtered on a farm is often better than that slaughtered in slaughterhouses that have no lairage.

### 2. Description

The lairage is an essential part to be considered in the design of complete slaughterhouses. It should be located in a place away from the slaughterhalls in order to avoid bad odors. The distance between the lairage and slaughteringhalls is unspecified and depends on the availability of land, direction of wind, and location near an accessible road. Lairages<sup>(9)</sup> in the northern hemisphere should always face north for protection of animals from the direct rays of sun.



The Technical Committee<sup>(10)</sup> on slaughterhouses design in England recommends the following five desirable features for a lairage:-

- a. Ease of entry for lairage from road or rail.
- b. Interchangeability of pens.
- c. Ease of exit from the lairage to the slaughterhalls.
- d. Central position for food storage.
- e. Ease of supervision, inspection and maintenance.

The animal space accommodation in a lairage varies with the kind of animals<sup>(9)</sup>. For cows and bulls an area of 24 to 30 square feet is required (2.5 - 3.00 sq. meters). For small animals such as pigs, sheep and goats only 6 to 8 square feet are needed (0.6 to 0.8 sq. meters). For cattle, enough space should be provided in order to permit the animal to stand or lie down in comfort. A chain connected to the neck of the animal and tied to a ring sliding over a vertical pole gives the animal complete comfort. Master cattle or bulls that tend to bully and injure others are either separated or dehorned. Separation adds to the expenses and, therefore, the trend now-a-days is to dehorn cattle. For sheep and goats one meter of width between two consecutive pens is required. The pens are the places within the lairage where individual animals are placed in order to rest. These pens should ensure a healthy condition for the resting animals. The same requirements for goats and sheep may be advised for pigs; at the same time several smaller pens should be provided for the accommodation of one sow or two or three pork pigs.

In general, there is no objection to cattle and sheep lairage being provided in the same building, while pigs, sheep and goats may be housed together without detrimental effect. However, cattle do not appear to rest well in the company of pigs. Also the pens should be made interchangeable, so that the same pens should be used and made adaptable to sheep and pigs, goats and sheep, sheep and cattle, and pigs and goats, depending on the seasonal demand of the consumers. In Moslem countries the pig is regarded as unclean and under no circumstances may the pig or any part of his meat or its manure come into contact with livestock or slaughtered animals. For this reason it is advisable, in Moslem countries, to separate the lairage of pigs from the other lairages as well as the slaughterhalls.

The wall of all pens should be fully panelled in concrete to prevent disturbance to animals already in lairage by those traversing the passages. Separation by wood or steel and iron bars should be completely eliminated. The height of the building or a story should never be less than 5 meters.

Lairages should be well ventilated and well lighted in order to secure the best conditions to the animal received. Enough light and air achieve ideally restful conditions prior to slaughter.

Open air lairages have often been recommended. This type of lairage has its own advantages and disadvantages. Some of these advantages are: easy ventilation, easy lighting, less expensive



in construction and are advised in the cases where the animals are being accustomed to the open air before their arrival to the slaughterhouse, because these animals have accommodations similar to those to which they were used. Some disadvantages are: difficult control of hygienic conditions and the poor climatic conditions in winter and rainy seasons as well as in summer where no provision is taken to shelter the animals from the sun.

In addition to lairage accommodation, holding grounds or pastures should be provided for animals to be kept for any length of time so they may graze under natural conditions and be available to enter the lairage when required for slaughter. The availability of such grazing area should be regarded as important in designing a slaughterhouse when refrigeration is not available for storage of carcasses and where, therefore, the daily slaughter has to be adjusted to the daily market demand.

### 3. Lairage Period

To obtain a better supply of meat, the animal should be lairaged before slaughtering for a period varying from a minimum of twelve hours to a maximum of one week. This period might well be extended to a week if the concerned animal had travelled long distances. All animals subjected to short period of stress recover rapidly but when subjected to stress for a prolonged period may take several days to regain physiological normalities.

By keeping animals in the lairage, they become accustomed to their surroundings by the time they are slaughtered. They will thus overcome much of their nervous excitement which causes poor bleeding and poor meat setting.

The lairage space requirements for three-days' supply of cattle and two-days for sheep, goats and pigs is regarded as ample<sup>(6)</sup>. The modern trend is to reduce the waiting period in a lairage in order not to exceed one day. One suggestion that may help in decreasing this period is to increase the charges after the first day. On the basis of this suggestion, dealers are the ones who will decide on the length of the lairage period.

#### 4. Drinking Water Supply

Animals should receive ample drinking water during the detention period in lairages. Water<sup>(8,9)</sup> serves to lower the bacterial load in the intestines and facilitates removal of hides during the dressing process. Electrical stunning is helped and rendered more efficacious if enough water has been given to the animals.

Cattle<sup>(8,9)</sup> should be provided with gravitational water supply, one cistern being sufficient to supply three troughs; automatic bowls, satisfactory for cows are less suitable for young cattle and calves as they tend to cause fright. Another method is to supply water in a long trough placed in front of the cattle. This kind of troughs is satisfactory especially because it is easily cleaned. Sheep and goat pens must be provided with water troughs placed some 25 cm. from the floor, for if placed too low, they

easily become fouled. Troughs are advised to be fixed whenever possible to simplify maintenance.

The quantity<sup>(11)</sup> of water required for livestock has been estimated as follows:-

Beef and cattle	7 - 12 gpd per head.
Sheep and goats	1 - 4 gpd per head.
Pigs	3 - 5 gpd per head.

It has been assumed that water safe for human consumption may be used safely by livestock which can tolerate higher salinity than man, and it is conceivable also that they differ in their tolerance of specific substances.

##### 5. Animal Feed and Storage

Throughout the world, the practice of fasting animals prior to slaughter has been long observed, and feeding of animals should be stopped about 8 to 12 hours before killing, because the presence of recently eaten food<sup>(8,12)</sup> has some disadvantages, and these are:-

- a. It impedes the efficient bleeding of animals.
- b. It increases the risks of contamination of the slaughter area when there is a large quantity of partially digested food in the alimentary canal.
- c. It helps in the dressing process.
- d. It makes the carcass brighter in appearance.

Scientific evidence for such assertions is lacking and a point of importance is that meat of hungry animals does not set as easily as the meat of animals which are well fed. There is, however, justification for discontinuing the feeding of animals for a period of about 8 to 12 hours prior to slaughter, to minimize the emigration of bacteria from the intestines to the blood stream during digestion.

During the lairage period which usually extends to more than twelve hours, enough food supply should be provided. Animals must be fed twice a day, mornings and afternoons, except for the meal preceeding their slaughtering. Enough food such as hay and barley besides water, rest and comfort will give the animal the chance to regain a part of the weight which has been lost during its journey.

Feed is provided in troughs at the head level of the animal. It is usually provided by slaughterhouses. Charges on the lairage period are considered per head for the duration of the lairage, and they are charged to the animal owners. In case of communal slaughterhouses where the slaughterhouse authority buys the animals, lairage fees are not considered.

The animal feed should be stored in a special storage place kept under sanitary conditions. These storages should be located in a way in a place where there is easy delivery of food stuff from the market to these stores and from these stores to the animal troughs. Also, to reduce the chances of fire hazard, special

notices forbidding smoking should be posted near the stores. Furthermore, fire hydrants and fire extinguishers in the vicinity of these stores are recommended.

6. Maintenance

The lairage should be well maintained and periodical cleaning is necessary.

Hydrant points should be placed conveniently so that all parts of the lairage can be reached by an adequate water supply. Hot water at 170°F (65°C) is recommended<sup>(8)</sup> for washing.

The floor of the lairage, which should be made of water proof non-absorbing material for easy and thorough good washing, should be washed and cleaned at the end of a day's work. The lairage floor should slope away from the slaughterhalls toward a drain which has a trap covered with grating consisting of bars about 3/8 inches apart (1 cm). The slope should not be less than 5/8 inches per foot (5%) for cattle pens, and 1/2 inch per foot (4%) for sheep, goats and pigs pens.

Lairages should be provided with suitable bedding materials for animals. The used bedding requires periodical removal to control fly breeding. It should be conveyed to an elevated covered site or to manure hoppers from where frequent removal may be done by contractors. The lairage area should be cleaned, inspected and disinfected. Rodent control should be practiced whenever it is required.

7. Other Facilities

It is necessary to provide offices near the lairage area for the veterinary inspector undertaking the ante-mortem examination. These offices shall provide space for workers and cleaners. The provision of sanitary facilities as lavatories and wash rooms for staff is essential.

In addition to the lairage a special block, known as isolation block, should be provided to accommodate animals which are suspected of being diseased and require isolation. This building is actually a miniature complete slaughterhouse which provides a minimum lairage area for four cattle and eight smaller animals. Separation of the animals by partitions is necessary to avoid the spread of disease from one animal to another. The isolation block should be situated near the suspected meat detention room, and direct communication between them should exist.

C. Slaughterhalls: Slaughtering and Subsequent Processes

The rested animals earmarked for slaughtering are led from the lairage to the slaughterhalls. These are premises where all the processes of slaughtering take place. Whatever <sup>the</sup> size of such a place is, it should be planned in a way to be functional, simple, durable and erected at reasonable price. Planning should always include future expansion with the least interference with the daily operations and without basic structural alteration to the original plan.

In general two types of buildings exist: a one story or two stories building. Both are common and practical. The governing principle remains the same in both and this is that the livestock enters from one side of the building and the dressed, fresh or chilled carcass leaves from the other. The main criterion which leads to a two stories building is the non-availability of land.

The size of these halls has a direct relationship to the number of animals to be killed and the slaughtering system to be adopted. When the slaughterhall is composed of two stories, the slaughtering areas are located in the second floor. Animals should be provided with an adequate ramp leading from the lairage to these halls, besides a man-way. The slope, of the ramp should not exceed 1 to 6, through which the animal can go without any strain. In certain slaughterhouses trained animals may be used to lead the flocks to the slaughtering areas. In some cases animals are stunned on the ground level, then hoisted after bleeding for subsequent dressing on the top floor. In any case, these areas should be of the open type which is well ventilated and lighted. Hygiene regulations<sup>(8)</sup> prescribe that efficient natural or artificial lighting of twenty foot-candle power be provided, except where inspection takes place when it shall be not less than 50 foot-candles.

The floor of ~~such~~<sup>the</sup> hall should be non-slippery and made of non absorbing materials to ensure safety and cleanliness. Walls should be of the same water-proofing materials, smooth and painted with a light color. Regulations in England<sup>(2)</sup> specify that the impervious,



smooth and hard material should be up to a height of not less than 6 feet from the floor. Lebanese regulations<sup>(13)</sup> specify a height of 1.80 meters (6 ft.) using porcelain or any similar non-absorbing material.

A floor sloping toward a drain away from the lairage area is stipulated in British regulations, the slope being 2 inches for every ten feet (1.66%). Water drinking facilities for personnel and sanitary facilities for quick sterilization are necessary.

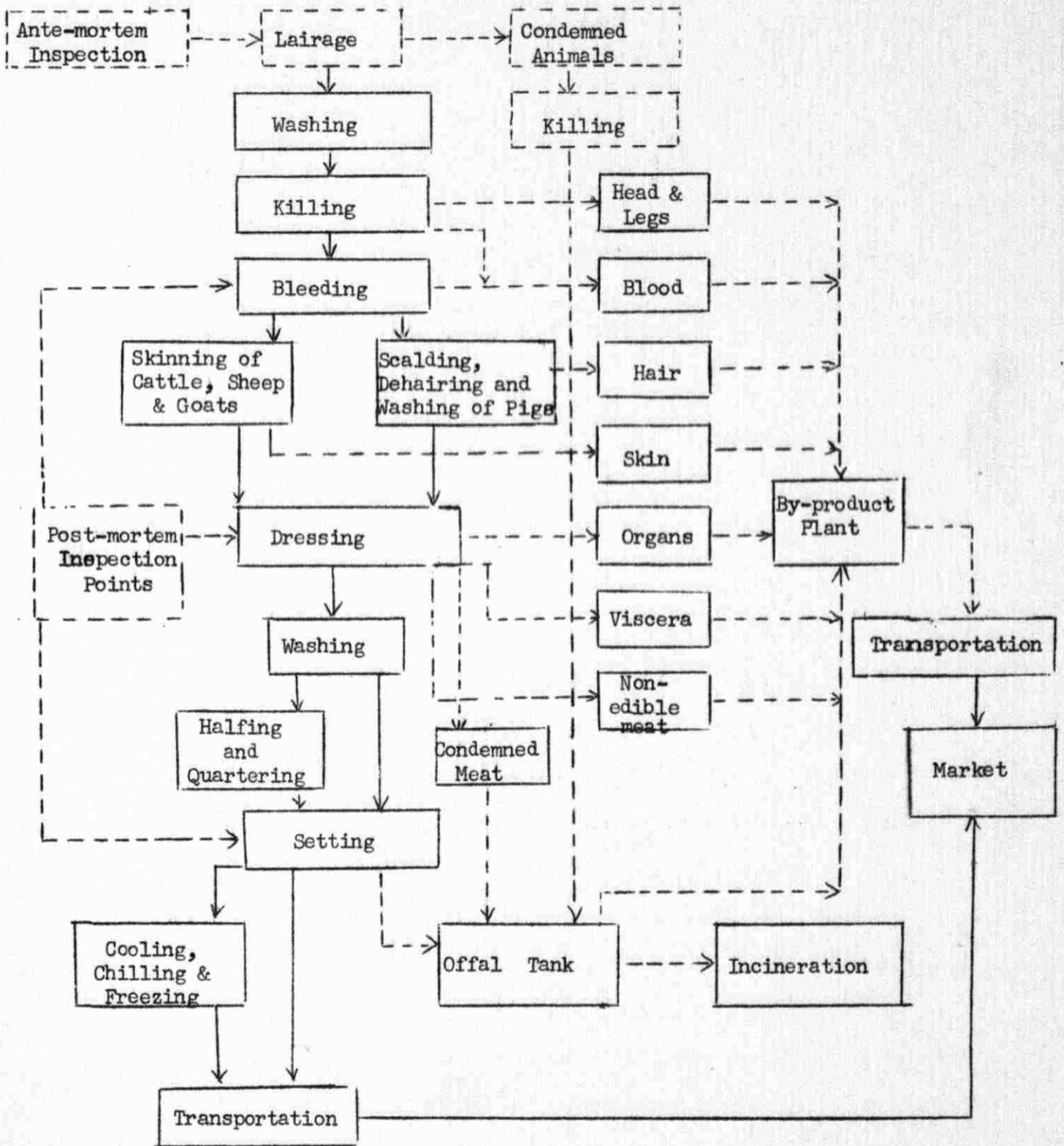
The slaughterhalls should communicate with all other parts of the slaughterhouse directly in the case of a one-story building, or indirectly with the help of chutes in a two storied building. In the other part of the building which includes the slaughterhalls, are the triperies, cold storage rooms (cooling and chilling) and mainly the other subsidiary industries such as blood processing, intestines and others. A separate block of these halls includes the administrative offices which should occupy a central position. This block may conveniently be contiguous to the carcass detention room and laboratory. The need to provide an adequately equipped and staffed laboratory depends primarily on economical considerations and the size of the slaughterhouse. In modern slaughterhouses, regardless of size, minimum requirements necessitate the provision of adequate laboratory facilities and equipment to secure at least the essential routine confirmatory examinations needed by inspectors.



In the slaughterhalls slaughtering and subsequent processes which include, as shown in Flow Diagram I, all processes starting the moment the animal leaves the lairage to the slaughterhalls, to the moment where the meat is ready for storage and consumption. Slaughterhouse and abattoir ( in French) derive from the slaughtering and dressing processes involved. Similarly the Arabic term "maslakh" means the skinning place.

#### 1. Washing of Animals

The animals to be slaughtered leave the lairage from a single door to the slaughterhalls through a path which may be covered or uncovered. This involves washing of the animals as the first step which may be carried out manually by laymen using water hoses. Alternatively, the animals can be made to pass through races where washing is facilitated by a system of fixed water sprayers. The object of washing is to reduce the dirt and eliminate the dust and adhering materials from the skin of the animals to minimize the possibility of contaminating the carcasses in the subsequent steps. Studies<sup>(14)</sup> showed that dirt and dust attached to skins may contribute up to 33% of the contamination of meat with dirt, bacteria and other parasites. Dirt and dust also increase the electrical resistance and hence hampers the process of electrical stunning.



Flow Diagram I  
A Complete Slaughter Process

## 2. Slaughtering

### a. Stunning

Following the washing process, the animals are directly transferred to the stunning pens, where they are rendered insensible prior to slaughtering and bleeding. The stunning of animals is mainly followed by most western and developed countries. The stunning pens and slaughtering areas should be separate in order to avoid the possibility of animals seeing others being slaughtered. Stunning renders slaughtering easier and more speedy because the animal is quieter. In England<sup>(8)</sup> and most European countries<sup>(15)</sup> it is laid down that this process is necessary and should be carried out by mechanical means; other countries<sup>(16)</sup> have adopted electrical methods for stunning both large and small animals. Moslem and Jewish slaughtering requires no stunning prior to slaughter<sup>(8,9,14,15,16,17,18)</sup> of the various methods of producing insensibility, the more common ones are:

- i. The falling hammer consists of a hammer that slides on the shaft and hits the head of the animal. This method is mainly used in packing houses and, since the brain of the animals is not damaged, it results in an efficient bleeding.
- ii. A leather mask covering the animal's eyes and head has been used so that the portion over the brain carrying an iron bolt is struck by a hammer to penetrate the brain with ease. This method is time consuming and, therefore, is

limited to places where small numbers of animals are slaughtered.

- iii. Other devices include a captive bolt which is operated by a blank cartridge or a strong spring, the end of the bolt being similar to that of a pole axe. Other types are devices firing a free bullet. The chief objection to these is that the bullet may be deflected and cause injury to workmen in the slaughterhouse.
- iv. A method known as "pithing" or "neck stubbing" utilizes a sharp pointed knife which is thrust into the nape of the neck so as to cut the spinal cord between the first vertebra and occipital bone.
- v. Electrical stunning is made by applying a low voltage alternating current through the brain of the animal. The device used, connected to a transformer, resembles a pair of tongs. This method, if not used properly, may paralyze the animal while it is fully conscious - an inhumane act. It requires skill and trained people to do it perfectly.
- vi. Stunning by CO<sub>2</sub> is a newer method used mainly for pigs. The animals are brought along a moving platform through a concave tunnel in which they inhale the gas (70% CO<sub>2</sub> and 30% air) and rapidly become unconscious. On emerging from the tunnel the anesthetized animal is shackled by a hind limb, and bled.

With CO<sub>2</sub> and electrical stunning, bleeding of the animal is done while it is in a horizontal position before hoisting to avoid traumatic hemorrhages due to ruptures in the acetabulum of the shackled hind limb<sup>(19)</sup>. All stunning methods, except the CO<sub>2</sub> are used efficiently for pigs, cattle, sheep and goats slaughtering.

b. Ritual Slaughtering

Islamic law lays down two conditions of slaughtering animals for human consumption: the animal should be slaughtered in a way so that the blood flows out completely; and the name of "Allah" , God, should be invoked when slaughtering. The animal as specified in the Holy Koran and in the Traditions and Practices of the Holy Prophet, which constitute the foundations of the Islamic law and have binding force on Moslems. It is stated also in the Holy Koran that blood is in the category of carrion and pork is forbidden as food, as well as any thing related to pigs.

Slaughterhalls when designed in Moslem and Christian areas should be constructed in a way to allow slaughtering of pigs in a separate place for the non-Moslem community. Apart from Moslem religious considerations, it is considered desirable to separate the pig slaughterhall from the main slaughterhouse - mainly due to the difference in the processes involved in each case.

The precise instructions in the "Traditions of the Prophet" indicate that only healthy animals should be slaughtered; animals should be slaughtered with the utmost dispatch; and the carcass should be completely bled to ensure meat of good quality. None of these conditions differ from the modern thoughts on meat hygiene. The following points must be considered:

- i. Animals must be fully alive.
- ii. Quick slaughter.
- iii. Complete bleeding of the carcass.
- iv. Moslem supervision.
- v. Orientation.

Animals must be fully alive at the time of slaughtering, therefore, stunning can not be practiced because the animal would be unconcious before slaughtering. Quick slaughter is required by Moslems and Jews in order to avoid suffering of animals. This is accomplished by laying down the animal on its back or side and the throat is cut by one stroke which severs transversely the trachea, oesophagus and large blood vessels. This procedure leads to the contamination of blood with stomach contents, and such blood should never be used for food. Blood, however, is not used as food by Moslems because it is prohibited. Complete bleeding is required by all faiths, including the Moslem faith. Moslem supervision is only necessary to assure that the name of God is invoked. If any other name is invoked while slaughtering the meat of the animal is not to be eaten. Slaughtering and supervision should

be practiced by Moslems so that all doubt is removed. Finally some Islamic schools specify that the animals be oriented toward Mecca; this is easily fulfilled.

Moslems uphold the idea of kindness to animals with a religious fervor because the Prophet has asked the followers to treat animals kindly and to cause them the least pain if it is unavoidable. Therefore, any method that reduces pain is accepted by Moslems on condition that it does not interfere with the fundamental conditions.

The "Kosher" method of slaughter practiced by Jews is similar to the Moslem method. The animal is cast on its back or side by ropes and the throat is quickly cut with a special sharp knife by a Shochet. Hindus and Christians do not object to eat such kind of meat obtained in this way of slaughtering which is not accepted by Sikhs who practice "Jhatka", a method by which the head is decapitated by a single blow of a heavy butcher's knife. Sikhs do not eat beef so that Jhatka is confined to sheep and goats.

I. Mann<sup>(9)</sup> during his visit to some Moslem countries, describes how Moslem sheiks from Arabia, Africa and the Near East assisted ~~to~~ <sup>in</sup> an experimental ~~in an~~ electric stunning process of a group of animals of different kinds. The sheiks wished to be assured that the effect of current is only temporary and when the throat is not cut the animal would recover. When this was demonstrated, the animals after some little time, recovered, rose to their feet and ate and drank normally.



This satisfied the sheiks who agreed that electrical stunning was in complete accord with the teachings of the Prophet. Electrical stunning causes no injury to animals before slaughtering and this method should be accepted by most progressive Moslem schools and once practiced by one of the leading Moslem countries will be followed in all the others.

c. Emergency Slaughter - Dead Animals

"Emergency slaughter" is the killing of injured or sick animals whose life appears to be in danger. This occurs either on the farm or in the slaughterhouse depending upon the regulations in different countries. For instance, in France it is illegal to slaughter an animal in emergency except at a slaughterhouse, while in Denmark and other European countries emergency slaughter can occur on the farm or any other place. In both cases emergency slaughter should be followed always in all developed countries by a bacteriological examination on the carcass and organs in order to have it passed for food. Lydtin<sup>(8)</sup> indicated that the danger from meat of emergency slaughtered animals when compared with the meat of those slaughtered commercially was 80 times greater in cattle, 12 times in calves, 100 times in sheep, 211 times in pigs and 3 times greater in horses.

Animals killed by accidents, without previous disease, and immediately eviscerated are considered as fit for man's consumption upon bacteriological examination. Moreover, if any animal at the verge of death is slaughtered, bleeding is



very imperfect and the carcass would have to be condemned as such flesh soon decomposes. It is suggested that whenever this meat is to be consumed, meat examination is required.

### 3. Bleeding

As the animal is stunned or slaughtered by any ritual method, it is hoisted by different kinds of hoists operated manually or driven electrically. Animals are then hung and totally raised from the floor to avoid contamination. In modern abattoirs the use of a rail system is provided for the hanging of carcasses.

Bleeding rails system entails the shackling of one or both hind limbs and the raising of the animal, after stunning or slaughtering, to a rail where the animal is kept to bleed.

To avoid deterioration of the meat, the blood should be removed by complete bleeding. Experiments<sup>(8)</sup> conducted on pigs showed the amount of bleeding yielded by the various methods of slaughtering. By comparing the delayed bleeding after shooting, the amount of blood remaining in the carcass by different methods of slaughter is given below:-

- |   |     |
|---|-----|
| a. Shooting and immediate bleeding              | 86% |
| b. Immediate bleeding without previous stunning | 70% |
| c. Immediate bleeding after electrical stunning | 60% |

These values show that the best method to evacuate the maximum amount of blood from the body is the electrical stunning followed by direct bleeding. However, several factors such as fatigue, feeding, environment, fright, age and sex affect the amount of bleeding. Usually, the color of the carcass is a good factor which shows the efficiency of bleeding.

Animals after stunning are hoisted by shackling the hind legs over a bleeding gulley. Cutting of the neck vessels by one transverse cut causes immediately the blood to run out completely; this allows a centralized collection of blood after which the head is cut and removed from the body.

Depending on the animals, size and weight, the amount of discharged blood of a cattle varies from 20 lbs<sup>(16)</sup> to 30 lbs<sup>(8)</sup>. The bleeding time should not be less than 5 minutes<sup>(2)</sup> which is the best time required for the bleeding process<sup>(8)</sup>. Bleeding of cows<sup>(8)</sup> yields more blood than bulls or bullocks of the same weight. Calves are bled rapidly and usually give around 6 lb. of blood<sup>(8,16)</sup>. Sheep and goats are bled in about 5 minutes, and the amount of blood obtained is about 4 to 5 lbs.<sup>(8)</sup> Pigs are bled in about six minutes<sup>(2,8)</sup> and the amount of blood obtained is about 5 to 8 lbs. The amount of blood varies with the age, sex, fatigue, and other factors.

#### 4. Skinning

After bleeding is completed such animals as cattle, sheep and goats are skinned, while pigs follow another series of processes for dehairing which will be discussed later.

Air inflation is an old practice which developed in relation to slaughtering of calves because it was said that it facilitates the removal of the skin, and avoids the deterioration and scoring of the skins. This practice of inflating carcasses should be discouraged.

In countries like Lebanon, where such a practice is traditionally accepted, only mechanical means of inflation with proper sanitary precautions should be used. Formerly air was introduced by mouth through a cut on the fore shanks and on the belly of the calf just posterior to the sternum. Legislation in England<sup>(2,8)</sup> and U.S.A.<sup>(8)</sup> and most European countries forbids this, though in England inflation by means of a pump is permissible. It is doubtful whether inflation does facilitate the removal of the skin or not<sup>(15)</sup>. In any event this method is completely unhygienic; and the objection to this practice is that air which is pumped into the carcass is usually drawn from the floor level, where it is most likely to be contaminated. Besides this unhygienic condition, the inflation of air misrepresents the bodily conditions of the carcass and also makes inspection more difficult.

Removal of head and feet of the carcass usually takes place directly after the animal is inflated; and if inflation is not practiced, skinning starts as soon as bleeding is over.

The skin is stripped by making a long incision from the neck to the anus, and the skin is taken off backwards on either side. It is necessary to avoid touching the carcass with the surface of the skin and cutting and scoring the skin when it is removed. Neglect of the first precaution increases the possibility of contamination of the meat, while neglect of the second decreases the marketing value of skins and hides.

5. Scalding and Dehairing Pigs

Scalding pigs is the next step after bleeding is over. The pig is ~~scalded~~ in a scalding tank at a temperature of about 140 to 144°F (60 to 62°C). At this temperature it requires a period of three to six minutes to loosen the hair and scurf, but there is no danger of setting the hair or cooking the skin. In autumn, when the winter hair is beginning to grow and most pigs are difficult to scald, temperatures as high as 146° to 150°F (63 to 65°C) are sometimes used.

In modern abattoirs, special machines are used for the dehairing process; then the carcass is moved to the gambrel table for a final scraping of dirt, hair and scurf. Where such machines are not available, scraping by hand is needed.

6. Dressing

After removal of the skins and hides in the case of sheep, goats and cattle, and hair in the case of pigs, the carcass is opened, the viscera and other organs are removed. During evisceration, care should be taken not to pierce the gut, the uterus, the urinary bladder, and the udder <sup>all of which</sup> ~~that~~ should be removed without causing contamination of the carcass by their contents. During this process the organs and tripes are directed to different areas for further processing; by-products are directed by chutes or conveyors to the by-product plant. Also, during this process post-mortem examination is done.

Washing of the carcass after evisceration is a practice recently adopted in some modern abattoirs. Its advantage lies in reducing contamination by at least 50%<sup>(14)</sup>. Contamination during evisceration and organ removal amounts to about 3% of the total contamination of meat<sup>(14)</sup>. Water used for this purpose should be clean and potable and be at a temperature of about 100°F. (38°C).

The carcass is transported to the cutting table where it is trimmed to halves and quarters or left as a complete one, ready for storage or consumption.

#### Line Dressing

The development of this method of dressing carcasses has emanated from the practice in the American continent. It consists in turning the carcass along an overhead rail where the process of dressing is divided into various single stages, each undertaken by an operator who performs his task as the carcass reaches him. This method is rapid and enables the slaughterhouse <sup>operations</sup> to run ~~very~~ ~~fast~~ and efficiently. Another advantage of this system is that semi-skilled labour can be used to the best advantage, the output per man is considerably increased, the floor space required is relatively small, and as mechanical equipment is not duplicated unnecessarily it is utilized to its maximum advantage. It is, however, important not to economize unreasonably in the matter of space of the actual slaughterfloor because adequate space is one of the main requirements for efficient inspection.

In small establishments, slaughterhalls for cattle, sheep and goats are interchangeable and this is specially true where cattle and sheep killing are not likely to take place at the same time. For this reason, a design of one hall for different kinds of animal slaughtering is recommended, on condition that local and ritual habits permit.

#### 7. Setting

Setting of the carcass signifies that it has passed into a condition of "rigor mortis" or death stiffening after the animal has been slaughtered and dressed. Setting is due to the coagulation of myosin or muscle clot. To facilitate setting of the carcass, it should be dressed rapidly and cleanly and hung in a dry well ventilated place, away from the slaughtering areas. The well set-carcass is easily cut up and has a better appearance due to the fact that the joints of the carcass retain their proper shape.

The setting time is about 12 hours and varies with the quality of the meat and the state of the carcass. Experience<sup>(5)</sup> has shown that a very rich, or a poor, lean carcass will take more time to set than a good medium one. Also dry weather facilitates setting while a foggy, moist atmosphere greatly retards it. When the carcass fails to set within a reasonable time, its meat is usually condemned<sup>(5)</sup>.

Unset meat when prepared for cooking is tasteless and so tough that it can only be masticated with difficulty. On the other hand, when enough time is given to the carcass to set, its cooked meat

is tender and palatable. This is mainly due to the sarcolactic acid, which is formed during setting in the carcass, to transform the interfibrillary connective tissue into gelatin.

In this connection a world's major meat packer<sup>s</sup> has developed an ingenious new method of using a tenderizer, Pro Ten, which is injected to the animal 10 minutes before slaughtering. It consists of an enzyme that moves through the animal's circulatory system. Later, during the cooking of the meat, the enzyme goes to work, tenderizing by breaking down tissue. This results in increasing tenderness without affecting the appearance, wholesomeness, flavor or keeping quality<sup>(20)</sup>.

#### 8. Cooling, Chilling and Freezing of Meat

Besides the advantage of good setting of meat in a good dry place, it is advisable that the carcass, intended for chilling should be hung for some hours, either in the open air of a cooling room, or in a cooling chamber before it is moved to the chilling room. The economical purpose of this is to permit the rapid dissipation of body heat and thus prevent deep-seated changes of a putrefactive nature. The cooling area facilitates quick loading into the chilling rooms. Cooling and chilling have another advantage on decreasing the capacity of the lairage area by regulating the problem of supply and demand of meat. With adequate accommodation for holding the kill this can be spread if necessary to five or six days per week, instead of being concentrated in two or three<sup>(8)</sup>.



Chilling space should be provided to accommodate at least two days' kill, and several small rooms are much better than one large room which has a high operational cost. The object of chilling is to hold the meat in good condition without destroying the "bloom", and for this purpose temperatures range between 30°F to 40°F (- 1°C to 5.5°C) have proved most satisfactory. Chilling is best accomplished between 34°F to 38°F<sup>(3)</sup> (1°C to 3.3°C) for cattle, 33°F to 35°F (0.5°C to 1.7°C) for pigs goats and sheep, at a relative humidity of 80 to 85%<sup>(15)</sup>, and an air circulation of 10 to 15 times the volume of the room per hour<sup>(21)</sup>. Temperatures near the freezing point check bacterial growth and prevent microorganisms from penetrating more deeply into the tissues. Satisfactory chilling may be obtained within 24-hours from the time of slaughter. On the other hand, chilling can not continue indefinitely without the production of substances that render the meat unfit for human consumption. Generally, this period depends to a considerable extent on the fat present in the meat. This may be attacked by fat splitting enzymes which cause the separation of fatty acids and glycerol which render it too tender up to the point where decomposition and putrefaction will result. This suggests that the chilling of the meat should be stopped in a few weeks. Commercial experiments<sup>(8)</sup> showed that the storage life of chilled beef is about 35 days and meat consumption of such a kind is necessary during this period.

Freezing is considered for longer period and freezing temperatures are lower than chilling temperatures. Freezing renders safe for human consumption carcasses infected by certain parasites. Pork affected with *cysticercus cellulosae* can be rendered safe if held for four days at 14°F to 18°F (-10°C to -7.7°C), while beef carcasses affected with *cysticercus bovis* can be rendered safe by holding for three weeks at a temperature not exceeding 20°F (-5.5°C) or for two weeks at a temperature not higher than 14°F (-10°C). *Trichinella* cysts in pork are destroyed by holding the carcass for 20 days at 5°F (-15°C) or by quick freezing for one day at 0°F (-17°C). Freezing also permits the detention of carcasses under suspicion pending further examination by laboratory methods. It is generally accepted that frozen beef has the longest storage period and frozen pork the shortest. Under suitable conditions beef will store for a year, veal slightly less, lamb and mutton seven to nine months, and pork about six months. Freezing temperatures are recommended commercially as 0°F to 10°F (-17°C to -12°C), and scientifically as 0°F to 5°F (-17°C to -15°C) for all the kinds of meat except for pork which requires a temperature range of -10°F to 10°F (-23.3°C to -12°C). Pork should preferably be frozen at -10°F for a period of six months.

Frozen meat produced and consumed locally is always cheaper than fresh or chilled meat. However, frozen meat is imported - as is the case in Lebanon - <sup>and so</sup> it is more expensive than the fresh local meat. Frozen Foods of Lebanon, S.A.L., is a corporation established

in 1964 in Beirut and is intended to place on the local and export market a whole line of frozen vegetables, meats and prepared Lebanese foods.

In an average or small size slaughterhouse chilling rather than freezing is recommended. The only purpose of freezing in such slaughterhouses is to destroy the parasites and to store suspected meat until laboratory results are obtained.

#### 9. Meat Transport

Carcasses and meat, fresh or frozen, require transportation from the slaughterhouse to the market. Short distance transport as in the case of conveyance of meat from the slaughterhouse to the retail butcher's shop should be distinguished from long distance transport of meat by road, rail, sea and more recently, by air.

Transportation provides many opportunities for gross contamination of product and this is specially true of countries where individual butchers take charge of their meat at the slaughterhouse and transport it to their own shops. For delivery purposes, the use of special vehicles should be available, and these should be hygienically constructed with waterproof and easily cleaned interiors with provisions for the hanging carcasses. In England<sup>(2)</sup> vehicles intended for meat transportation are required to be kept clean on the inside, and the receptacles in which the meat is placed should be as clean as possible. With uncovered vehicles care should be taken to cover the meat with clean and sterilized cloth

or other suitable material. It is also required that all workers handling meat and carcasses wear, at all times, washable and clean special overalls and head coverings of a light color. The practice of wearing blue or brown overalls is to be deprecated as it is not possible to know when these become dirty. Workers should not permit any part of the meat to come into contact with the floor or dirty surfaces, and should take all precautions which are necessary to prevent the exposure of the meat to contamination. Transportation of livestock in the same vehicle is an undesirable practice that should be prohibited. If carcasses are to be transported in the same vehicle as other goods the meat products should be wrapped in material which will prevent contamination. Experiments showed<sup>(14)</sup> that the main source of contamination of meat occurs during transportation and accounts for half the total contamination from various sources.

D. Post-Mortem Inspection

Post-mortem inspection follows the evisceration of the carcass and should be performed directly, after slaughtering, on the carcass and organs. This is because carcasses of beef and pork set rapidly and if inspection is delayed particularly in cold and dry weather, examination of the carcass-lymph nodes is rendered more difficult. This inspection is governed by several conditions:-

- a. The adequacy of personnel.
- b. The facilities available for such examinations.
- c. Whether recourse can be made to laboratory assistance of a bacteriological and biochemical nature.

Though the procedure for any post-mortem examination may require adaptation to local conditions in a given country, there are certain basic guiding principles which must be observed regardless of conditions.

Post-mortem inspection must be done in places where enough natural light is provided. Inspection of carcasses in artificial light is sometimes unsatisfactory especially in judging those carcasses which are badly bled or fevered.

This veterinary inspection must be undertaken by the same inspector who carries out ante-mortem inspection<sup>(5)</sup>. The method of conducting the inspection is an important factor. Most regulations specify the necessity of a methodic pattern following a definite sequence. The Ministry of Food in England has issued a memorandum<sup>(22)</sup> on the general inspection of cattle, pigs, horses, sheep and goats. It states: "Organs and viscera should be examined as they are removed from the carcass or as soon as possible thereafter." It states further: "Every carcass should be examined for:

- a. State of nutrition;
- b. Evidence of bruising, hemorrhage or discoloration;
- c. Local or general oedema;
- d. Efficiency of bleeding when slaughtering;
- e. Swelling, deformities or other abnormalities of bones, joints or musculature;
- f. Age;
- g. Sex; and
- h. Abnormal odor."

This kind of inspection may not be possible in some of the countries due to lack of personnel and facilities. Not all examinations for different diseases should be practiced but only for those present in the country. For imported animals, examination for the diseases present in the exporting country should be given particular attention.

The detailed post-mortem examination of meat and organs follows the general examination of the carcass. This includes the examination of head, thoracic cavity, abdominal cavity, udder, testicles, penis and feet. These inspections vary with the kind of animals, sex and age.

When local infection is present, the affected organ only is condemned. Probably the most important bacterial diseases affecting cattle and pigs, but rarely sheep and goats, is bovine tuberculosis. The usual practice is to condemn the affected organs or portions of the carcass in localized cases.

Condemned animals are slaughtered in special premises and condemned parts and organs are transported carefully to these premises, there they are sterilized for the preparation of by-products or burned in small slaughterhouses.

Inspectors should be present during slaughtering, from killing and bleeding to trimming and stamping the meat. The amount of bleeding should be noticed to determine its efficiency in order to satisfy the taste of the consumer.

During the cutting of diseased parts care should be given not to soil the other parts of the carcass, the floor and the inspector's hands.

When making incisions care should be given so that not more than the required object is cut. Carcasses should not be mutilated while taking samples because, if this fact is neglected, the value of the marketable meat is lowered.

At the completion of each inspection, the inspector seals or marks the meat. This has the following advantages: it indicates that the carcass has been inspected and is, therefore, a guarantee to the consumer; it will prevent the substitution of sound organs for diseased ones; it forms a ready means of identification of meat about which questions may subsequently arise, and it has a further value in that it is likely to discourage a butcher from accepting the meat of animals slaughtered illegally.

The marking of meat may be done in three ways by the use of a stamp, branding or tags and label. The best and easiest method among these is the stamping method by the use of a metal stamp which is durable and readily visible. Though this method is employed for making of carcasses, lungs, etc, it is unsuitable for the marking of livers, because of their dark color. The liver is best marked by branding with a hot iron. The seal should bear the date on which the post-mortem examination was made and, if considered necessary, the initials or number of the inspector.

The inspectors should release the carcass and organs unconditionally as fit for human consumption, or they may find the carcass and organs unfit and have them destroyed. Several European countries<sup>(23)</sup> have adopted additional categories which recognize that the meat may be of



a quality inferior to that which is normally accepted as sound meat or partially and slightly affected without being justified for condemnation. These procedures are justifiable both on economic and scientific grounds and a great service could be rendered by encouraging their wide adoption throughout the world.

E. The By-Product Plant

The last part of the modern slaughterhouse is the by-product plant. This is the place where blood, skins, hides, hair, condemned meat and organs, fat, grease and others are treated and processed to obtain different products. The need for efficient treatment of these by-products is based on:-

- a. The necessity for their hygienic disposal thus avoiding any sanitary problem in the area; and
- b. The security of an economical return on materials which would otherwise be wasted. This economical return has the advantage of being one of the sources of income to the slaughterhouse as well as the whole country.

An old way of getting rid of offals and by-products was to spread them out in the fields surrounding the slaughterhouse, especially the condemned meat which causes infections and parasitic diseases to some animals like dogs, cats and others, as well as to human beings. Besides, this practice results in odors and fly-breeding. To avoid such problems, condemned animals are directly slaughtered in special premises and condemned meat and organs are sent to the by-product plant for sterilization and further processing or reduced to an other-

wise inoffensive non-infective state. Incineration is the best method to ensure the safety requirements but the worst from an economical view point, as it requires fuel for burning and does not result in useful materials. This method is used in small slaughterhouses in which a by-product plant does not exist. On the other hand, blood, skin, hair and others are mainly processed for their economical value.

New and large slaughterhouses are designed in such a way to provide sufficient space and facilities for the treatment of by-products. For small ones preliminary treatment which constitutes the washing and preparation of the products to other industries will be required to guarantee the safety of the public.

In general, most of the by-products should be processed in order to secure different substances for use in many fields. Although meat production is a main reason for slaughtering the animal, by-products remain an important factor in industry. Processing of by-products is not only a source of income that boosts the economy of a country but entails a more efficient and a more hygienic slaughterhouse operation and maintenance. Added to these advantages, an important reason for the utilization of by-products is to render the problem of waste disposal easier, cheaper, and economical.

It is sometimes said that the only thing lost from the animal in modern slaughtering industry is the last cry. What was said at first as a joke has become more and more as a truth.

#### 1. The Building and its Operation

The building of a by-product plant should be situated so that raw materials can reach it with the least amount of handling to avoid any extra contamination.

The space of such building should be enough to accommodate and efficiently conduct the required processes. Enough light and ventilation is required. The building requires a strict division into two departments: the department where materials are brought in and the department where materials are sterilized, treated and stored. The former department should consist of an unloading platform, a room for skinning and cutting up dead animals and condemned meat, a room for salting and storing hides, a room for crushing and sterilization of bones, etc., cloakrooms, washrooms and sanitary facilities for workers working in this department. There must be no admittance to this department except for the drivers, workers of the department and in special cases, engineers and the head of the plant. Special care should be taken to prevent any kind of animal such as dogs, cats and birds to enter this department. Special disinfecting substances should be used constantly. Floors and walls should be perfectly smooth and hard and made of water proofing materials to ensure the cleanliness of the plant. Daily washing and cleaning of premises and equipment is needed. The floor should be sloped to open channels leading through fat traps to the drains. Steam, hot water and cold water should be provided. Also, a room for sterilization, a room for machinery and equipment and different rooms for the storage of the final by-products must be provided.

## 2. The By-Products

To give an idea about the by-products, the following discussion points out some of the uses and advantages of some important by-products.

### a. The Blood

The blood is the first by-product which is obtained as a direct result from the slaughtering process in slaughterhouses. In old and small slaughterhouses, as is the case in most of the Lebanese slaughterhouses, the blood is disposed and wasted. Occasional slaughter or a small number of slaughtered animals, does not lend itself to the economical treatment of blood, as the quantities are small, and it is only in plants where the daily kill is large that full use can be made of blood by the installation of a plant by which the liquid can be dried. In such a plant, animal bleeding should occur over troughs which lead to one common reservoir. From there it is pumped into a boiler where it is cooked with steam while agitated for the purpose of further processing<sup>(8)</sup>.

The use of blood may be for the preparation of:

- i. Food for human consumption<sup>(5,8,19,24,25)</sup>;
- ii. Animal feeds<sup>(5,8,19,24,25)</sup>;
- iii. Fertilizers<sup>(5,19,24,25)</sup>;
- iv. Pharmaceutical products<sup>(24,25)</sup>; and,
- v. Commercial and technical products<sup>(24,25)</sup>.

It is desirable that animals should be bled in a central position to provide sanitary conditions and easy blood collection. This will enable faster processing which is of primary importance because the blood decomposes rapidly with an appreciable loss in nitrogen content.

The use of blood for food products has long been used for the production of blood sausages or for blood puddings. But, as slaughtering of animals started to increase in official slaughterhouses it was found impossible to use the large quantities of blood for this purpose, and instead, it was made into animal feeds after coagulation of the blood, drying and grinding. Five tons of raw blood yield one ton of the dried product which find a ready sale in the fertilizer market.

When the fibrin is separated from the blood it is usually prepared as dry fibrin powder which is used in the pharmaceutical industry as a rather pure lecithin. After separation, the fibrin is washed with water, drained, dried under vacuum and then ground.

Commercially, the blood of animals is used for the preparation of albumen. Dark albumen is used as glue in wood industry; light albumen is used in the dyeing of textile, paper and leather industries. Blood albumen has also a value as a clarifying agent for wines, in the preparation of sugars and photographic papers, and a fixative for colors in cotton goods. The three main constituents of blood are:

Albumen	5%
Fibrin & corpuscles	13%
Water	82%

b. Hair & Bristles

The hair is mainly a by-product resulting from pigs during the dehairing process. Also cattle provide little hair which are taken care of in the tanneries.

Hair, when dried, has excellent insulating properties and is used as felt for placing beneath carpets and in the manufacture of hats.

The pig bristles which are long are used for brush making after being sterilized, while short hair of pigs after purification with hydrochloric acid which sterilizes them, are used for stuffing mattresses in furniture making.

c. Hoofs, Horns and Bones

Hoofs are removed after steeping the feet in hot water, being then dried and sold for the manufacture of combs and buttons. Horns are sawed and sold for the same purpose as the hoofs.

Bones require special treatment for drying. They are crushed and sold to manufacture fertilizers or feed animals.

Hoofs, horns and bones are defatted by the extraction of fat to produce gelatin which contains most collagen tissues, whereas the defatted parts are easily ground for the production of bone meal, the main constituent of which is calcium phosphate.



Also, if further treatment is followed, a fertilizer may be obtained. Usually, such industries are located away from slaughterhouses where such by-products are transported to these industries in the raw form. Transportation of such materials is recommended in special closed water proof containers, in order to keep away the flies as well as to prevent the escape of any odor.

d. Organs and Legs

Organs and legs, when discarded, produce with the condemned meat, the animal feeds after sterilization and treatment. This kind of industry is recommended near large slaughterhouses because such a by-product with the blood secure the best quality of feed for cattle, sheep and goats.

Legs, if processed and treated, produce a technical grease<sup>(24)</sup>, which may be used in tanneries for fine leather and in watch making. During the Second World War, the Germans used this kind of grease for the lubrication of submarine torpidos.

e. Stomach and Intestines

These organs used in Lebanon and other Arab countries as food for human consumption and form with the feet one of the most delicious local dishes.

Renet may be produced from the stomachs of some young animals and is used for curdling milk in the cheese industry. Pig stomach produces pepsin an enzyme which is used medically in the treatment of human gastric disorders.

Intestines are processed for many purposes. Some are processed for the preparation of hot dogs and sausages. Others are processed for the production of catguts for surgical operations and musical instruments. However, these have recently been substituted by synthetic materials.

f. Skins and Hides

Skins and Hides, which constitute the most valuable material removed from the animal carcasses, may be processed in tanneries for the production of leather.

Depending on the locality and size of the slaughterhouse the need of establishing a tannery in the slaughterhouse area can be debated. In the case of small slaughterhouses, tanneries can not be recommended but only the primary processing of hides and skins which consist of salting and drying to prevent putrefaction is necessary. This is done in a special room in the by-product plant for the production of what is known as "green hides". Tanneries may be recommended only in very large slaughterhouses. In a modern slaughterhouse preparation of green hide is the only primary treatment done on hides, which requires skilled labor for the purpose of avoiding putrefaction that results in bad odors.

Tanneries constitute a flourishing industry in Lebanon although most of the hides are exported after being salted and dried in special establishments. Hides and skins are collected daily from slaughterhouses. The process of salting and drying

takes about two weeks after which the hide will become stiff and firm. Others are sold to the Lebanese tanneries for further processing.

During the process of salting as well as the skinning process care should be given to the cutting of the skin in order not to depreciate the quality of the leather. Also all the remaining fat and flesh from the skinning process should be removed from the hides, because if they are left the tendency of the hide to be spoiled or rot will increase.

During hot weather salting of hides should be immediate and delay salting may start their putrefaction. In cold days, salting may be delayed a few hours but never more than a day.

The amount of salt needed is approximately one kilogram per kilogram of hides, and the salt crystals are preferred to have the size of peas or smaller<sup>(3)</sup> in order to cover all the surface of the hides. The storage rooms, located in the by-products plant, should be designed away from direct sunlight and in a cool place. The floor of these rooms should be sloping to provide drainage in order to prevent any accumulation of liquor and, therefore, spoilage of hides and skins. Also the storage room should have a smooth and fine, hard water-proofing materials for walls and floors in order to secure effective washing which result in a safer and healthier condition.

g. Fat and Grease

Fats and grease, apart from hides, form an important and commercially a valuable by-product used for soap manufacture, dressing of leather, and production of commercial glycerine - a valuable commodity used in many commercial processes, including medical preparations, nitroglycerine, gunpowder, cordite and dynamite.

## Chapter II

### SLAUGHTERHOUSES IN LEBANON

#### A. Slaughtering & Slaughterhouses

##### 1. Meat Supply and Demand

##### a. Meats Consumed

Different kinds of animals have served as a source of meat for man through the ages, but little by little man started to eat the meat of certain herbivorous animals that consume plant foods as hay, straw, roots or grains. The flesh of carnivorous animals including the dog and cat is repugnant to many, though at one time it constituted a proportion of the protein diet of the labouring classes of certain countries like Bavaria<sup>(1)</sup>. Except in time of famine when rats too have been consumed, notably in the siege of Paris 1871, the consumption of dogs' and cats' flesh has now practically ceased in all civilized countries. However, such meat is still being used in some of the underdeveloped countries like Laos and Thailand.

It has been estimated that of the two million known species of animals only fifty have been domesticated and normally contributed to the food supply. However, in many countries, man's ingenuity is making full use of local animals and is becoming master of his environment.

The great majority of animals slaughtered in most of the civilized countries for human consumption besides the meat of rabbits, poultry and fish, consists of cattle, calves, sheep and pigs. Others like goats, camels, buffaloes and horses are slaughtered in different countries in the world. In Europe, horse flesh forms an important meat product and the prejudice that once existed against it was based on its prohibition by the Christian Church<sup>(1)</sup>. The Danes reintroduced this meat in Europe as a result of the economic stress during the siege of Copenhagen in 1807. Actually, slaughter of horses and sale of their meat for human consumption is well established in Denmark, Belgium, Holland, Germany, and France. During the Second World War ~~time~~, horse meat has been consumed in England, but the demand has disappeared with the resumption of normal supplies of the accepted meat foods.

In the Arab and Islamic countries, the consumption of camel meat has been in use for centuries. The Arabs who lived in the desert have domesticated the camel for their transport, milk and meat production. Lebanon is no exception and some people do eat camel meat - 22 camels were slaughtered and consumed in south Lebanon in 1963<sup>(26)</sup>.

In Lebanon, most of the Arab countries and Far Eastern countries, goat meat is consumed and forms a high percentage of local meat production and consumption. The goats slaughtered in Lebanon in 1963 constituted approximately 1/6 of the total consumption of sheep and goats - 320000 sheep and 61000 goats<sup>(26)</sup>.



Cattle, sheep, goats and pigs are the main animals slaughtered in Lebanon for the production of meat. Pork is only consumed by the Christian and Jewish communities, while the other meats are consumed by Lebanese of all faiths. Pigs are slaughtered by Christian and Jewish communities or in special licensed abattoirs owned by private people. These special abattoirs are usually associated with pig farms. In the Beirut slaughterhouse, pigs are slaughtered in a special place situated at a distance from the main slaughterhouse in order to satisfy the objections of the Moslem community.

Sheep and cattle are the animals mostly slaughtered in this part of the world. In Lebanon more sheep are slaughtered than any <sup>other</sup> animal where-as in the United Arab Republic and Iraq cattle slaughtering predominates.

The consumption of meat in Lebanon is not limited to meat produced from local slaughtering, but depends on imported meat and meat products as well. Imported frozen meat and canned meat supplement the local supplies.

The foreign communities in Lebanon, including Americans, British, French and others, consume canned meats, frozen meat and packed meat products. Imported meat is usually more expensive and its use is limited to a large extent to the higher societies and foreign communities. The reasons given by foreigners for refraining from utilizing local fresh meat relate to the prevalence of uncontrolled animal diseases, unhygienic conditions in slaughterhouses, and improper meat cutting, handling and storage.

b. Quantity of Meat Consumption

In Beirut slaughterhouse 700 sheep and goats, 75 cattle and 10 pigs as average numbers are slaughtered daily<sup>(27)</sup>. No data on the number of animals slaughtered in the other Lebanese districts is available before 1963. Table I shows the number of slaughtered animals in Lebanon in 1963.

The city of Beirut consumes yearly about one half of the total imported animals into Lebanon<sup>(27)</sup>. On the basis of these figures the total annual slaughtering in Beirut is computed as follows:

700 x 365 = 255500 sheep and goats  
75 x 365 = 27375 cattle  
10 x 365 = 3650 pigs

On this basis the total number of animals slaughtered in Lebanon leads approximately to the following figures:

Sheep and goats	500000
Cattle	55000
Pigs	8000

The annual figures on slaughtered animals in Lebanon give an idea of the amount of meat of goats, sheep, cattle and pigs consumed, which constitutes approximately two thirds of the total local meat consumption. The other third is supplemented by imported frozen meat, canned meat products, local and imported poultry meat. The imported meat - as frozen, canned or packed - forms around 15 to 20% of the total amount consumed, Table II. Also local animals supplement the needs by around 20% more<sup>(28)</sup>.

TABLE I

SLAUGHTERED ANIMALS IN LEBANON IN 1963\*

Districts	Sheep	Goats	Cattle	Pigs	Camels
Beirut	205771	22589	29615	2345	-
Mount Lebanon	41169	11481	9922	29	-
North Lebanon	29738	9205	13116	5	-
South Lebanon	17920	13205	9217	-	22
Beka'a	26166	4715	3449	-	-
Total	320764	61195	65319	2379	22

\* Ministry of Agriculture, Veterinary Department. General Report of  
1963, No. 457/6.

TABLE II

IMPORTED MEAT PRODUCTS TO LEBANON IN 1963\*

Exporting Countries	Frozen Meat Kgs	Packed Meat Kgs
Turkey	2962	
Syria	7950	
Jordan	9510	
Africa	4292	
Ouganda	2797	
Kenia	15927	4725
Uruguay		38698
France	24553	157278
Denmark	110631	583872
Holland	49235	407330
Hungary	33408	36299
Germany	3542	4512
Italy	1095	333330
New Zealand	12414	14
Poland		13414
Spain		1900
United States	15629	14498
England	29208	26212
Japan	5417	1696832
Argentina	72526	1038225
China	11482	125054
Switzerland		10300
Rumania	9721	38988
Ireland	45702	
Yugoslavia	14347	
Austria		35
Australia	30207	20884
Canada		2500
Chile	1420	
Czechoslovakia	29275	31667
Total	547014	2863434

\* Ministry of Agriculture, Veterinary Department. General Report of

During the last few years the trend in meat consumption has been changing a lot from animal meat to poultry meat because of competitive prices brought about by the significant increase in the local poultry production. The local market prices for 1963-1964 for these two kinds of meat were L.L. 4.5 per kilogram and L.L. 2.5 per kilogram respectively.

Poultry farms in Lebanon have increased during the last decade and are now about 500 in number. Dairy farming is only limited to milk production because of the lack of grazing land which is required by cattle and sheep. Pig farms are rare and limited to Christian areas like the farm in Boushrieh and the one in Zahleh.

Goats are limited to mountainous and rural areas, but these are gradually decreasing in number and are being replaced by sheep. The disadvantage of raising goats is that, because they feed on trees and shrubs, they therefore destroy them. This contributes to soil erosion.

c. Importation of Animals

The animals imported to Lebanon for slaughtering are mainly from Turkey, Iraq, Syria, Sudan and others. Traders are the ones who decide which country to import from. They usually import meat animals from the two neighboring countries, Turkey and Syria, political relations, distances and transportation costs being the decisive factors. Table III shows import figures for 1960-63; Table IV shows import figures and exporting countries during 1963.



TABLE III

IMPORTATION OF ANIMALS TO LEBANON, 1960-63

Year	Animals		
	Sheep	Goats	Cattle
1960+	373505	53758	53798
1961+	388176	140880	71790
1962+	553051	173979	91267
1963*	481524	157155	72231

+ Harawi J. Project de Generalisation des Abattoirs  
au Liban, (1963).

\* Ministry of Agriculture. General Report of 1963,  
No. 457/6

TABLE IV

IMPORTED ANIMALS IN 1963\*

Exporting Countries	Sheep	Goats	Cattle	Pigs
Turkey	247129	155068	43662	-
Syria	218343	2087	28042	64
Rumania	16052	-	-	-
Denmark	-	-	480	-
Holland	-	-	47	3

\* Ministry of Agriculture, Veterinary Department. General Report of 1963, No. 457/6.



Animals are transported to Lebanon by sea and railroad under the laws of the exporting countries. Sometimes transportation is done simply by driving the animals on the hoof, which is the case with most animals exported from Syria. When animals are imported by sea and railroad they are transported from the landing point to the various destination points through the country on their hoof. In the present regulations concerning the matter of transportation of animals to Lebanon, animals have to be inspected upon their arrival at the Lebanese boarders. However, this is not practiced and instead officials at the receiving stations are satisfied with checking exportation documents issued by the exporting countries verifying the freedom of the animals from communicable diseases.

Animals are driven afterwards to all parts of the country where traders use the lairages, if available, as the distributing centers or selling centers. Such is the case in Beirut and Baalbeck where the area surrounding the slaughterhouse is utilized for this purpose. Proper distributing centers do not exist in the country and slaughterhouse areas are the main places for selling and distribution.

## 2. Slaughterhouses & Slaughtering Practices

Slaughterhouses in Lebanon are few and limited to large cities like Beirut, Tripoli, Sidon, Zahleh and Baalbeck. The number is limited, at the present time, to 14 slaughterhouses distributed all over the country; (Table V). In villages and small towns far from slaughterhouses, slaughtering and meat marketing are publicly

TABLE V

EXISTING LEBANESE SLAUGHTERHOUSES, 1961\*

District	Kada	Number
Beirut	Beirut	1
North Lebanon	Tripoli	1
Mount Lebanon	Kasrawan	2
	Matn	2
	Aley	4
	Sidon	1
South Lebanon	Sidon	1
Beka'a	Baalbeck	1
	Zahleh	1
	Hasbaya	1
Total		14

\* Ministry of Health, Existing Slaughterhouses up till 1961.

Decree No. 8377, Dec. 30, 1961.

exhibited operations. This causes everybody to interfere in the slaughtering process including the dogs and cats which wait for their shares from the slaughtered animals. In these villages and towns as well as in the ~~present~~<sup>existing</sup> slaughterhouses, each butcher slaughters his own animals. Slaughtering outside the slaughterhouses is done in shops and homes under no control or inspection.

a. The Structures

The buildings of the existing slaughterhouses are very primitive and are frequently not designed to be slaughterhouses. They normally consist of primitive unhygienic buildings or sheds which are unsuitable for both personnel and slaughterhouse operations. In most of the slaughterhouses no lairages exist and are used only for the killing and dressing processes. In others, the same area is used for the lairage, slaughtering and dressing processes. Walls, floors and ceilings are constructed of material which is usually not the best for easy cleaning and maintaining proper sanitation. Many cracks and crevices and open joints are found which render the maintenance of sanitary conditions difficult.

Lighting and ventilation are very poor and are mainly based on natural lighting and ventilation. Windows are rare, un-screened and are often used as shelves. Artificial lighting and ventilation is not possible in some of the slaughterhouses and this is because of lack of electrical power.

Water supplies are in most cases unsafe and untreated. No sanitary waste disposal system is followed. Solid wastes are thrown away in the vicinity of the slaughterhouse while the untreated liquid wastes are discharged into sewers, a body of water, or on land. Cleaning facilities for personnel and workers do not normally exist and if they do exist they would be badly installed and maintained.

Most of the slaughterhouses are old and located in the center of towns and, therefore, cause nuisances to the public. Beirut slaughterhouse is a typical example of one located close to residential areas.

In all the slaughterhouses the processes are carried out manually. Few of them provide devices for air inflation prior to the skinning process. In others butchers simply use their mouths to blow air under the skin. Such a method is unhealthy and unfortunately is a common practice throughout the country. Laboratories affiliated to slaughterhouses do not exist. Most of the essential sanitary facilities are reduced to the bare minimum.

b. Personnel and Staffing

Each public slaughterhouse in Lebanon is directed by a veterinarian. In some exceptional cases no veterinarian is provided and the responsible person is the public health officer of the "kada" or municipality.

Lack of qualified personnel and poor staffing system prevails in all the slaughterhouses. Understaffing is supplemented by private butchers and animal owners who perform several slaughtering functions for personal benefits. The official staff members are responsible for office work only including record keeping and maintenance. In such disorganized and chaotic systems in which anybody is allowed to interfere with the functions and management the end results are obvious. With the exception of the veterinarian, the level of education of slaughterhouse personnel is very low. Personal hygiene practices do not exist. In fact, slaughterhouse conditions and practices are lamentable.

c. Operations

i. Ante-Mortem Inspection

The ante-mortem inspection in Lebanon is very poorly performed and rarely exceeds examination of the animals from a distance. Butchers or owners of the animals often bring the animals to the slaughterhouse without the approval of the veterinary inspector who, in fact, is rarely present for duty. To avoid financial losses butchers and owners consider every animal fit for slaughtering.

In the Beirut slaughterhouse two veterinarians are employed by the Municipality. In other districts, the veterinary inspector of the district is responsible for all the slaughterhouses that exist in the district, and this presents one of several reasons for the poor performance.

Although veterinarians are authorized to condemn animals and carcasses on the basis of ante-mortem or post-mortem findings, they refrain from performing their duties for fear of threats by animal owners or butchers.

ii. Lairage

Slaughterhouses in Lebanon have no lairages with the exception of the slaughterhouse of Beirut. The main object of the lairage in this case is merely to provide a sort of market to facilitate commercial transactions between animal traders and potential buyers who are usually butchers. In places other than Beirut, animals are stabled in privately owned places. Animals are driven daily to the slaughterhouses and sold in the markets located in the neighborhood of slaughterhouses. The animals sold are slaughtered while the rest are returned for custody by their owners, and this cycle is repeated daily thereby increasing the misery of the animals.

The absence of lairages in most slaughterhouses in Lebanon is accounted for by the fact that slaughterhouses are located in very close proximity to towns or villages where the animals are stabled, thus animals do not have to traverse long distances to and from the slaughterhouses. In most instances, the distance traveled does not exceed two to three kilometers requiring about half an hour on foot.

iii. Killing and Dressing

Slaughtering operations in Lebanon are limited to killing and dressing which comply with laymen's understanding of the functions and purposes of a slaughterhouse. These operations are carried out haphazardly on the floor of the slaughterhalls, and constitute a picturesque scenes that provoke human feelings and disgust. Killing of animals is performed in accordance with ritual requirements but without regard to sanitary and humane requirements, and no attention is given to the proper care, handling and pretreatment of the animals prior to slaughtering.

In the absence of individual pens, animals are forcefully and cruelly laid down on the floor in the slaughterhalls and killed by cutting the throat and the jugular vein. Moslems proclaim the slaughtering operation in the name of God. No stunning to render the animals insensible is practiced. One person is required to kill a goat or sheep, while three or four are needed to kill a cow, a bull or a camel. Thus, in the absence of stunning more people are needed for the slaughtering operation of larger animals - a factor that contributes to inefficiency, waste of effort and man power and congestion of slaughtering area coupled with the arising confusion and insanitary practices.



In the new slaughterhouse of Beirut which is under construction provisions are made for the separation of the animals during slaughtering. To satisfy the ritual requirements of the Moslem community of the city, slaughtering is to be done automatically with a single stroke by a sharp knife under the control of a butcher who will invoke the name of "Allah".

In existing slaughterhouses the blood resulting from slaughtering is actually wasted. Collection of blood, however, is not recommended in any slaughterhouse where the number of kills is not large, and the use of the ritual method which cuts the trachea, oesophagus and blood vessels together, the blood becomes contaminated with the food in the stomach. Contaminated blood has little or no commercial value; processing of blood obviously adds to the initial and operational costs of a slaughterhouse and should not be undertaken unless the yields and demands justify such undertakings.

After killing, the animals are allowed to bleed on the floor and then hung for skinning and dressing. Skinning is aided by air inflation which is accomplished by mouth except in Beirut, Tripoli and few others, where mechanical devices are utilized. Killing, <sup>air</sup>inflation ~~air~~ and skinning occur at the same place. The head and feet are removed first and later the skin. These by-products are thrown on

the filthy floor, where they acquire further contamination and dirt by contact with the blood and stomach contents. Amazingly, the butchers purposely smear the hides and skins with the blood and liquid wastes spattered on the floor to deliberately increase their weight for they are usually sold on the basis of weight. Contamination of carcasses from various sources is not surprising under the existing conditions. To allviate the situation butchers should avoid such practices and should at least wash the carcasses and floors free from dirt.

iv. Evisceration and Post-Mortem Examination

After the removal of the skin evisceration takes place. This and subsequent processes should be supervised by veterinarians for post-mortem examination. The veterinary inspector, whenever ~~is~~ present, rarely examines all the organs and parts of the carcass and, therefore, reduces the examination to a minimum. In reality an unqualified employee, stamps the carcasses with or without veterinary approval. Not infrequently it is the butcher who stamps his own carcasses using his own discretion and at the expense of stamping carcasses and meat which should otherwise be discarded and condemned.

Thus the official figures for condemned meat as shown in Table VI are not truly representative of the existing situation for obvious reasons.

TABLE VI

CONDEMNED ANIMALS & ANIMAL ORGANS 1963\*

	Cattle	Sheep	Goats	Pigs	Total
Whole Animal	266+	431	227	-	924
Liver	1876	2663	473	8	5020
Liver & Lungs	1022	1775	284	81	3162
Lungs	132	30	131	-	293
Kidneys	68	-	-	-	68
Spleens	3	-	-	-	3
Total	3367	4899	1115	89	9470

+ Out of the 266 cattle 104 were detained and isolated for observation.

\* Ministry of Agriculture, Veterinary Department. General Report  
of 1963 No. 457/6.

v. Transportation of Meat

After the carcasses are sealed they are transported by vehicles to different places in the town. These vehicles are very badly maintained from a sanitary point of view. Taxi cabs carrying carcasses to retailer's shops is a common sight in the early hours of the morning. Careless handling during transportation is yet another source of contamination.

vi. By-Products

Animal by-products are generally discarded with the exception of skins, hides and intestines. No provisions are made in slaughterhouses for processing of by-products such as blood, hair, bones, hoofs, fats and grease. These constitute the main wastes of local slaughterhouses.

The utilization of by-products may supplement the income of slaughterhouses, but since the initial and operational costs would be increased economical conditions may bar the establishment of by-product plants in all but few slaughterhouses in Lebanon.

As a result of the poor conditions in slaughterhouses, the flagrant slaughtering practices, the negligent handling of carcasses and the obvious absence of control, the local meat supplies are heavily contaminated and serve as a vehicle for the transmission of food-borne diseases.

B. Public Health Aspects

1. Sources of Contamination

Sources of bacterial contamination of carcasses and meat may be divided into: (a) contamination when the animal is alive; (b) contamination during slaughtering and dressing; and (c) contamination during transportation and handling of meat at retail shop.

In the live animal, micro-organisms are present on the skin and hair, and also in the cavities that communicate directly with the exterior of the body by way of the natural body openings. These openings hold the micro-organisms and harbour the bacteria and spores in a particular media which has become adapted to the environmental conditions.

The physiological condition of the animal immediately prior to slaughter has a profound influence on the development of bacteria. When the animals are weakened, the bacteria can invade easily the blood vessels from the intestines and cause an illness of such animals before their slaughtering. These animals if slaughtered immediately without a rest may lead to the contamination of meat by such bacteria. Besides, the flesh of animals slaughtered while ill or exhausted possesses a high alkalinity (high pH) and may have a high blood content; both of these conditions lead to the multiplication and spread of bacteria which cause decomposition. Ante-mortem bacterial infection of meat may be due to specific organisms responsible for illness of an animal prior to slaughter. Some of these bacteria may belong to the pathogenic group which may cause disease to man or may be responsible for food poisoning.

The sources and modes of infections of meat or other foods with bacteria capable of causing food poisoning in man may occur in one of two ways:

- i. Consumption of meat of a diseased animal.
- ii. The contamination of food from extraneous sources.

The diseases in animals may be transmitted from one animal to another prior to slaughter. This occurs through the agencies of feces, drinking troughs and others.

During the slaughtering process, bacteria can enter the jugular vein or anterior vena cava during the act of sticking as in pigs or ritual slaughtering as in cattle, sheep and goats. Bacteria will then reach the blood, muscles, bone marrow and lungs. Experiments conducted in the U.S.A. <sup>(8)</sup> have shown that the blood in the right auricle of the heart of slaughtered pigs contains more bacteria than the blood in the left ventricle.

During the dressing process the contamination of the carcass may be due to contact with feces. Under ordinary conditions the heaviest and potentially the most dangerous load of bacteria is the animal's digestive tract. It is estimated that one gram of fresh bovine feces contains 50 million bacteria. Another possible contamination of the carcass is its contact with the skin. The kind of bacteria found on hides depends on the bacteriology of the soil of the pastures on which the animals are fed. It is estimated that one gram of soil can contaminate the whole carcass of a beef to an extent of 3000 organisms per square centimeter <sup>(8)</sup>.



During slaughtering and dressing another cause of contamination is contagion by dirty hands or clothing. Swabbing with dirty cloth is an important factor in accounting for the number of bacteria found on meat. Interesting data<sup>(8)</sup> concerning bacterial contamination of carcasses showed that bacterial counts of the water used for washing carcasses were made in an old private slaughterhouse and a modern abattoir, and whereas in the modern abattoir the counts were 15,000 organisms per cubic centimeter, with 5 B. coli per 10 cubic centimeters, in the private slaughterhouse the counts were 2,000,000 to 25,000,000 organisms per cubic centimeter, with 5,000 B. coli per 10 cubic centimeters.

Investigations<sup>(8,13)</sup> at the beginning of the World War II showed that the origin and extent of contamination of meat in slaughterhouses caused by superficial contamination were:

dirt and skins of animals	33%
pollution of the abattoir atmosphere	5%
pollution with the visceral content	3%
utensils, personnel	3%
trimming & packing of the carcasses	2%
transport of meat	over 50%

Deficiencies in space may lead to further contamination during the killing and dressing processes because of the greater possibility of contact with contaminated surfaces.



## 2. Effects of Contamination

### a. Food Poisoning

Food poisoning is as old as civilization itself, and man acquired, by better experience a considerable knowledge as to what food was good to eat and what should be left alone. Food poisoning may arise from:

- i. Food allergy;
- ii. Chemical contamination;
- iii. Poisonous substances; and,
- iv. Bacterial contamination.

The following discussion will be limited to bacterial contamination which includes two forms: an infection with living organisms or an intoxication by pre-formed bacterial poisons. There are different kinds of organisms that cause infections such as the Salmonellae and the dysentary bacilli. The important organisms that cause intoxication are the Staphylococci. Food poisoning in Lebanon which is mainly due to spoiled or infected meat has been and still is abundant. Local newspapers frequently report such incidents. Table VII gives the number of food poisoning cases occurring in Lebanon during 1960-64. These figures do not reflect an exact picture because not all cases are reported<sup>(29)</sup>. Most of the cases reported occurred during outbreaks caused by meat from uninspected carcasses in rural areas while others are cases of other food poisoning than meat.

TABLE VII

REPORTED FOOD POISONING CASES IN LEBANON\*

Year	Number of Cases
1961	39
1962	10
1963	121
1964 +	5

+ Ministry of Health, Statistical Department. Unpublished data given by Head of the Department for 9 months (Jan. - Sept.).

\* Ministry of Health, Statistical Department. Statistical Yearly Reports.

b. Decomposition of Meat and Fats

Decomposition of meat and fats is the breaking up of organic matter by the action of bacteria which split up the meat or fat into a number of chemical substances, many of which are gaseous and foul-smelling. This is why during inspection of meat, care should be given to odors and colors of such meat.

After slaughter of a healthy animal decomposition eventually develops in the parts exposed to the air. Decomposition depends on the heat and moisture of the surrounding areas and both are favorable for bacterial growth. Decomposition starts with the aerobic bacteria and then followed by the anaerobic putrefactive bacteria which can grow within the deeper tissues of the meat. Propagation of bacteria spreads gradually by way of nerves and connective tissues, and along the surfaces of the blood vessels. This condition is greatly influenced by the state of the animal before slaughtering where sickness and fatigue enhance the propagation of bacteria.

c. Local Meat-Transmitted Diseases

The diseases transmitted by animals to man through meat or other agents are very numerous. Long ago man has realized that animals can be endangered by outbreaks of diseases, but the acceptance of the fact that the human health and life can be endangered by the transmission of such diseases to man took more time to be realized. To give an example, Virgil had noted

the spread of <sup>a</sup> Anthrax among flocks and sheep; but it was proved only in the sixteenth century and lately during the eighteenth century that some of the animal diseases can be transmitted to man (1).

Today, it is known that animals are subject to many diseases. Such diseases can be transmitted to man and can be classified according to their causative agents: viral, rickettsial, bacterial, cryptogamic, protozoal, fungal, and helmenthic (1,30). The term "Zoonoses" has been given to all primary infections of animals which are conveyable to man.

Local zoonoses are very numerous and others found abroad can reach Lebanon in one way or another. Table VIII shows the main local zoonoses which occur among local animals used for meat production.

### 3. Control of Contamination

Due to the ease of contamination of meat care and control in all procedures should be practiced. The cause of bacterial infections of animals can be reduced by providing the animals with comfortable means of transport and a rest period in a lairage for at least twelve hours prior to slaughter. This helps in obtaining perfect bleeding and therefore, reduces contamination and production of bacteria in the meat.

Another step in reducing the bacterial contamination of the live animal is washing the animal on arrival at the lairage and once more prior to killing. In some modern slaughterhouses this

TABLE VIII

ZOONOSES IN LEBANON \*

Diseases	Causative Agent +	Spread by	Vectors or Transmission Agents +	Diseases in Man & Symptoms +
1. Anthrax	Bacillus Anthracis	Cattle Sheep	Meat, insects, direct contact with infected blood, skins & hair.	Swelling, fever, blood infection. (If not diagnosed is fatal).
2. Brucellosis	Brucella	Cattle Sheep Goats Pigs	Meat, milk, air.	Febrile illness, undulant fever.
3. Encephalitis	Virus	Cattle Sheep Goats Pigs	Mosquitos, ticks.	Inflammation of the brain, high fever.
4. Hydatid Cyst	Echinococcus Gramulosis	Cattle Sheep Goats Pigs	Contaminated food with feces of infected dogs.	Tumour like cyst in different parts of the human body.



TABLE VIII (Cont'd)

Diseases	Causative Agent +	Spread by	Vectors or Transmission Agents +	Diseases in Man & Symptoms +
5. Leptospirosis	Leptospira	Cattle Pigs	Polluted water by rats, meat, skin abrasion, sexual intercourse .	Sudden onset with chills, high fever, nausea, vomiting, abortion.
6. Listeriosis	Bacterium Monocytogenus	Cattle Sheep Goats	Unknown .	Large mononuclear leucocytosis, abortion.
7. Liver Flukes	Flukes Fasciola hepatica	Cattle Sheep Goats	Liver.	Irritation of the throat by the flukes which stick to it, human liver is attacked.
8. Local Bacterial Infections.	Different Bacteria	Cattle Sheep Goats Pigs	Meat.	Inflammation of the skin, fever, boils.
9. Pasteurellosis	Pasteurella Tularensis	Cattle Sheep	Meat, direct contact with wound.	Abdominal illness followed by fever and general illness and fatigue.
10. Q. Fever	Rickettsia Burnetti	Cattle Sheep Goats	Air, milk.	Chills, prostration and fever, headache, continuous fever for few days.

TABLE VIII (Cont'd)

Diseases	Causative Agents +	Spread by	Vectors or Transmission Agents +	Diseases in Man & Symptoms +
11. Salmonellosis	Salmonella	Cattle Pigs	Meat.	Typhoid like fever.
12. Taeniasis	Taenia Saginata	Cattle	Meat .	Tapeworm in intestines.
13. Tuberculosis	Mycobacterium Tuberculosis	Cattle Sheep Goats Pigs	Meat, milk, air.	T.B. in man.

\* Listed in alphabetic order of the local slaughtered animals.

+ Thomas G. Hull. Diseases Transmitted from Animals to Man. Fourth Edition (1961).



is ensured by spraying water prior to slaughter and passing the animals through a race so that they are cleansed.

Control of meat contamination involves the control measures during slaughtering and dressing. These measures are associated with the conditions of the environment and the available facilities.

Adequate floor space in the slaughterhalls should be provided for slaughtering and dressing to minimize congestion, facilitate manouvering and thus decrease the possibility of contamination by direct contact. Maintenance of clean floors may be secured by designing them to slope towards a manhole, and by providing running water to wash floors and walls. A hand washing basin should be provided for every eight persons.

After the animal is hung and the skin removed, care should be taken to avoid contact of the carcass with the surface of the skin. Before evisceration, the hands of the operator should be washed.

During evisceration care should be taken to avoid bursting or incising the viscera and permitting the extrusion of the contents. By-products which are obtained during these processes such as the skins, legs, heads, viscera, intestines, lungs, livers are immediately conveyed to their respective department, for further processing, to avoid any possible contamination.

Personal hygiene of the workers, the use of sterile knives, availability of proper work clothes and locker rooms are matters that need attention. The halls should be provided with adequate ventilation as a safeguard against contamination by air. Enough

light should be provided during all the processes specially during the post-mortem examination to enable veterinarians to detect any possible sign of defect in the meat.

Other measures include wrapping of carcasses and meat with clean materials during transportation, the initiation of health education programs for meat handlers and butchers, and the medical examination of all slaughterhouse personnel.

### C. Rules and Regulations

Most of the Lebanese rules and regulations regarding slaughterhouses date back to the Turkish regime, but the newer ones were legislated under the French Mandate. However, few have been legislated during the period of independence, such as the decree of 1964 concerning slaughterhouses and the sale of meat.

#### 1. Historical Review

The first law existing in Lebanon concerning slaughtering, slaughterhouses, transportation of animals and animal diseases dates back to December 5, 1913<sup>(31)</sup>; this law with some amendments is still effective.

Beirut slaughterhouse, the only one then in existence in Lebanon, stopped operating between 1914 and 1918 because of the war. After the war in 1919 it was reopened and an act was passed prohibiting slaughtering of animals outside the slaughterhouse.

In 1921, under the French Mandate, a special department was established for the inspection of animals and meat throughout Syria and Lebanon.

On June 30, 1932 a legislative decree No. 16/L was proclaimed, and it stipulated the requirements for establishing slaughterhouses. It encourages every municipality or group of closely associated municipalities to construct and operate a slaughterhouse to be controlled by a veterinarian following the approval of the Ministry of Health and the Ministry of Agriculture. It also stipulates that, in the event the establishment of a slaughterhouse is not practical in a given locality, the governor (mohafez) would have the right to assign a suitable place for slaughtering. It also stipulates that meat should not be used for human consumption unless it is sealed by the veterinarian responsible for the area or slaughterhouse.

On July 22, 1932, a legislative decree No. 21/L was passed whereby slaughterhouses were considered among the places hazardous to public health. This decree was supplemented by a presidential decree in 1936 whereby slaughterhouses were classified under the first priority of hazardous public places and licencing of slaughterhouses became mandatory.

The governors of Beirut issued various acts since 1940. The most important of these acts is that issued in 1940 and which consists of a set of rules and regulations for safe and sanitary slaughterhouses and meat shops. In 1961, this act was revised\*.

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\* The writer was a member of the Revision Committee.

Finally, in 1964 a presidential decree was approved, the object of which is to provide the sanitary rules concerning slaughterhouses and meat shops, to ensure a supply of hygienic and safe meat from source to consumer, and to emphasize the hygienic production of meat and its proper handling and marketing.

2. Existing Rules (31)

The following are translations of excerpts of current rules and regulations concerning slaughterhouses and slaughter animals:-

- a. All imported animals should be subjected to animal inspection by a veterinarian at the borders of the country or port - (Law: 5.12.1913 Article 2).
- b. Animals from countries having any sort of an epidemic animal disease should not be imported at all to the country. Animals imported to the country are to be subjected to very strict inspection upon arrival to Lebanon - (Law:5.12.1913 Article 5).
- c. When any animal communicable disease appears in Lebanon, the owner should immediately report it to the proper authorities, otherwise he will be penalized - (Law: 5.12.1913 Article 6 and 20).
- d. If an animal is found sick immediate isolation is obligatory, and exportation of other animals from the same area is prohibited. If the sick animal dies disposal of the carcass should be carried out under strict supervision - (Law: 5.12.1913 Article 12 and Act 1004: 30.7.1921 Article 7).

- e. Isolation blocks should be provided as necessary for diseased animals - (Law: 5.12.1913 Article 15).
- f. All equipment exposed to diseased animals should be subjected to disinfection - (Law: 5.12.1913 Article 16).
- g. Vehicles used for animal transportation should be cleaned and disinfected under the supervision of the responsible veterinarian - (Law: 5.12.1913 Article 29).
- h. A sanitary slaughterhouse should exist in each district - (Law: 5.12.1913 Article 30 and decree 16/L, 30.6.1932 Article 34).
- i. The sale of meat of animals dying from any disease is prohibited - (Act 214, 19.2.1919, Article 3).
- j. Slaughtering of a pregnant animal is prohibited - (Act 214, 19.2.1919, Article 4).
- k. All meat for human consumption should be inspected and sealed by a veterinarian - (Act 214, 19.2.1919, Article 7).
- l. A camel should not be slaughtered for meat production unless a veterinarian inspects it, or in his absence, the physician assigned for the area - (Decree 753, 10.12.40).
- m. Any animal that enters a slaughterhouse should not come out of it alive - (Decree 16/L Article 40).
- n. Lambs should not be slaughtered before April 1st - (Decree 150 N.T. 9.3.1942, Article 1 and 2).
- o. Cows under eight years of age should not be slaughtered except for a good reason, provided its meat is safe for consumption - (Decree 181 N.I. 21.5.1942, Article 1).

- p. Pork should be subjected to thorough examination in an accredited laboratory before consumption - Decree 5484 K, 26.3.1946, Article 1).
- q. Pig's carcasses completely infected with trichinosis should be condemned and discarded - (Act 213, 18.6.30 Article 1).
- r. Pig's carcasses partially infected with trichinosis should be stored in a cold room for eight days at (- 8°C) - (Act 213 18.6.30 Article 2).
- s. All people authorized to enter a slaughterhouse should be subjected to a general physical examination and a blood test - (Act 116, 9.4.52 Article 1).
- t. Workers handling meat should wear knee-long gowns with long sleeves which should be kept clean - (Act 1445, 17.5.1945, Article 1).
- u. Transport of meat is forbidden in private or public cars, or open cars - (Act 118, 9.4.1952 Article 1).
- v. Butchers are forbidden to carry knives or any instrument used for slaughtering outside the slaughterhouse or their shops - (Act 142, 23.2.52 Article 1).
- w. Any imported meat found defective by the Lebanese authorities should be immediately condemned even though the same meat has been subjected to inspection in the exporting country - (Act 1470, 31.7.1956 Article 5).



To any reader the rules and regulations seem to be adequate but, unfortunately very few have been enforced. Their effective application would have had an impact on the existing lamentable situation. Comparison with the rules and regulations current in the U.K. and U.S.A. would indicate the exorbitant deficiencies in Lebanon<sup>est</sup> legislature. An important deficiency, for instance, is the lack of provisions for lairages.

D. Future Plans

1. Proposed Plans

The existing slaughterhouses in Lebanon are few and are limited to large cities and towns. There were fourteen public slaughterhouses in 1961<sup>(32)</sup>. Privately owned slaughterhouses established in Christian areas are intended solely for pigs.

The Lebanese authorities - The Ministries of Health and of Agriculture - are now evaluating various plans to establish slaughterhouses throughout the country and to improve the existing ones. The proposed plan of the Ministry of Health is to provide small slaughterhouses to serve each city or town. For example, three slaughterhouses have been proposed for the Baalbeck area: one to serve the city itself, and the other two to serve the northern and southern parts of Baalbeck area. The total number of slaughterhouses proposed by the Ministry of Health is seventy three distributed all over the country including the new slaughterhouse of the city of Beirut. The second plan which is proposed by the Ministry of Agriculture differs from the one of the Ministry of Health. The plan



provides for a common slaughterhouse to be shared by several municipalities located in the same area<sup>(27,28)</sup>.

Both plans have advantages and disadvantages; but the more practical one seems to be the one of the Ministry of Agriculture and the government is inclined to adopt it in preference to the other. In fact the present study is based on similar principles.

## 2. General Design Criteria

The projected number of animals to be handled in a slaughterhouse constitutes an important design criteria. Such data is normally derived from records or estimated from population figures if the rate of meat consumption is known. In the absence of records and essential data, estimates must be arrived at in an indirect manner.

The only available figures, Table 1, are those published for 1963 by the Veterinary Department, Ministry of Health. However, these figures are not absolute since they do not take into consideration the number of animals slaughtered in places other than the municipal slaughterhouses which may amount to about 20% of the annual figures<sup>(28)</sup>.

The estimates should also account for any trend in meat consumption. As an example, it would not be illogical to consider an increase in meat consumption to meet the demand by tourists which is expected in the event the projected town planning program for Baalbeck is executed in the foreseen future.

On the other hand, when designing a new slaughterhouse it will be logical to consider that the meat which is going to be produced

in the slaughterhouse is cleaner and safer, and for this reason foreigners from Europe and America will be encouraged to buy local meat rather than the imported meat and thus another 20% may be increased for the design purpose. A third factor which may increase the number of slaughtered animal is a higher standard of living in the country. In the past, meat was supposed to be a luxurious item in a meal, while at the present time it has become a necessity. In Lebanon people are <sup>now</sup> eating more meat than <sup>in</sup> the past and consequently this will lead to <sup>a</sup> 40% <sup>(28)</sup> of increase <sup>of</sup> the present official figures. Finally, the last factor is due to the increase in population, future expansion, and tourists and <sup>so</sup> a 20% increase is considered. On the other hand, there is a drawback in the above consideration because it is based on the data of only one year but unfortunately no other possible data was available.

The capacity of each slaughterhouse in the proposed plan of the Ministry of Agriculture was based upon the above mentioned figures taking into consideration the geographical location, type of the community and its population.

The suggested classification of slaughterhouses <sup>on the basis of</sup> capacity <sup>by</sup> the Ministry of Agriculture is as shown below <sup>(27)</sup>:

- Class I 500 - 1000 sheep and goats and 25 - 100 cattle.
- Class II 250 - 500 sheep and goats and 15 - 25 cattle.
- Class III 150 - 250 sheep and goats and 10 - 15 cattle.
- Class IV less than 150 sheep and goats and less than 10 cattle.

### 3. Future Needs for Modern Slaughterhouses

There is no doubt that local slaughterhouses are in such poor conditions and improvement is imperative. Excluding the city of Beirut where a new modern slaughterhouse is under construction, the Lebanese situation necessitates twenty two slaughterhouses<sup>(27)</sup> classified with respect to their capacity<sup>in</sup> to four classes, as already classified. These slaughterhouses should be planned to be mechanized as much as possible, as well as to have places for lairage, by-product plant, refrigeration rooms and selling counters.

This classification is based on meat consumption rates and embodies the advantage of concentrating slaughtering facilities in sufficient populated areas that justify the establishment of a slaughterhouse. Moreover, this tends to reduce the health hazards and nuisances, provides better control and inspection of animals and meat, and restricts slaughtering to appropriate and authorized places. Slaughterhouses common to a group of neighboring communities allow for the provision of qualified and skilled personnel and equipment for proper meat inspection. Also, it limits the veterinarian to one slaughterhouse serving the area and thus facilitates his work and increases his efficiency. It also will cut down the first cost and the operational expenses.

A group of municipalities sharing the expenses would be able to afford the construction and operation of a common slaughterhouse. It would be better to design a complete and modern slaughterhouse that includes all the essential facilities, a refinement that cannot otherwise be afforded by individual municipalities.

4. Siting

Selection of the proper site is an important aspect that should not be overlooked. It is only seldom that a slaughterhouse can be erected to supply the needs of both the animal - producing and the meat consuming areas. In the producing animal area, the needs of meat of the local population will often be greatly exceeded. If the slaughterhouse is erected in the consuming areas, transportation difficulties would arise. Where legislative measures do not exist as in Lebanon, there are certain considerations in relation to siting which should always be observed and these require that a slaughterhouse be located:

- a. Away from dwellings.
- b. At the center of the maximum demand area.
- c. In an area where the land is relatively cheap.
- d. In an unpopulated area.
- e. In a place that allows for the future expansion of both slaughterhouse and neighboring town.
- f. Near a main road that does not pass through the residential areas.
- g. The direction of prevailing winds should be taken into account so that odors and dust are carried away from inhabited areas.
- h. Near an adequate water supply.
- i. In a place where drainage is possible or in a place where the effluent of the treated sewage may be used or disposed.
- j. Easy access for livestock - road, rail or sea.
- k. Near a power supply.



## Chapter III

### PROPOSED SLAUGHTERHOUSE FOR BAALBECK

#### A. General Considerations

##### 1. Baalbeck: Location, Topography and History

Baalbeck, one of the oldest towns in Lebanon, is situated at 1150 meters above sea level at the foot of the Anti-Lebanon, north of the Beka'a valley - Appendix A, Drawing No. I. It is at 34°10' latitude north and 36°10' longitude east of Greenwich.

Ancient Baalbeck extended over a small area which was not larger than the present city. It rapidly developed into one of the most important cities in Syria because of its favorable position and climate.

Since the Roman days, Baalbeck was an important city and continued to flourish throughout the whole Byzantine period. But, after the conquest of the Arabs in the 9th century, many of its inhabitants migrated. After the Arabs, Baalbeck became a "Liwa" under the Turkish regime in 1850, and remained so until 1918 when it was annexed to Lebanon in 1920<sup>(33)</sup>.

##### 2. Existing Municipal Facilities

The existing sanitary facilities in Baalbeck are limited to the following:-

a. Water

Baalbeck was supplied by the waters of Ras-El-Ain, a nearby spring situated at 1170 meters above sea level.<sup>(33)</sup> Until 1932 the municipality of Baalbeck undertook the exploitation and distribution of the water from another source known as Al-Lejooj 9 Kms to the east of the town.

b. Sewers

Prior to 1946, people discharged their wastes into improperly constructed sanitary pits. In 1946 a sewerage system was constructed and put into operation by the Municipality. This faulty system which is still in operation continues to be a source of nuisances and hazards. The raw sewage discharges into the Ras-El-Ain stream which flows through the town and is used for irrigation of its gardens without any kind of treatment. Some of the inhabitants use Ras-El-Ain water for swimming as well as for drinking purposes.

c. Swimming Pool

Near the source of Ras-El-Ain, a pool was constructed in 1937 to serve as a reservoir for water storage and for recreational purposes. Because of the conservative attitude of the people the pool ceased to be used for swimming, and now it merely serves as scenic place enjoyed by the customers of the bordering cafes and restaurants.

d. Slaughterhouse

Baalbeck had its first slaughterhouse under the Turkish regime. A new one was erected in 1944 and has been in operation since 1946.

Besides the ones mentioned above, no other <sup>public</sup> facilities exist at present. The government, however, is considering a project to provide Baalbeck with three incinerators for garbage disposal, and two dispensaries<sup>(32)</sup>. A hospital is now under construction which will serve Baalbeck and its Kada.

### 3. The Existing Slaughterhouse

The first slaughterhouse ever constructed in Baalbeck was built before World War I during the Turkish Regime and served the town until the year 1946. This slaughterhouse was built on the bank of Ras-El-Ain after it leaves the town. The untreated stream water, polluted by the discharged raw sewage, was utilized by the slaughterhouse. These conditions created various public health problems.

The slaughterhouse was not provided with a lairage nor with any secondary plant, and all animals were brought daily to this slaughterhouse by their owners or butchers. Animals were killed and dressed in the absence of any kind of inspection, and the ritual method of slaughtering was, and still is, the only practiced method. Carcasses were taken by a carriage to the city where they were distributed to the butcher's shop. Post-mortem inspection was done only by and at the discretion of the butchers who were the only persons able to condemn the defective meat which would be thrown into the surrounding areas. The person responsible for inspection during the period which followed the proclamation of the 1932 decree was a medical officer, who never cared to visit the slaughterhouse. In the absence of supervision and as a result of



poor management and operation popular disgust eventually led to the abandonment of this old slaughterhouse which, moreover, had become obsolete for the following reasons:-

- a. The slaughtering area was very small in size and the slaughtered number of animals gradually increased with the increase in population.
- b. The butchers violated the laws and started to slaughter most of the animals outside the slaughterhouse.
- c. The people using the polluted stream water after the slaughterhouse complained to the authorities and ventured to threaten the butchers themselves.

Following the 1936 - decree requiring that slaughterhouses be licenced, the Baalbeck slaughterhouse was not appraised in its light and continued to operate under poor sanitary conditions until 1946 when a new slaughterhouse was established.

This slaughterhouse was constructed away from the inhabited area near the southern entrance of the town and about 300 meters off the main road. Unfortunately, little by little the sanitary conditions in this new establishment started to decline and within a few years it became evident that it was following a trend similar to that of the old slaughterhouse. The new slaughterhouse, being a municipal enterprise, was limited to the service of Baalbeck butchers at the exclusion of those from nearby villages. Consequently, all slaughtering in these villages continued to be conducted in streets, village centers and sometimes in butchers' shops without any supervision and inspection.

Several visits to these unfortunate villages revealed the fact that most of the animals slaughtered are either sick or old, or else animals that have suffered an accident.

Interrogation further indicated that once an animal bleeds upon slaughtering, the meat is rendered safe and fit for consumption regardless of the health condition of the animal. Undoubtedly, this belief has exerted its adverse effects on the public. The only animals destined for condemnation are the dead ones which are prohibited in the Koran, and since most of the people in the area are Moslems this doctrine has been religiously practiced.

The present slaughterhouse in Baalbeck does not have any place for lairage. During the mornings the surrounding area turns into a busy market for animals from where butchers buy their need and slaughter their own animals in the most deplorable manner characterized by the lack of lairage, technique and precautions.

The concrete building consists of a large hall where all processes take place. Each butcher is responsible for killing his own animals on the floor by the ritual method, allowing the blood to flow on the floor. The carcass is then hung for complete bleeding. Dressing starts after bleeding is over and inflation with air is done by mouth. The skin when removed is thrown on the filthy floor. The organs removed and sometimes thrown over the skin which is considered to be cleaner than the floor itself. The carcasses and organs are transported to the town in an old motor vehicle unfit for the purpose. The butchers shoulder the carcasses from vehicle to shop. Handling does not comply even with

the basic rules of sanitation. No equipment or machines are used in the slaughterhouse. All processes are done manually. Sanitary facilities are very poor. Windows have frames but no glass panes, and screening is not considered essential. Ventilation is poor and because no electricity is available only natural lighting is utilized. Municipal water is used. Solid wastes are screened while liquid wastes are discharged through the sewers into Ras-El-Ain stream which is used for irrigation. The community, aware of this miserable situation, has often complained in vain.

The existing slaughterhouse is claimed to satisfy the present needs of the town<sup>(34)</sup>. The number of slaughtered animals varies from day to day and from season to season. Many visits to this slaughterhouse were made at different times of the year in order to collect data that is otherwise not available. It was found that the maximum number of slaughtered animals reaches a peak of 85 sheep or goats and 7 cows and calves on Sundays during summer. In winter these figures drop to 50 sheep and goats and 3 cows. Variation between summer and winter may be accounted by the increased tourism and the greater number of people resorting in Baalbeck during summer. On the other hand, meat demand decreases during winter because most of the inhabitants process and preserve their meat, "awarma", for winter consumption.

#### 4. Future Plans for Baalbeck

Most of Baalbeck community dwell in old houses that are in poor sanitary conditions. Their income derives from three main sources: agriculture, commerce and tourism.

The Lebanese Government aware of these conditions and appreciating the touristic attraction of the town, is endeavoring to improve the situation to help raise the economic status of the community. The Baalbeck festival held annually in summer since 1956 is an outstanding example. More recently, the government has initiated a competition for plans of the new city of Baalbeck. Several engineers and engineering firms have participated in this competition. The eight prize - winning plans, exhibited in Beirut in November 1964, would serve as a basis for the final one which necessarily should take into account the need to excavate and reconstruct the ancient archeological city of Baalbeck. This requires selection of an appropriate site for the new city in the vicinity of the old one - a point considered in the plans submitted for evaluation. The proposed sites are:-

- a. The hill near Ras-El-Ain;
- b. A location south<sup>of</sup> the existing town; and,
- c. A location north<sup>of</sup> the existing town.

There are advantages and disadvantages for each of the proposed plans, but it is felt that the first two proposed sites are more practical because tourists would have to pass through the new city on their way to the ancient one, and thus provide in one way or another a certain income to the inhabitants. The best of the three proposed sites seems to be the one on the hill because it overlooks the archeological area providing an exquisite panorama. Besides, the hill would form a protective barrier against the cold easterly winds in winter.

5. Population

The population of Baalbeck was approximately 7,500 according to the 1932 census. The figures published in the "Official Journal"<sup>(35)</sup> in 1964 indicate that the population of Baalbeck was 15,560 in 1961 taking as a basis the 1932 census. On the other hand, the population of the Baalbeck "Kada", which includes 77 villages and small towns, was 111,040 inhabitants in 1961<sup>(35)</sup>.

Since the population of Baalbeck has doubled in a period of 30 years (1932-1961), the same rate of increase may be assumed to take place in the next ~~fourty~~ years as from 1961. Thus, in the year 2000 the population will become 40,000, the same rate of increase applies to the "Kada". This estimation was considered among many others which was felt the best.

The proposed slaughterhouse in this project is intended to serve Baalbeck and some of the neighboring villages in the "Kada". Accordingly, the population to be served is estimated to have been about 45,000 in 1961, Table IX, and are expected to reach 120,000 in 2000. The total figure for the population to be served in 2000 would be 160,000.

Baalbeck and its "Kada" are composed of two religiously distinct communities: the Moslems comprising 4/5 of the population, and the Christians constituting the remainder.

6. Meat Demand

Meat consumed in Baalbeck consists of mutton, beef, goat meat and, seldom, camel meat. Not more than one camel is slaughtered per month in the Baalbeck area. With the recent boom in poultry



TABLE IX

POPULATION OF BAALBECK AND NEIGHBORING TOWNS AND VILLAGES \*

Baalbeck	15560	Keddam	709
Ainata	925	Khodr	844
Ain Bourday	325	Kreibeh	483
Beit Mchik	1129	Knaisseh	1013
Bishwat	675	Majdaloun	447
Bouday	2685	Makneh	1972
Brital	2770	Maraboun	423
Btedii	547	Nabha	1990
Chaat	2335	Nabi Sbat	1623
Chlifa	1702	Nahleh	1523
Dar El Ouassaa	309	Ram	474
Deir El Ahmar	4081	Riha	622
Douris	1333	Sabouya	191
Flaoui	474	Siaideh	341
Ham	213	Talia	902
Hazzin	419	Taybeh	635
Haouch Barada	409	Tfeil	183
Haouch Dahab	81	Yaot	2143
Haouch Sneid	110	Yammouneh	845
Haouch Talsafiyah	375	Younin	3716
Howr Tahlah	1366	Zarazir	141
		Total	<u>59043</u>

\* Lebanese Official Journal No. 4, January 13, 1964, page 138-139.

farming, poultry meat consumption has markedly increased within the past few years, inevitably cutting down consumption of other kinds of meat. Canned meat and fish are rarely used, and their consumption may not exceed one per cent of the total consumption. "Awarma" meat prepared in the fall and preserved for winter use, would decrease the winter demand, if this traditional practice is to be continued. However, there are indications in other parts of the country that it is rapidly declining.

The daily consumption of meat based on actual slaughtering in the slaughterhouse of Baalbeck during the summer of 1964 and winter of 1965 was as follows:-

Summer :- 80 goats and sheep, and 9 cattle per day.

Winter :- 60 goats and sheep, and 5 cattle per day.

Average:- 75 goats and sheep, and 7 cattle per day.

However, these figures do not include the animals slaughtered in private places.

Assuming that 20% of the animals are slaughtered in places other than the slaughterhouse, this leads to the following figures that may be assumed to represent the true daily consumption of fresh meat in Baalbeck by a community of 15,000:

$$75 + \left( \frac{20}{100} \times 75 \right) = 90 \text{ goats and sheep}$$

$$7 + \left( \frac{20}{100} \times 7 \right) = 9 \text{ cattle}$$



For a population of 45,000 which represents the total figure for the community in the neighboring villages the daily consumption is assumed to be double that of Baalbeck alone, even though the population is triple. This is accounted by the difference in the living standards between town dwellers and villagers. Therefore, the present daily consumption of the area under question is:

$$90 + (90 \times 2) = 270 \text{ goats and sheep}$$

$$\text{and, } 9 + (9 \times 2) = 27 \text{ cattle}$$

Assuming the population is increasing at the rate stated above then the projected future kills are derived below, keeping in mind that the commencement of operations in the proposed slaughterhouse would be after five years, in 1970.

In 1970

$$270 + 45 = 315 \text{ goats and sheep}$$

$$27 + 5 = 32 \text{ cattle}$$

In 1980

$$315 + 90 = 405 \text{ goats and sheep}$$

$$32 + 9 = 41 \text{ cattle}$$

In 1990

$$405 + 90 = 495 \text{ goats and sheep}$$

$$41 + 9 = 50 \text{ cattle}$$

In 2000

$$495 + 90 = 585 \text{ goats and sheep}$$

$$50 + 9 = 59 \text{ cattle}$$

Following the execution of the plans of the new city of Baalbeck progress in all phases of life seems to be inevitable and is bound to be accompanied by a significant improvement in income, and therefore an increase in meat consumption. Consequently a factor of 40%<sup>(28)</sup> is used to account for this increase, and hence:

In 1970

$$315 + \left( \frac{40}{100} \times 315 \right) = 441 \text{ or approximately } 450 \text{ sheep and goats.}$$

$$32 + \left( \frac{40}{100} \times 32 \right) = 44 \text{ or approximately } 45 \text{ cattle}$$

Similarly:

In 1980        600 sheep and goats, and 60 cattle

In 1990        750 sheep and goats, and 75 cattle

In 2000        900 sheep and goats, and 90 cattle

The approximation of the figures given above is justified on the basis that the approximate figures shown are more convenient to suit the capacity of equipment and to provide a factor of safety.

## B. The Proposed Slaughterhouse

### 1. Design Criteria

#### a. Location

The location of the proposed slaughterhouse is greatly influenced by the official plans for the new town of Baalbeck. The proposed slaughterhouse will, therefore, be located as shown in Appendix A, Drawing No. II outside both the old and the new towns. Reasons for selecting this specific location are:

- i. The site of the slaughterhouse will not conflict with either the archeological town to be excavated, or with the new proposed cities.
- ii. The value of the land north of Baalbeck is cheaper than the value of the land south of it. However, this would be a minor criterion because the value of the land in the area rarely exceeds 500 L.L./Dounom or approximately 0.5 L.L./m<sup>2</sup>.
- iii. The southern area is not considered because the land is projected for future excavation.
- iv. Future expansion of the slaughterhouse is possible because in the selected area the price of land is to remain nearly constant unlike the land in other areas.
- v. The site is very close to the principle roads which would connect the slaughterhouse with Baalbeck and its neighboring villages and with Syria and Turkey from where the animals are mainly imported.
- vi. Traffic through the Baalbeck residential area would be avoided.
- vii. Prevailing winds are southern and, therefore, odors when present would drift to the north and away from the town.
- viii. Water can be supplied from the town without pumping because the land is at a lower level than the source. Pumping would be required to elevate the water from the distribution system of the town to the water reservoir of the slaughterhouse.



- ix. Sewage treatment is possible and the treated sewage effluent will obviously serve the area for irrigation.
- x. The proposed location is very near a main substation of electric power and, therefore, electricity will be available.
- xi. The location is very close to Baalbeck which is the center of maximum meat demand.
- xii. Possible grazing area would be available if land is purchased.
- xiii. The slaughterhouse would be located near the sewage treatment plant, the layout for which was proposed by one of the firms that won a prize for the design of ~~the~~ new Baalbeck.
- xiv. Sand and gravel are available and transport of such materials during construction would be reduced to a minimum.

b. Capacity

Some places in the "Kada" of Baalbeck are more than 20 kilometers from the town. The present project is based on serving the population within a radius of 20 kilometers. Consequently it is proposed that <sup>the</sup> northern part of the kada will be served by the slaughterhouse of Hermel, and the southern part of the kada will be served by the slaughterhouse of Rayac; these two slaughterhouses are among those which the country needs to meet the demand in Lebanon. The purpose of limiting the area served and excluding distant communities is to reduce

transportation cost. The area supplied by the proposed slaughterhouse is shown in Appendix A, Drawing No. I, and the 1961 population of the town and villages included in the area is shown in Table IX.

As mentioned previously, the population to be served by the proposed slaughterhouse in the year 2000 is estimated at 160,000. The population was assumed to double every thirty years and this was based on the assumption that this population had doubled between 1932-1961. The following kills are expected with respect to the years as indicated:

	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>
Goats and Sheep	450	600	750	900	1050
Cattle	45	60	75	90	105

A period of forty years (1970 - 2010) may be considered as the maximum period of service for the proposed slaughterhouse. For this reason, special considerations was assumed to satisfy the needs of this period i.e. 1970-2010.

Since the proposed system allows for 150 kills/hour (sheep and goats), three work-hours will be enough to supply in 1970 the required 450 kills. For 600 kills an increase of one work-hour will satisfy the needs. The work-hours needed to achieve the required kills would be therefore, 4, 5 and 6 in 1980, 1990 and 2000 respectively.

In 2010, after 40 years of service, the proposed slaughterhouse will have accomplished its object and then consideration would have to be given to the following possibilities:-

erection of a new slaughterhouse, remodelling and expansion. Final decisions on this matter would have to be taken in future at the appropriate time.

The proposed system<sup>d</sup> of increasing the work-hours and utilizing the same personnel to do the extra work has the following advantages:-

- i. It allows the personnel to earn more wages by working for longer periods.
- ii. The utilization of the already experienced and skilled labors and butchers for the additional work annuls the need and expenses of training more employees.
- iii. The work schedule may be altered to fit the needs of the slaughterhouse, as for instance, working for 4 hours on one day and 5 or 6 hours on another day, without increasing expenses other than wages.

Cattle slaughtering is accomplished by means of a slaughtering pen at the rate of 20 kills per hour. The capacity of this device would be adequate for the entire period of service without expansion.

## 2. General Procedures

### a. At The Lairage

Animals imported from Syria, Turkey or other countries will be transported to the lairage by railway or motor vehicles, roads or simply driven on hoof as would be the case with those animals raised in the vicinity of the slaughterhouse.



The animals will be received at the lairage and placed in two pens, 30 x 20 meters each, goats and sheep in one receiving pen and cattle in the other. Animals will have to be detained for a minimum of twenty four hours in the lairage under the control of a slaughterhouse authority. The purpose of the receiving pens is to record the ownership of the animals and to issue receipts for them. Also dehorning would be done here. Retailers would have to buy their needs at the counters. Any condemned animal, carcass or organs will be a loss to the slaughterhouse authority.

The moment an animal enters the lairage, it will not be allowed to depart from the slaughterhouse alive in accordance with the current Lebanese Laws. The animals in the lairage are destined :-

- i. To be killed for the production of meat.
- ii. To be condemned and their carcasses destroyed.
- iii. To be isolated for a certain period prior to killing or condemning.

In the lairage, animals are kept in resting pens which are supposed to serve as shelters against snow, rain and sun. Food and water will be provided in these pens by the slaughterhouse authority. Food is placed in troughs or mangers that are readily accessible to the animals. One disadvantage of this method of feeding is that some of the animals may get less than their share for one reason or another. But, because such system is inexpensive and easy to operate it is usually

preferred to others. Water troughs are recommended to be placed at 25 cm above floor level and fixed to the floor whenever possible. Water should preferably be supplied continuously from an automatic cistern and surplus water will be drained to the sewers by an overflow pipe placed in the trough. Water should be supplied to the animals at all times, but food should be stopped twelve hours prior to slaughtering for reasons already mentioned. The area of the pens should at least be enough to satisfy three days' kill for cattle and two days' kill for sheep and goats. The area required for these pens should be as follows:-

for cattle 3 days x 100 kills/day x 3 m <sup>2</sup> /head =	900 m <sup>2</sup>
for sheep 2 days x 1000 kills/day x 0.8 m <sup>2</sup> /head =	1,600 m <sup>2</sup>
	<hr/>
(Net area)	2,500 m <sup>2</sup>

This estimated area will be enough to satisfy the number of animals to be lairaged in the year 2000 and, hence, is the maximum area needed. It should be divided into two distinct types of pens: one type for cattle and another for sheep and goats. Each cattle pen should be enough to provide space for 20 cattle and each sheep or goats pen should be enough to provide space for 80 animals. Therefore, 15 cattle pens and 25 sheep pens are required, the area of each is about 80 m<sup>2</sup>. The pens are grouped in groups of 5, and each pen is designed to be interchangeable for goats, sheep and cattle during emergencies or when necessary.

The floors of pens should slope 4% and <sup>1/2</sup> made of granolithic, non-slip concrete finish. The concrete is 12 cm. in thickness, laid over a hard core. Raceways are made of asphalt and provide communication between the receiving pens, the resting pens, the spray races and slaughterhalls. Pens should be separated by fences in order to prevent the animals from trespassing to other pens.

Besides the receiving pens and the animal pens the lairage area should include the sections indicated below:-

i. Food Storage

The location of the food storage place should be easily accessible both to the road and to the resting pens. Special attention should be given to the need to provide dry conditions in the stores, to the prohibition of smoking and fires in the vicinity of the storehouse, and to the provision of fire extinguishers and fire hydrants at the appropriate and strategic points.

This last provision was emphasized because similar places in Beirut were subject to several fire accidents because of lack of preventive and control measures. Furthermore, these places should be rat-and fly-proofed.

ii. Isolation Block

The isolation block, which is actually a miniature slaughterhouse, is another important structure in the lairage. It should provide a space for four cattle and ten sheep and goats, together with a slaughterhall. It



should be situated near the suspected meat detention room. This building should provide direct communication with a small incinerator for the final disposal of any condemned meat . The area of this block should be about 160 m<sup>2</sup>.

iii. Manure Hoppers

Considerable quantities of the lairage waste in the form of bedding and dung require periodical removal and this should be conveyed to manure hoppers where contractors will be responsible for daily removal and disposal.

iv. Offices

The building for offices in the lairage area should include offices and a small laboratory for the veterinary inspector who performs the ante-mortem inspection, all the sanitary facilities for workers and staff. Such facilities include washroom, lavatories, toilets and closets.

The lairage as a whole should be so oriented with respect to the slaughterhalls as to prevent any chaos in function and communication. The location is governed by such ~~many~~ factors as: availability of land, kind of animals and direction of wind. An ample supply of water for drinking and cleaning is needed. The floor level should slope away from the slaughterhalls. Proper drainage is important. Buildings should be well ventilated and, whenever natural lighting is not available, artificial lighting is necessary inside and outside the building.

b. At The Spray Races

Once the animals have had the required rest and care in the lairage and are ready for slaughtering they are moved to the slaughterhalls through a spray race for washing. One spray race for cattle and another for sheep and goats is to be provided. A spray race consists of an enclosure which obliges the cattle, sheep or goats to march in a single file. The race should be approximately five meters long for cattle and three meters long for sheep and goats, and should be provided with a system of spray nozzles set above, below and on either side of the animals. Each race is provided with two cubic meters reservoir, and chemicals for disinfection are added when necessary. These reservoirs should be continuously fed from the water mains, and a pump should be used to supply the nozzles with the wash liquid at a pressure of 1.5 atmosphere. The resulting waste is drained to the sewers. The two races should be independant from each other and may be interchanged in case of an emergency. After washing, animals would be ready for slaughtering, and are then introduced to the slaughterhalls where they are killed.

c. At The Slaughterhalls

The animals expected to be slaughtered in the proposed slaughterhouse include sheep, goats and cattle. Pigs and horses are not considered because of local faith and customs. On the other hand, camels are to be slaughtered whenever needed

in the cattle slaughtering pen following the practices in the new slaughterhouse of Kuwait where 300 sheep, 50 cattle and 3 camels are slaughtered daily.

The slaughterhalls are designed as one-story building. This will require more land which is available in the area. These halls should provide enough space for cooling and chilling the meat. Freezing will be required only for a small part of meat or organs for the destruction of certain bacteria and parasites. Slaughterhalls should be properly lighted, ventilated and screened. Walls should be constructed of water proofing materials and tiled with porcelaine tiles for easy cleaning and maintenance. Floors should be very smooth, of non-absorbing and non-slipping materials. Proper drainage is of primary importance.

i. Slaughtering

The slaughtering method recommended is the ritual method which complies with the beliefs of the majority of the community to be served. For this, special casting pens designed for ritual slaughtering should be provided. In cattle slaughtering, the animal is entirely held inside the pen and then turned over into the slaughtering position. Steady manual or electrical control are feasible. After the animal is killed it should be possible to easily remove the slaughtered animal for further processing. The pens are made of galvanized steel construction where no painting is allowed. This kind of machine is designed for 20 kills



per hour. For slaughtering sheep and goats, special tables in the form of cradles should be provided, and the animal is manually raised to the cradle where it is slaughtered. These are to be provided to supply the dressing line at a rate of 150 kills per hour, which requires about five cradles.

ii. Bleeding and Blood Collection

After the animals are slaughtered they are to be hung and left to bleed for about five minutes. Cattle are to be lifted by mechanical hoists and are to be hung onto a rail for bleeding. A power hoist mounted on top of the receiving end of the bleeding rail is to be provided. It should be rated for a weight of 1500 kgs. loads and should be suitable for local operation by means of an electric motor. The bleeding rails are to be located at 4 meters above the finished floor level, and the rails intended for other processes at 3.25 meters above the finished floor. The rails should be of the twin bar type made of mild steel, hot galvanized, and should safely carry loads of 800 kgs. per meter length. Rollers with hooks suitable for use in conjunction with the twin bar are provided to carry a load of 300 kgs. For sheep and goat carcasses carriers are to be provided. The type provided should be made of hot galvanized steel and provided with hooks 90° apart to carry four carcasses. The blood collected under the bleeding

rails or carriers should be drained into a collecting tank outside the slaughterhalls. The tank should have a holding capacity of at least two days to accommodate the blood obtained from 1800 sheep and goats and 200 cattle which amounts to:

$$1800 \times 2 = 3600$$

$$200 \times 5 = 2000$$

---

5600 kgs of blood.

The minimum tank capacity should, therefore, be 6000 liters or 6 cubic meter.<sup>5</sup> Care should be given to avoid unnecessary contamination of the blood which should be disposed daily by contractors.

iii. Skinning and Parts Removal

Skinning should be accomplished through inflation with air supplied from a compressed air tank through special needles inserted under the skin of the animal. This method is preferred to the automatic dehiders which require special installations. Inflating utensils consist of four needles with five meters of suitable rubber hose, approximately five millimeters in diameter for the sheep dressing line. The same may be supplied for the cattle line where only two needles would be needed. Each needle should be supplied with a valve and connected directly to a compressed air line after the bleeding area; hoses, valves and needles are to withstand a minimum pressure of ten atmospheres. Air inflation facilitates skinning with

special electrically driven instruments that simplify the process and help in getting a perfectly raw hide with a better trading value.

Removal of heads and legs should be done with the aid of special electrical saws, a procedure that requires little time and experience. The removal of these parts should be made directly after inflation and the severed heads should be subjected to post-mortem examination. They should then be carried on special carriages to the heads' rooms where the brain is removed and collected for sale. Similarly, the legs should be carried to the legs' rooms where they are collected for further processing. The skins are to be carried in similar carriages to the skin room for immediate preliminary treatment.

#### iv. Carcass Washing

Before the carcass is ready for evisceration, washing with a spray of water is an essential requirement to decrease the possibilities of contamination and to improve the appearance of the carcass. Warm water at 38°C is recommended for this purpose. The cloth used for wiping carcasses should be clean and dry.

#### v. Evisceration

Opening of the carcass, removal of the inside organs, intestines and paunch constitute the evisceration process. Post-mortem examination should accompany this process and should also be carried out on the carcass and organs

after conveying to the inspection table. When all organs have been removed and examined, the safe carcasses should be rewashed, sealed, split and either transported to the market, chilled or stored. Suspected carcasses should be retained for more detailed inspection or for condemnation.

A special weighing device should be available for weighing carcasses or parts thereof.

vi. Chilling

Chilling rooms which are designed to provide space for a two days' kill involving a maximum of 200 cattle and 2000 sheep and goats. But, because this is the demand needed after 40 years it is recommended to design only a few rooms at the initial stage and increasing their number as needed. The requirements in 1970 necessitate a space to store 90 cattle and 900 sheep or goats with a total area derived as follows:-

$$\begin{array}{rcl} 90 \times 1.2 \text{ m}^2 & = & 108 \text{ m}^2 \\ 900 \times 0.4 \text{ m}^2 & = & 360 \text{ m}^2 \\ \hline \text{Total} & = & 468 \text{ m}^2 \end{array}$$

The rooms should be designed to provide possible extension for future expansion whenever needed. Also, two additional rooms ( 4 x 5 meters each) should be provided for freezing.

The selling counters where the meat is to be weighed and supplied to butchers and consumers should be closely located to the chilling rooms. The area needed is estimated to be 200 m<sup>2</sup>.

3. Handling of By-Products

The by-product obtained in the proposed slaughterhouse may be subjected to the appropriate primary treatment at the slaughterhouse pending further processing, if necessary, elsewhere. The need for such action arises from the fact that the small quantities of by-products - heads, legs and intestines being used for food - would not justify having a complete by-product plant. Nevertheless, this does not preclude the fact that the by-products could be more efficiently utilized through the use of new techniques provided that a constant and adequate supply is assured.

Slaughterhouses are financed by municipalities while by-product plants are usually privately owned industries. Therefore a slaughterhouse should not undertake such an industry to avoid competition with private industries which may eventually hamper individual initiative and free enterprise.

A slaughterhouse including the proposed one, should restrict its activities to comply with its objective of producing hygienic meat fit for human consumption. A by-product plant is intended for the profitable utilization of by-products which are otherwise worthless and require disposal.

a. Manure

The manure from the lairage area and the bedding materials from the pens are removed daily to produce sanitary conditions in this area. The manure is disposed off into manure hoppers where contractors should remove away the collected waste from

the hoppers for further processing. This leads to a certain income to the slaughterhouse.

b. Blood

The proposed slaughterhouse is a small one and as such does not lend itself to the economical processing of blood and the installation of a processing plant is not warranted. To illustrate this point the following figures are cited.

Five tons of raw blood produce one ton of fertilizer as dried blood. The maximum amount of blood that can be produced at the proposed slaughterhouse would be 2800 kgs. per day in the year 2000. This would produce only 560 kgs of dry blood which is too small a quantity to justify the cost of the undertaking.

Disposal into the sea is to be practiced at the new Beirut Slaughterhouse which is expected to produce 5 times the quantity of blood estimated above for Baalbeck. However, a contractor now (March 1965) negotiating with the Municipality of Beirut to obtain a concession for the procurement of the blood. In the event that this contractor succeeds it is possible that he might be interested in procuring blood from other sources. This leads to the necessity of recommending that the proposed slaughterhouse be provided with the essential facilities for the collection and storage of blood to be sold to a contractor for processing. The stored blood should be treated with a chemical coagulant to prevent clotting.



c. Horns, Hoofs and Bones

Dehorning of animals at the receiving pens yields horns which are collected together with bones and hoofs in special tanks. These may be sold in the raw form for further processing. The collection tanks should be tightly closed, periodically cleaned and emptied daily by the contractor. Transportation in closed containers to avoid any contamination, odor and fly problems is essential.

d. Organs, Legs, Heads and Large Intestines

After removal of the edible offal and organs as the stomach, large intestines, lungs, liver, spleen and testicles they should be examined and then sold to the public; when found unsafe they are to be condemned and sent to the incinerator. The heads may be sold to the public as such or after the removal of tongues and brains for the preparation of a special Lebanese dish that includes intestines and viscera. This national dish cannot be discontinued, but care should be taken to provide safe and sanitary ingredients. Special attention should be given when examining the liver, and it should be condemned upon mere suspicion because it is eaten raw by many.

e. Small Intestines

The small intestines are collected, salted and sold daily to special traders. The collection is made in the intestines room where they are washed, rinsed and salted. This is done in order to avoid their decomposition and putrefaction.

f. Fats and Grease

Fats and grease should be collected in special tanks and sold to the public for use as edible fats, or to contractors for processing.

g. Hides

Hides are the most important of the by-products for they are used for leather production by local tanneries of which there are several in Lebanon. Because the slaughterhouse is small, full processing is not recommended, and only primary treatment should be considered. The hides are easily putrefied and for this reason the preparation of "green hide" should start immediately after slaughtering. Delayed treatment will cause a lot of bad odors. Under no circumstances there should be delay of more than 24 hours during cold days, and 18 hours during warm days. The rooms where hides are to be treated and stored should be constructed of waterproof materials and well drained to the sewers.

Mashghara, a town in the south of Beka'a District, is a well known center for tanneries. Actually, two hide traders from Baalbeck buy the raw hides from butchers, salt them and resell them to the Mashghara tanneries.

This area where the by-products are treated and stored is to be located near the slaughterhalls at one side of the building. The transfer of by-products from slaughterhalls to this area may be done through special carriages designed for

this purpose and should always be cleaned and well maintained. The proximity of this area to the slaughterhalls may cause sanitary problems due to negligence and improper maintenance. For this reason care should be given to provide this area with adequate ventilation, water and proper drainage system to ensure optimal sanitary conditions.

#### 4. Proposed General Layout

The different parts of the slaughterhouse as listed below are shown in the general layout plan, Appendix A, Drawing No. III.

- a. Entrance and gate house.
- b. Receiving pens.
- c. Spray race.
- d. Resting pens.
- e. Offices for personnel.
- f. Food storage halls.
- g. Water reservoir.
- h. Manure hoppers.
- i. Isolation block.
- j. Spray race and slaughterhalls.
- k. Parking Area and Offices.
- a. Entrance and Gate House

The entrance to the slaughterhouse is designed to allow the entry of vehicles to deliver their load of live animals at the receiving pens, or animals driven on their hoofs.

The gate house which is at one side of the entrance serves to control pedestrians, animals and vehicular traffic. It also provides a shelter with all facilities for physical comfort during day and night for the gatemen and watchkeepers.

b. Receiving Pens

When the animals are brought to the slaughterhouse they are received at the receiving pens, which consist of two halls - one for cattle and one for sheep and goats. Each area is about  $600 \text{ m}^2$  and provides a net area of about  $450 \text{ m}^2$ . The division of these pens is shown in detail in Appendix A, Drawing No. IV.

c. Spray Race

Animals driven from the receiving pens are all forced through the spray race which is designed to give them a shower before they enter the resting pens.

d. Resting Pens

In the rest pens ante-mortem care and inspection are carried out. They consist of eight pens, three for cattle and five for sheep and goats. Each pen consists of a gross area of  $720 \text{ m}^2$  (40 x 18 m) and provides approximately  $375 \text{ m}^2$  as net area. Therefore, the total net area provided is:

for cattle	$375 \times 3 = 1,125 \text{ m}^2$
for sheep and goats	$375 \times 5 = 1,875 \text{ m}^2$
	<hr/>
Total	$3,000 \text{ m}^2$

Details are shown in Appendix A, Drawing No. V.

e. Offices for Personnel

These offices serve the personnel responsible for ante-mortem inspection and the general maintenance of the slaughterhouse. They consist of three offices, a laboratory, wash rooms and a large work shop. This block is situated near the lairage area.

f. The Food Storage Halls

Food for animals are stored in halls located near the resting pens and the entrance. This block should be enough to provide space for a month's supply of hay and preferably for a period of four to eight months. This will allow storage of hay during the summer period when it is cheap.

g. Water Reservoir

This reservoir with a capacity of 600 m<sup>3</sup> is located near the food stores.

h. The Manure Hoppers

The manure hoppers are two identical tanks built of concrete or steel for the temporary storage of manure and other solid wastes prior to their removal. They are located near the gate for easy access.

i. Isolation Block

Suspected animals are driven from the resting pens to the isolation block which is a small structure of about 216 m<sup>2</sup> (18 x 12 m). It consists of four parts; details are shown in Appendix A Drawing No. VI.

- i. The isolation of animals in individual pens: four for cattle and ten for sheep and goats. Safe animals will be driven to the slaughterhalls while unsafe ones will be taken to the second part: the slaughterhall of the isolation block.
- ii. The slaughtering hall of the isolation block is a miniature slaughterhouse which serves to kill condemned animals. (Stunning may be used in this connection because the product of such meat is not eaten and is destroyed).
- iii. The third part consists of a room to which condemned meat is transferred.
- iv. The incinerator room which is provided with a small incinerator and fuel tank serves to incinerate the condemned meat. A high smoke stack is needed for proper dispersal of smoke and fumes. Smokeless incinerators are preferred.+
- j. Spray Race and Slaughterhalls  
Details are given later in section 5.
- k. Offices and Parking Areas  
The main offices are a part of the slaughterhall building. A covered pathway leads from these halls to the offices which include:-
  - i. A lounge.
  - ii. Six offices for personnel and staff.



iii. Kitchen.

iv. Dining room.

An outdoor parking area for cars is also provided.

## 5. Proposed Plan for the Slaughterhalls

The plan for the slaughterhalls and annexes allows simple operation, easy maintenance, and safe and sanitary meat production. For the divisions given here under the reader is referred to Appendix A, Drawing No. VII or page 129. Facades and Sections are shown respectively in Drawings Nos. VIII and IX.

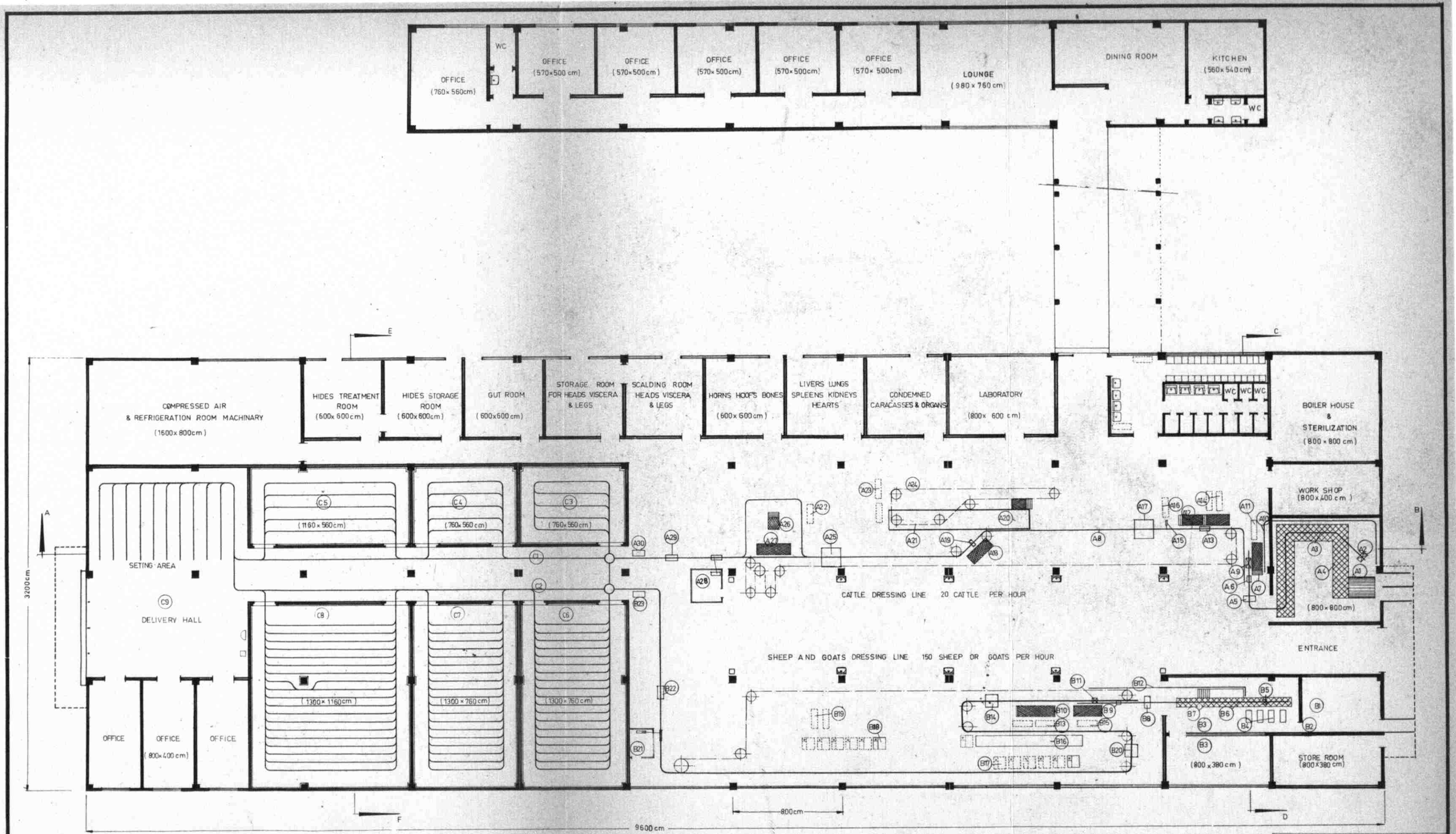
- a. A cattle dressing line (A).
- b. A sheep or goat dressing line (B).
- c. A refrigeration plant and selling counters (C).
- d. A by-product treatment plant.
- e. Offices, laboratory, work shop, boiler house, etc.

### a. Cattle Dressing Line

The cattle dressing line is adequate for operation at a killing rate of 20 cattle per hour and consists of three parts described below:-

#### i. Cattle slaughtering pen

The animals are brought into a machine, the slaughtering pen (A 1), figure 1, which comprises a fabricated steel framework of welded and bolted construction. A rotating section is fitted between two mild steel rings mounted on rollers with bearings. The entrance door has a self



**SLAUGHTERHOUSE FOR BAALBECK**  
 SLAUGHTERHALLS AND OFFICES. Plans  
 SCALE 1/250 DRAWING NO VII JUNE 1965  
 ENGINEER Nicholas F. Shamma *N. Shamma*

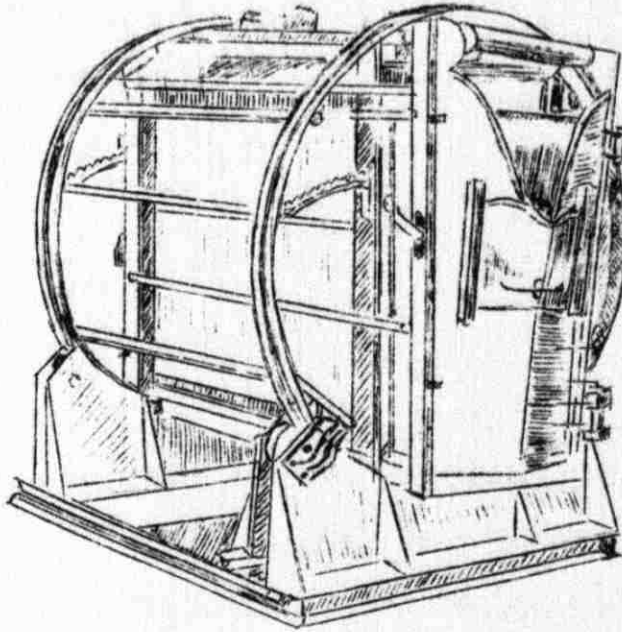


Figure 1

Ritual Cattle Casting Pens  
(The IWEL Engineering Limited.)

locking device and plate for persuading the animal forward and is operated through a screw thread. Quick acting, lever operated locks are fitted to the exit door. An adjustable neck rest is provided to suit any size of animals, and is controlled by a brake to stop its rotation and lock it at any required position. When the animal is upside down, the neck of the animal is cut.

ii. Bleeding rails

The animals when slaughtered are lifted by a hoist (A 2), electrically driven and manually operated and controlled, to the bleeding rails (A 3) over a gridded area where the blood is drained to the reservoir through a pipe, 2" in diameter and installed with the proper fittings. The gridded plates (A 4) are made of hot galvanized steel. The power of the hoist should be enough to carry a load of 1500 kg.

When bleeding is over, the animal reaches position (A 5) where inflation is conducted by means of two needles connected to the compressed air line. The animal reaches position (A 6) where the head and legs are removed by a special machine and saw. A platform (A 7), figure 2, constructed of non corrosive metal of welded tubular construction with non-slip flooring and plate steps which are completely galvanized, helps the operator to perform this operation at any required level. At the same time the hind legs are shackled and transferred to the dressing rails (A 8).

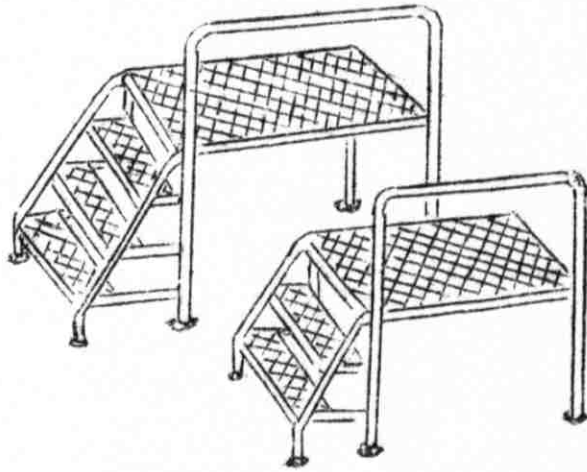


Figure 2

Cattle Dressing Platforms  
(The IWEL Engineering Limited.)



iii. Dressing rails

The transfer from the bleeding rail to the dressing rail is done by means of a second hoist (A 9) similar to (A 2). The shackles used on the bleeding rail are transferred to an inclined rail (A 10) leading to a position near the slaughtering pen. A second platform (A 12) similar to (A 7), helps the operator to remove the skin of the hanging animals by a pneumatic instrument (A 13) specially designed for this purpose. A pneumatic saw (A 15) is used to remove the tail and sternum. Carriages (A 11) carry the head and legs to the inspection table whereas carriages (A 14) and (A 16) carry the skin and tails respectively to the by-products plant. The number of carriages required depends on their size and capacity.

At this stage, the carcass receives a shower from the spray system (A 17), figure 3, which opens automatically when the carcass passes through it. The next stage of evisceration occurs on platform (A 18) similar to (A 7). The carcass is opened with a special saw (A 19) and all organs are removed and placed on the inspection table (A 20). This table, 10 meters long, 1 meter wide and adjustable height, is made of galvanized steel with a well rounded edge of approximately 8 cm. Special examination of the liver ensures its safety as well as the safety of the whole carcass. The heads which are moved along their respective



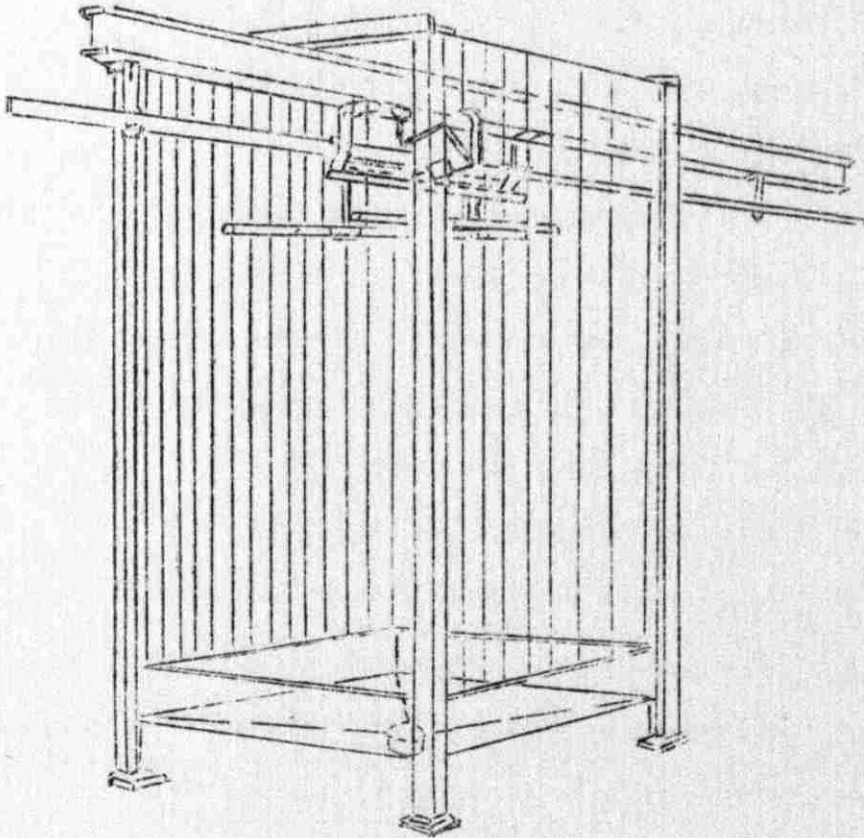


Figure 3

Automatic Carcass Sprayer

(N.V. Noord - Nederlandsche Machinefabriek.)

carcasses are examined and after approval are transferred to the by-product plant. The red parts such as hearts, kidneys, lungs, spleens and livers are carried by a conveyor (A 21) which leads to carriages (A 22) that transfer them to the by-product room where they are washed and delivered to consumers. The white parts, like the viscera and intestines are transported by carriages (A 23) to the by-product plant for further processing. Condemned meat are transported in red carriages to the condemned meat room, where suspected carcasses are retained for further inspection at position (A 26) which is a by-pass rail.

The carcasses after evisceration are again washed at position (A 25) by a system similar to (A 17). The suspected ones are retained while the safe ones are divided when needed into parts by a special saw (A 27), figure 4, designed in a way to avoid the spreading of saw burns and bone dusts. This saw is electrically driven and manually operated and controlled. The carcasses or parts are then weighed by a special balance (A 28), rinsed by a manually controlled sprayer (A 29), figure 5, and then sealed by the veterinarian or assistant (A 30). The meat is then ready for refrigeration or sale.

b. Sheep or Goats Dressing Line

This second line is adequate to satisfy a killing rate of animals of 150 unit/hour. It includes:

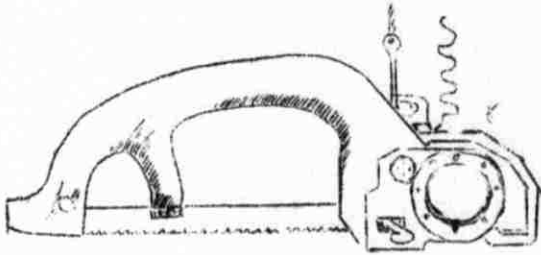


Figure 4

Beef Splitting Saw

( The IWEL Engineering Limited. )

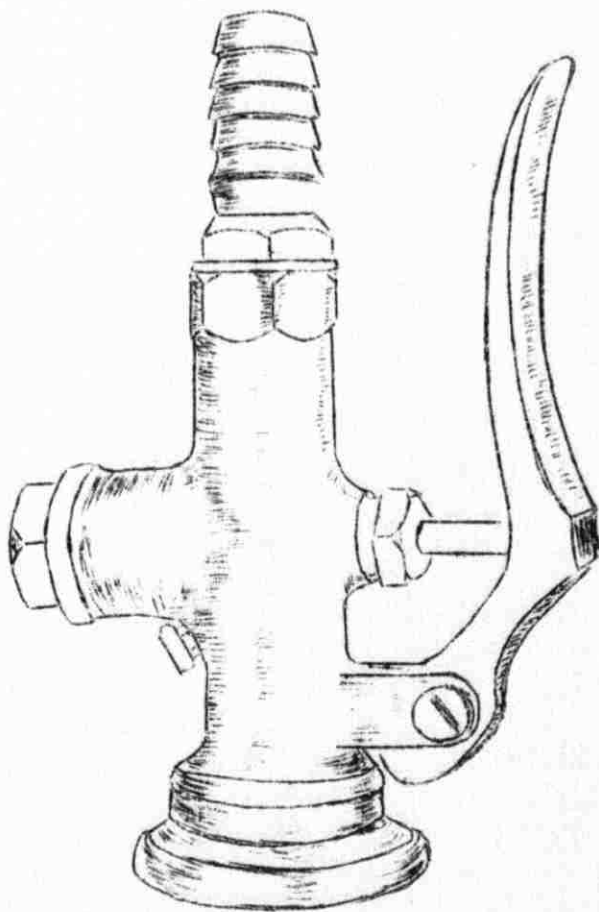


Figure 5

Hand Sprayer

( N.V. Noord - Nederlandsche Machinefabriek, )

i. Slaughtering and Bleeding Rail

Animals are received at the waiting room (B 1). A temporary partition (B 2) is to keep the other parts of the rooms for future expansion. In the meantime these partitioned rooms may be used as may seem convenient. The animals are manually raised and tied to the sheep slaughtering cradles (B 4), figure 6, which are made of galvanized steel. The neck is cut ritually by a knife. Blood is collected under the cradles and drained to the blood reservoir in a similar way as mentioned in the cattle dressing line. Then, the animals are shackled from the hind legs and lifted by a hoist (B 5), with a lifting capacity of 300 kgs, to the bleeding rail (B 6) over a grilled area (B 7) under which the blood is collected and drained. When the animal is completely bled, it is inflated by air (B 8) from one of the needles after which the head and legs are cut by a saw (B 9). The carcass is transferred to the dressing line (B 10) by a hoist (B 11) similar to (B 5). The hooks or shackles are returned to their original position through an inclined rail (B 12), by gravity.

ii. Dressing Rail

A skinning platform similar to (A 7) would be helpful to the operator. Skinning instruments similar to those needed for cattle are essential. Skins are placed in carriages (B 13) for transfer to the by-product plant. Carcasses are

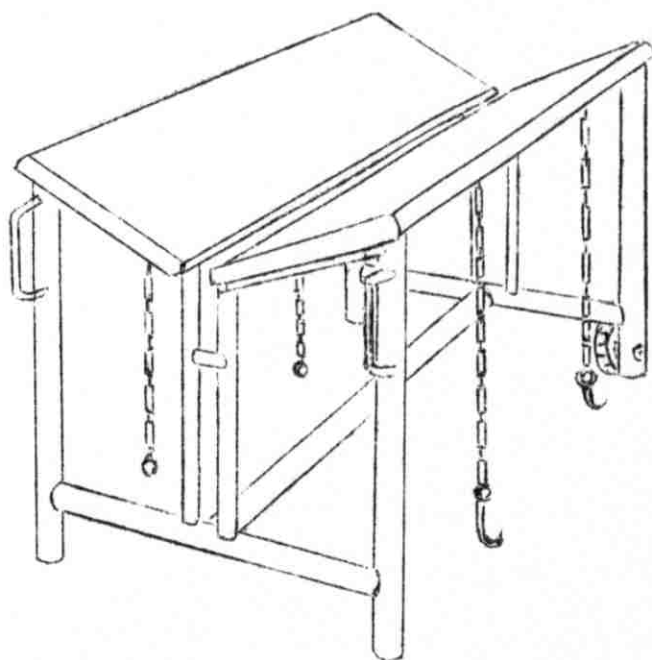


Figure 6

Sheep Slaughtering Cradle.

( N.V. Noord - Nederlandsche Machinefabriek.)



then washed by a shower (B 14) similar to (A 17) but having a size suitable for sheep and goats. The heads and legs are transferred by carriages (B 15) to the examination table where they are examined together with their respective carcasses. The examination table (B 16), figure 7, is made of a conveying system composed of many cells, one for each animal. Each cell is divided into three divisions: one for intestines and viscera; one for heads and legs; and the third cell for the red organs viz. hearts, spleens, kidneys, livers and lungs. The conveyor leads to a special carriage (B 17) in which each type of organ or part is collected separately and conveyed to its respective room in the by-product plant. Suspected organs are collected in carriages (B 18) and <sup>kept</sup> pending further examination. The red carriages (B 19) are used for conveying the condemned meat to the condemning room.

Safe carcasses are then washed at (B 20) by a shower similar to (B 14), weighted at (B 21), washed again from the outside by a sprayer system (B 22) similar to (A 29). Finally, after sealing at (B 23) by the veterinarian or his assistant, the meat would be ready for refrigeration or sale.

c. Refrigeration Plant and Selling Counters

After the carcasses are sealed they are transferred either to the refrigeration rooms or selling counters depending on the meat demand. The same rails from the dressing lines are

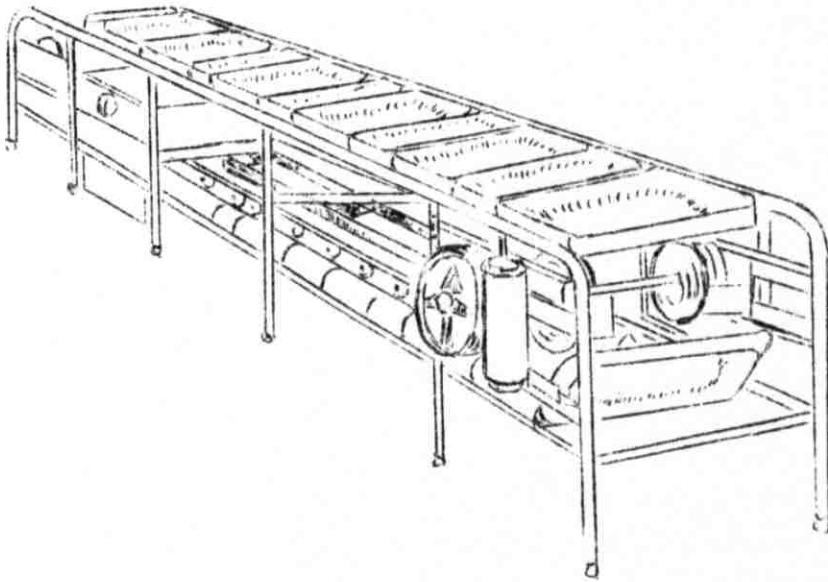


Figure 7

Moving Top Examination Table

( N.V. Noord - Nederlandsche Machinefabriek )

continued to the refrigeration area indicated as (C 1) and (C 2). These rails should be designed to ensure safety in the refrigeration rooms. Room (C 3) is the freezing room needed for the treatment of carcasses infected by certain parasites. The two rooms (C 4) and (C 5) are for the refrigeration of cattle carcasses, each having an area of about 45 and 70 m<sup>2</sup>, respectively. (C 6), (C 7) and (C 8) are three other rooms for the refrigeration of sheep or goat carcasses with a total area of 360 m<sup>2</sup>. These rooms are designed in such a way as to be interchangeably used for cattle and sheep or goat carcasses. Also the size of the rooms ensure different combination areas in the demand of refrigeration.

Any meat not intended for storage, is sent to the selling counters (C 9) where cooling of the area is necessary to ensure the proper setting of meat prior to marketing. The area also includes three offices and an accounting section to accommodate personnel concerned with transactions and accounting.

Once the animal reaches the delivery room it should never be returned. Special vehicles should be used, for distribution under acceptable conditions.

d. By-Product Plant

The by-product plant includes several rooms, each of which is intended for the treatment or preparation of a specific by-product. These rooms are:

- i. Hide treatment and storage rooms.
  - ii. Scalding room for viscera, legs, heads and large intestines.
  - iii. Gut room.
  - iv. Bones, hoofs and horns collection room.
  - v. Room for cleaning of organs: hearts, spleens, livers, kidneys and lungs.
  - vi. A small room for collecting condemned parts and organs.
- e. Miscellaneous Sections
- i. Laboratory.
  - ii. Workshop.
  - iii. Boiler house.
  - iv. Refrigeration and compressed air machinery.
  - v. Showers, baths, toilets, lavatories and closets.
  - vi. Storage room.
  - vii. Electrical distribution room (part of item iv).
  - viii. Entrances.

## 6. Water Supply

### a. Quantity and Quality

Slaughterhouses require large quantities of water for consumption by animals awaiting slaughter in the lairage, for consumption by personnel, for washing the animals before slaughtering, for washing the carcasses during the dressing process, for washing the by-products and their treatment, and for general routine cleansing and washing. Water is also used to feed boilers for the production of steam and hot water, and

for cooling purposes.

In developed countries an ample supply of clean and potable water under adequate pressure and sufficient amounts for all operations is a legislative requirement<sup>(9)</sup>. It must be distributed to every part of the slaughterhouse including the fire hydrants.

The daily requirements of water in the lairage for livestock only is 7 to 12 gpd per head of cattle, and 1 to 4 gpd per head of sheep or goat<sup>(11)</sup>. The total water requirements for all purposes in the slaughterhouse is assumed to be 1500 liters per day per head of cattle, and 500 liters per day per sheep or goat. This assumption is based on the normal quantity of slaughterhouse wastes<sup>(36)</sup>. Therefore, the quantity of water needed in the slaughterhouse for its maximum operation in the year 2000 would be:-

$$900 \times 500 = 450,000 \text{ liters} = 450 \text{ m}^3$$

$$90 \times 1500 = 135,000 \text{ liters} = 135 \text{ m}^3$$

---

$$\text{Total} \quad 585 \text{ m}^3 \text{ or approx. } 600 \text{ m}^3$$

In the year 1970 an amount of  $300 \text{ m}^3$  is considered to satisfy all the daily needs. A  $600 \text{ m}^3$  storage tank would serve for two days. More of the tanks would be installed in future as needed.

Since the slaughterhouse would be about 70 meters below the source of water supply, Ras-El-Ain, flow by gravity would serve the purpose. If proper measures are taken to protect the source

and water in the distribution system it would be possible to obtain water fit for drinking and other purposes at the slaughterhouse; otherwise treatment either by the municipality or at the slaughterhouse, with chlorination as a minimum, would be necessary. Most waters in Lebanon are hard, and that of Ras-El-Ain is no exception. Boiler feed water should be softened at the slaughterhouse to avoid scale problems.

b. Source

Most of Ras-El-Ain water supply is owned at present by the municipality of Baalbeck and the rest by land owners who use the water for irrigation. Should the plans for the new town of Baalbeck with its sewerage and sewage treatment plant be executed, then the treated sewage effluent may be utilized for irrigation in place of Ras-El-Ain water which could then be used solely for municipal purposes including the new slaughterhouse. This would be a more favorable and economical solution than an alternative one based on the utilization of Al-Lejooj spring as a supplementary supply.

c. System Layout

The projected plan for the slaughterhouse water supply system includes a main 6" water pipe of galvanized steel connecting the source to the slaughterhouse. This line should bear a pressure of at least 70 meters or 7 atmospheres which can be withstood by a 6" welded pipe of galvanized steel. At the slaughterhouse the water would be stored in a water reservoir



for distribution through the internal distribution system. Pumping may be necessary in case of pressure drop in the internal distribution lines.

The areas that need to be supplied with water are:

- i. Lairage area and foddors.
- ii. Spray races.
- iii. Offices.
- iv. Slaughterhalls.
- v. Sanitary facilities (closets, lavatories, washing rooms, drinking fountains and sterilizing sinks, figure 8).
- vi. Boiler house.
- vii. Refrigeration system.
- viii. Fire hydrants.
- ix. Cooling tower.
- x. Isolation block.

Besides the cold water system, a hot water system and steam need to be provided at the points requiring such facilities.

A central heating system would serve a very useful purpose because of the extreme cold in winter.

## 7. Waste Disposal

### a. Sources of Wastes

Slaughterhouse wastes being objectionable and hazardous must be properly treated and disposed. They include a variety of things from various sources, namely: manure, blood, paunch manure or liquor, flesh, grease, hair, dirt and wash water.

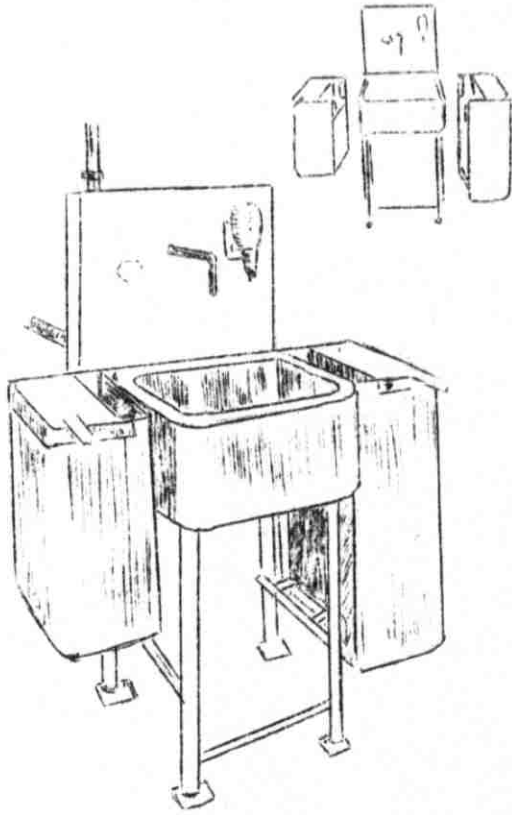


Figure 8

Sterilizing Sink

( The IWEL Engineering Limited.)

Part of the waste may be separated and recovered like blood, manure and bedding from the lairage. The rest will be diluted and carried by water to waste.

It was stated earlier that the manure and bedding materials from the lairage is to be collected in manure hoppers for further processing and recovering. Blood too is to be collected in a special tank for the same purpose. The remaining wastes would have to be disposed into sewers. This kind of industrial waste is liable to have a high B.O.D. value, because of the high organic content. For mixed animals the B.O.D. may reach a value of 2200 mg/l with a population equivalent of 40.2 per animal<sup>(8)</sup>. These values are reported for large animals like cattle, but for the smaller animals like sheep and goat the value may be 1000 mg/l of B.O.D. with a population equivalent of 7.5 per animal.

Because  $1.5 \text{ m}^3$ /cattle and  $0.5 \text{ m}^3$ /sheep or goat were assumed for the water supply and because most of this water is assumed to reach the sewers,  $600 \text{ m}^3$  constitute the maximum amount of liquid wastes.

b. Preliminary Treatment

The preliminary treatment of the liquid waste will consist of screening the large suspended solids and trapping the grease which consists of fat resulting from small pieces of fatty tissues, fat melted by the warm water used for washing, and treatment of tripery and by-products especially hides.

Solid particles, estimated to constitute approximately 900 ppm in the waste, are skins, hairs, meat, bone trimmings, gulls and urinary bladders. These must be removed by screening which may be accomplished through a variety of screening devices placed as near as possible to the operational points. A screening chamber or gulley at the end of the drain is another efficient arrangement, for it reduces the rate of flow of the waste so that small particles settle beneath the screenings. It screens the materials which have passed the preliminary screens and at the same time prevents rats from entering the slaughterhouse through the sewers. For this purpose screens with 1/16 of an inch mesh are adequate. A finer screen may cause clogging. The screens should be fitted in such a manner so that they can be easily removed for cleaning.

Fat dissolved or suspended in water will pass through the screens and, if not trapped, will clog the sewers by forming a permanent scum. At the same time if the effluent is used for irrigation, it will clog the soil and lower its absorbing capacity. For these reasons the use of a grease trap is highly recommended. Grease traps reduce the rate of flow and thus allow grease to rise to the surface forming a scum which is collected and disposed. In these traps the velocity of water passing under the baffle should not be greater than 1 foot in 4 seconds. The detention

period should be about 30 minutes. The final effluent is to be discharged into the municipal sewerage system for further treatment.

This scheme is based on the assumption that a municipal sewage treatment plant is to be constructed and that the treated effluent of the sewage plant will be used for irrigation of the area near the treatment plant.

## 8. Other Utilities

### a. Rain Water System

The rain water system should be designed to carry the rain through the slaughterhouse area in an appropriate drainage. No treatment of any kind may be required and therefore it can be easily directed to the area where it is used for irrigation.

### b. Refrigeration Plant

This plant is intended to ensure the safe and proper storage of meat. The equipment needed for this plant to secure these requirements should include:

- i. Compressors.
- ii. Condensers.
- iii. Cooling units and cooling tower.
- iv. Water circulating pumps.
- v. Liquid reservoir.
- vi. Automatic capacity control and control gear.
- vii. Refrigerant.
- viii. Piping installation.

- ix. Exhaust fans.
- x. Insulation of pipes and equipment.
- xi. Insulation of the refrigeration areas.

c. Compressed Air

A compressed air system should be installed to provide the necessary air needed for inflation or any other purpose. It should include:

- i. Air compressors.
- ii. Air reservoirs.
- iii. Piping system.

d. Boiler House

Steam and hot water are needed for washing, sterilizing equipment, and possibly for other purposes such as heating during winter. The system should include:-

- i. Boilers.
- ii. Fuel tank.
- iii. Fuel preheater, if necessary.
- iv. Steam supply.
- v. Heat exchangers.
- vi. Piping fittings and insulation.

e. Offices

The area provided for offices includes the offices, laboratory, washing area, kitchen and rest room.



f. Work shop

A work shop should be available for urgent and minor repairs which secure better maintenance.

g. Electrical Supply

The electrical supply to the slaughterhouse is assumed to have to depend on the city or any other available supply at 190-110 volts, three phase, 50 cycles. Control equipment and switch gear and a complete panel board should be available.

h. Lighting

Lighting and wiring should be done in accordance with Lebanese Regulations\* or an approved code. The system should include: lighting board, distribution panel and lighting fixtures and fittings. Also, lighting for streets, yards and pens is necessary. Outdoor lamps should be fitted with water tight and dust proof fittings and should be installed on wooden poles. Protective fuses and switches, and a panel board located in the switch gear room of the slaughterhouse is provided as a part of the refrigeration and machinery room.

i. Car Parking

Private car parking area is required to satisfy the needs of personnel, staff, workers and traders.

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\* Under preparation by the Municipality of Beirut.

Chapter IV

ECONOMICAL STUDY

The tendency in Lebanon and other countries of the world is to erect new slaughterhouses to meet the needs and often to replace the old and obsolete ones, or, at least, to remodel and extend existing ones. No doubt, slaughterhouses have merits not only from the **hygienic and social** viewpoints but from the economical as well.

A communal slaughterhouse as the one proposed for Baalbeck and its neighboring villages has many advantages. First of all, a common slaughterhouse serving several communities is more economical than having one slaughterhouse for each community in respect to cost of construction, operation and maintenance. Duplication of facilities, equipment and skilled personnel would be avoided. Continuity of operations at both the production and sales levels is more likely to be attained. Proper **organization**, management and control would be more feasible. Modern facilities and equipment offer an added advantage in respect to efficiency, yield, and hygienic quality. Processing of adequate quantities of by-products would assure the recovery of useful material which should otherwise require proper disposal, thereby augmenting the income and meeting local needs. This would not be possible in a small slaughterhouse.

A. Cost Estimate

The initial cost of the proposed Baalbeck slaughterhouse as estimated hereunder represents the sum of the costs of land, construction and equipment. In most of the cases, costing was based on actual price quotations, but the cost of some items are mere estimates, based on prices quoted in a tender for equipment and supplies for the new Beirut Slaughterhouse. Unnecessary details have been omitted. Slightly high values in some cases may be justified on the ground that the trend in costs is upward as in the cost of labor cost - assuming significant increases at the time of erection of the proposed slaughterhouse. Another factor contributing to the significant decrease in the cost of imported equipment and supplies would be the wavering of customs. Some of the cost estimates are flexible and, therefore, only approximations can be offered. For instance, the cost of laboratory equipment may range from L.L. 5,000 to L.L. 100,000 depending upon the quantity, type and make. The inclusion of such items is merely for the record and for the sake of completeness. The construction costs were based on estimates for a square meter.

The following are the itemized estimates:-

	<u>Cost - L.L.</u>	<u>Total Cost</u>
1. Land		
a. Area: 70000 m <sup>2</sup> @ 0.5 L.L./m <sup>2</sup> .	35,000	
b. Excavation of land, and leveling.	15,000	
c. Tree planting.	8,000	
d. Fence.	7,000	
	<hr/>	
Sub-total	<u>65,000</u>	65,000
2. Slaughterhalls		
a. Structure and all the building without equipment. Area 3000 @ 90 L.L./m <sup>2</sup> .	270,000	
b. Cost and installation of the cattle dressing line.	200,000	
c. Cost and installation of the sheep dressing line.	175,000	
d. By-product plant equipment.	75,000	
e. Refrigeration machinery, insulation of the refrigeration rooms - ready for operation- .	250,000	
f. Boiler house and sterilizer.	80,000	
g. Compressed air equipment.	40,000	
h. Laboratory equipment.	20,000	
i. Work shop equipment.	10,000	
j. Drinking fountains.	6,000	
k. Sterilization units.	9,000	
	<hr/>	
Sub-total	<u>1,135,000</u>	<u>1,135,000</u>
C.F.		<u>1,200,000</u>

	<u>Cost - L.L.</u>	<u>Total Cost</u>
B.F.		1,200,000
3. Offices		
a. Two buildings. Area 1000 m <sup>2</sup> @ 120 L.L./m <sup>2</sup> .	120,000	
b. Central heating for both.	30,000	
c. Furniture.	30,000	
	<hr/>	
Sub-total	180,000	180,000
	<hr/> <hr/>	
4. Entrance and gate house		
Structure and furniture .	15,000	
	<hr/>	
Sub-total	15,000	15,000
	<hr/> <hr/>	
5. Receiving pens		
Area 1200 m <sup>2</sup> @ 75 L.L./m <sup>2</sup> .	90,000	
	<hr/>	
Sub-total	90,000	90,000
	<hr/> <hr/>	
6. Resting pens		
Area 3000m <sup>2</sup> @ 70 L.L./m <sup>2</sup> .	210,000	
	<hr/>	
Sub-total	210,000	210,000
	<hr/> <hr/>	
7. Spray races		
Two units @ 7500 L.L. each.	15,000	
	<hr/>	
Sub-total	15,000	15,000
	<hr/> <hr/>	
C.F.		1,710,000

	<u>Cost - L.L.</u>	<u>Total Cost</u>
B.F.		1,710,000
8. Storage halls		
Area 400 m <sup>2</sup> @ 80 L.L./m <sup>2</sup> .	32,000	
Sub-total	<u>32,000</u>	32,000
9. Water reservoir		
Capacity 600 m <sup>3</sup> .	50,000	
Sub-total	<u>50,000</u>	50,000
10. Manure hoppers		
Two units @ 10,000 L.L. each.	20,000	
Sub-total	<u>20,000</u>	20,000
11. Parking areas and roads		
Parking areas 1000m <sup>2</sup> @ 10 L.L./m <sup>2</sup> .	10,000	
Roads 6000 m <sup>2</sup> @ 10 L.L./m <sup>2</sup> .	60,000	
Sub-total	<u>70,000</u>	70,000
12. Isolation block		
a. Structure. Area 200 m <sup>2</sup> @ 90 L.L./m <sup>2</sup> .	18,000	
b. Equipment.	5,000	
c. Incinerator with chimney.	25,000	
Sub-total	<u>48,000</u>	48,000
C.F.		<u>1,930,000</u>



	<u>Cost - L.L.</u>	<u>Total Cost</u>
B.F.		1,950,000
13. Lighting of yards		
a. Poles and fixtures.	16,000	
b. Main control room.	4,000	
Sub-total	<u>20,000</u>	20,000
14. Transport vehicles		
a. Trucks, three @ 30,000 L.L. each.	90,000	
b. Stations, two @ 15,000 L.L. each.	30,000	
Sub-total	<u>120,000</u>	120,000
15. Water system and sewage system mains	200,000	
Sub-total	<u>200,000</u>	200,000
16. Study and supervision of the project 6% approx.	125,000	
Sub-total	<u>125,000</u>	125,000
Total		2,395,000
	Unforeseen (8.5%)	205,000
	Grand Total	<u>2,600,000</u>

The cost estimate of the proposed slaughterhouse, ready for operation in 1970 and to serve a community of 70,000 inhabitants is two millions six hundred thousand Lebanese pounds. This gives a cost of 37 L.L. per capita. In Table X, the cost per capita and other data for some Lebanese slaughterhouses under study or construction are presented for purposes of comparison with those for the proposed Baalbeck slaughterhouse.

Table X

Comparison of Cost/Capita among Local Slaughterhouses

Slaughterhouse	Type of Community	Population Served *	Total Cost L.L.	Cost/Capita L.L.
Baalbeck	Semi Urban	70,000	2,400,000	37
Beirut	Urban	500,000	10,000,000	20
Zahleh	Urban	140,000	4,000,000	29
Jounieh	Urban	110,000	3,500,000	33

\* Estimated at start of operation.

High cost per capita is limited to small slaughterhouses because initial cost of equipment remains the same regardless of the size of the slaughterhouse. This becomes evident on considering the cost of the cattle slaughtering pen, to cite only one typical example, which is estimated at L.L. 10,000 . In the Beirut slaughterhouse two such units would serve a population of 500,000 in beef, whereas in Baalbeck

or any other small slaughterhouses would require one slaughtering pen irrespective of the small size of the population served.

Taking all facts into consideration, the estimated cost of the new Baalbeck slaughterhouse seems reasonable enough to warrant the attention and approval of the authorities concerned. As a model communal slaughterhouse to be adopted in other areas in Lebanon, it would not merely fulfill its objectives economically, but would also meet a dire need.

B. Management and Operation

The proposed slaughterhouse is expected to operate under government control through the Ministry of Agriculture as is the case with all Lebanese slaughterhouses with the exception of that in Beirut which is controlled by the Municipality. It will have to be directly managed by a director, a veterinarian by profession, who would concurrently serve as director of the veterinary department. The two other departments would consist of the engineering department and the administration department.

As far as transactions are concerned, it is assumed that the slaughterhouse authority would buy the animals from dealers and undertake the slaughtering operations at its own expense and responsibility including the sale of meat to butchers. Therefore, fees for the lairage period and for the slaughtering process would not be required. The slaughterhouse authority would buy the live animals on the basis of gross weight and sell the meat on the basis of net weight. Since

the slaughtered animal loses 55 to 60% of its original weight, the price of a kilogram of the carcass will be 222 to 250% of the purchasing cost of livestock. From the value obtained the price of edible organs and by-products should be deducted and the result should be adjusted to compensate for the loss of any condemned meat or organs. To illustrate this, consider a sheep weighing 40 kilograms bought for L.L. 70 or at the rate of L.L. 1.75/kgm. When killed and processed, the carcass would weigh 60% less or 16 kgs. Assume that the edible organs cost L.L. 6, therefore, the selling price will be:

$$\frac{70 - 6}{16} = \frac{64}{16} = 4 \text{ L.L./kgm.}$$

Adjusting this value by 2.5% to compensate for the loss of condemned meat and organs, the actual selling price should be L.L. 4.10/kgm.

This item will not be considered in the budget because it is assumed that no loss should occur between the buying and selling processes.

As shown in the budget, the main income to the slaughterhouse would be from the sale of the skins and guts. The budget is based on the minimum number of animals slaughtered during the first phase of operation of the slaughterhouse - i.e. in 1970.

The Budget

1. Expenditures

a. Wages (monthly)

	<u>No.</u>	<u>@</u>	<u>L.L./month</u>	<u>Total</u>
i. Veterinary department:-				
Veterinarian, General Director	1	1,500	1,500	
Veterinarian, Assistant	1	1,200	1,200	
Veterinary Inspector	4	400	1,600	
Laboratory Technician	2	400	800	
Nurse	1	350	350	
Clerk	2	300	600	
Technicians for by-products preparation	6	300	1,800	
Inspectors	6	225	1,350	
Stampers and weighers	4	225	900	
Technicians Aids in by-product plant	6	200	1,200	
Butchers	6	200	1,200	
Animal Distributors or Leaders.	2	200	400	
Line Workers	14	200	2,800	
Office boy	1	200	200	
Unskilled Workers	20	175	3,500	
Cleaners	12	175	2,100	
	Sub-total		<u>21,500</u>	<u>21,500</u>
	C.F.			21,500

	<u>No.</u>	<u>@</u>	<u>L.L./month</u>	<u>Total</u>
B.F.				21,500
ii. Engineering Department				
Engineer	1	1,200	1,200	
Assistant engineer	2	400	800	
Mechanics	2	300	600	
Electrician	1	300	300	
Work shop technician	3	300	900	
Incinerator technician	1	300	300	
Clerk	1	300	300	
Drivers	5	240	1,200	
Incinerator worker	1	200	200	
			<hr/>	
		Sub-total	5,800	5,800
			<hr/> <hr/>	
iii. Administration and Accounting Department				
Head of section	1	600	600	
Chief accountant	1	600	600	
Accountant	2	400	800	
Treasurer	1	400	400	
Store keeper	1	400	400	
Treasurer assistant	1	300	300	
Store keeper assistant	1	300	300	
Secretary, clerk recorder	3	300	900	
			<hr/>	
	C.F.		4,300	27,300



	<u>No.</u>	<u>@</u>	<u>L.L./month</u>	<u>Total</u>
B.F.			4,300	27,300
Workers for food distribution	2	200	400	
Office boy	1	200	200	
Gateman	2	200	400	
Watchman	3	200	600	
Cleaners	16	175	2,800	
			<hr/>	
	Sub-total		<u>8,700</u>	8,700

b. Running Expenditures (monthly)

i. Fuel	30 tons/month @ 120 L.L./ton	3,600	
ii. Electricity	60000 KWH @ 0.10 L.L./KWH	6,000	
iii. Salt	90 tons @ 50 L.L./ton	4,500	
iv. Food: Sheep:	(450 x 2) x 0.30 L.L./day x 30 days = 8100	8,100	
	Cattle: (50 x 2) x 0.80 L.L./day x 30 days = 2400	2,400	
v. Laundry expenses		9,000	
vi. Gasoline for cars	30 L.L./day x 30 days	900	
vii. Laboratory expenses		400	
viii. Stationary		800	
ix. Soap, bleaching, disinfectant		3,300	
x. Brooms, mops, brushes ... etc.		1,300	
xi. Overalls, towels		1,000	
		<hr/>	
	C.F.	<u>41,300</u>	<u>36,000</u>

	<u>L.L./month</u>	<u>Total</u>
B.F.	41,300	36,000
xii. Wrapping papers	1,200	
xiii. Overheads	8,500	
	<hr/>	
Sub-total	51,000	51,000
	<hr/> <hr/>	
c. <u>Maintenance and Depreciation</u>		
i. New equipment, spare parts and engineering tools for maintenance	15,000	
ii. Depreciation	10,000	
	<hr/>	
Sub-total	25,000	25,000
	<hr/> <hr/>	
d. <u>Unforeseen Expenditures</u>		
	15,000	
	<hr/>	
Sub-total	15,000	15,000
	<hr/> <hr/>	
	Grand Total	127,000

Total yearly expenditure :

$$127,000 \times 12 = 1,524,000 \quad \text{or}$$

L.L. 1,530,000

2. Annual Income

(Slaughtered animals: Cattle 45/day or approx. 16,500/year

Sheep & Goats 450/day or approx. 165,000/year)

.L.L./year

a. Skin and Guts

i. Cattle:  $16,500 \times ( 8.0^* + 1.0^{**} + 4^+ ) = 214,500$

ii. Sheep :  $125,000 \times ( 4.5^* + 0.5^{**} + 2^+ ) = 875,000$

iii. Goats :  $40,000 \times ( 3.5^* + 0.5^{**} + 2^+ ) = 240,000$

	1,329,500	1,329,500
Sub-total	1,329,500	

b. Blood, Hoofs, Bones Manure etc.

365 days x 300 L.L./day	109,500	
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	109,500	109,500
Sub-total	109,500	

c. Transport of Carcasses

i. Cattle	16,500 x 1 L.L./unit	16,500
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ii. Sheep and Goats	165,000 x 0.35 L.L./unit	57,750
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	74,250	74,250
Sub-total	74,250	

d. Confiscation of Meat, Fines etc.

	68,750	68,750
--	--------	--------

	Grand Total	1,600,000
--	-------------	-----------

\* L.L./raw animal hide.

\*\* L.L./raw animal gut.

+ L.L./preliminary treatment of one hide and one gut.

3. Annual Net Profit

a. Income . .	L.L. 1,600,000
b. Expenditure	L.L. 1,530,000
	<hr/>
Net Profit	L.L. 70,000

These figures indicate an annual net profit of L.L. 70,000 which when deposited in a bank at 6% compound interest for forty years would accumulate an additional profit derived as follows:

$$S_n = \frac{a (1 + i\%)^n - 1}{i\%}$$

where (a) is the sum invested yearly during (n) years at a rate of (i)%.  $S_n$  will be the accumulated amount.

$$\begin{aligned} S_n &= \frac{70,000 (1 + 0.06)^{40} - 1}{0.06} \\ &= \frac{70,000 (10.3 - 1)}{0.06} \\ &= \frac{70,000 (9.3)}{0.06} = 10,850,000 \text{ L.L.} \end{aligned}$$

The accumulated sum would probably be sufficient to cover the cost of erecting a new slaughterhouse in the year 2010.

### Summary and Conclusion

In view of the shortage of slaughterhouses in Lebanon, particularly those serving small communities, there is a need for the design of a model slaughterhouse adapted to local conditions and practices.

Taking Baalbeck and its neighboring villages, as a typical Lebanese situation, it is believed that a common slaughterhouse would be much more economical than several small slaughterhouses. The estimated cost of the proposed slaughterhouse is L.L. 2,600,000 which amounts about L.L. 37/person. These figures are considered to be reasonable when compared to the estimated figures for some of the new slaughterhouses in Beirut, Zahleh and Jounieh.

Because of local traditions and practices it was deemed necessary to adopt suitable slaughtering procedures which influence the design. Attention has been given to animal care, hygienic measures, and simplicity in operation and maintenance.

The processing of waste products, although desirable, cannot be fully accomplished at the proposed slaughterhouse on account of the limited production capacity which would render such a project uneconomical. However, it is recommended that future plans should involve the utilization of the waste-products from several slaughterhouses.

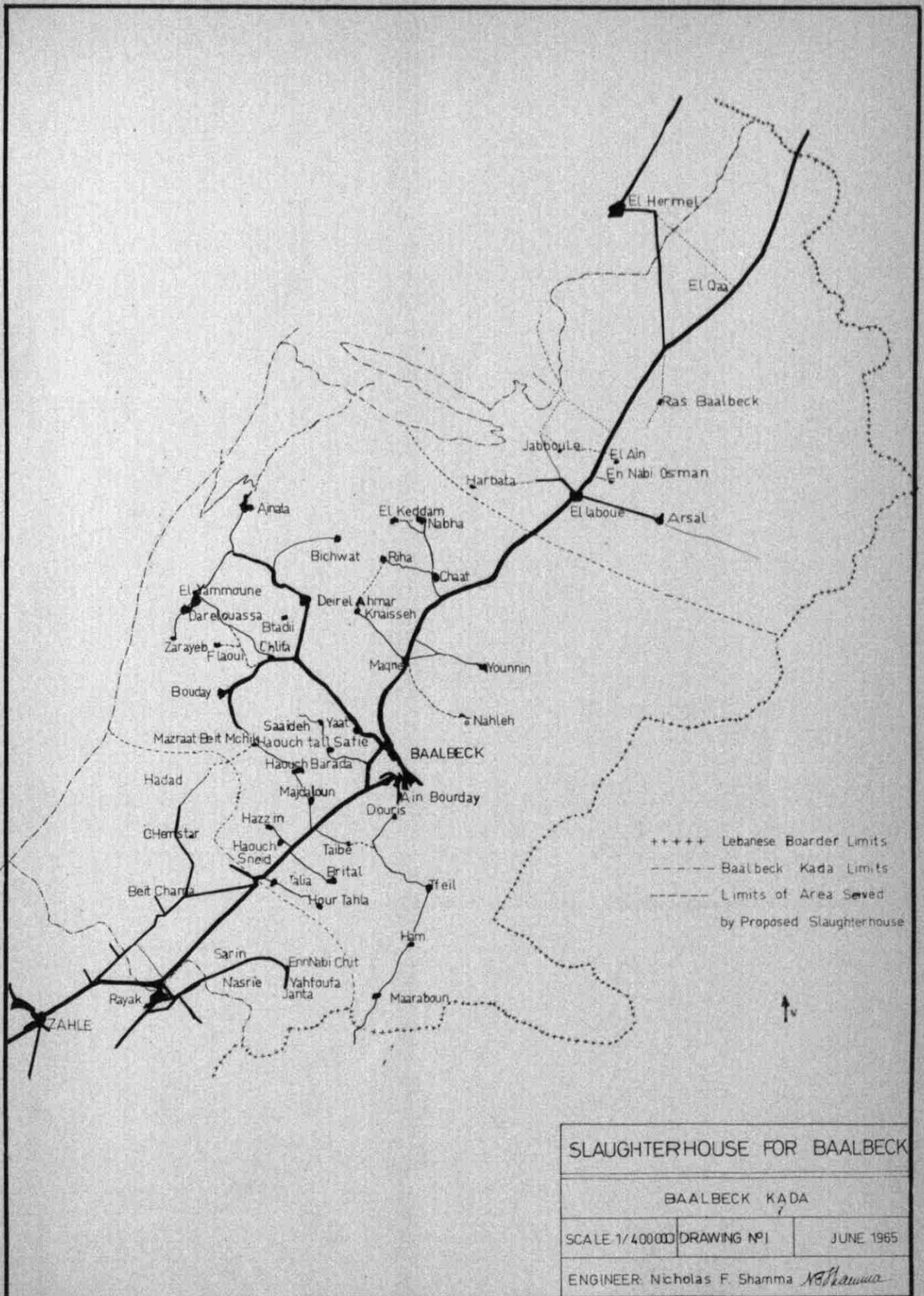
Skilled labor may present a practical problem if not made available. Their importance is so great that, it would be unwise to design and erect a slaughterhouse without due consideration to this matter.

There is no doubt that the proposed slaughterhouse will be self-sufficient from the financial standpoint and that it would be a step-forward in improving the health status of the communities concerned.

APPENDIX A

- DRAWING I. BAALBECK KADA
- DRAWING II. LOCATION OF THE SLAUGHTERHOUSE
- DRAWING III. GENERAL LAYOUT
- DRAWING IV. RECEIVING PEN
- DRAWING V. RESTING PEN
- DRAWING VI. ISOLATION BLOCK
- DRAWING VII. SLAUGHTERHALLS AND OFFICES: PLANS
- DRAWING VIII. SLAUGHTERHALLS AND OFFICES: FAÇADES
- DRAWING IX. SLAUGHTERHALLS: SECTIONS





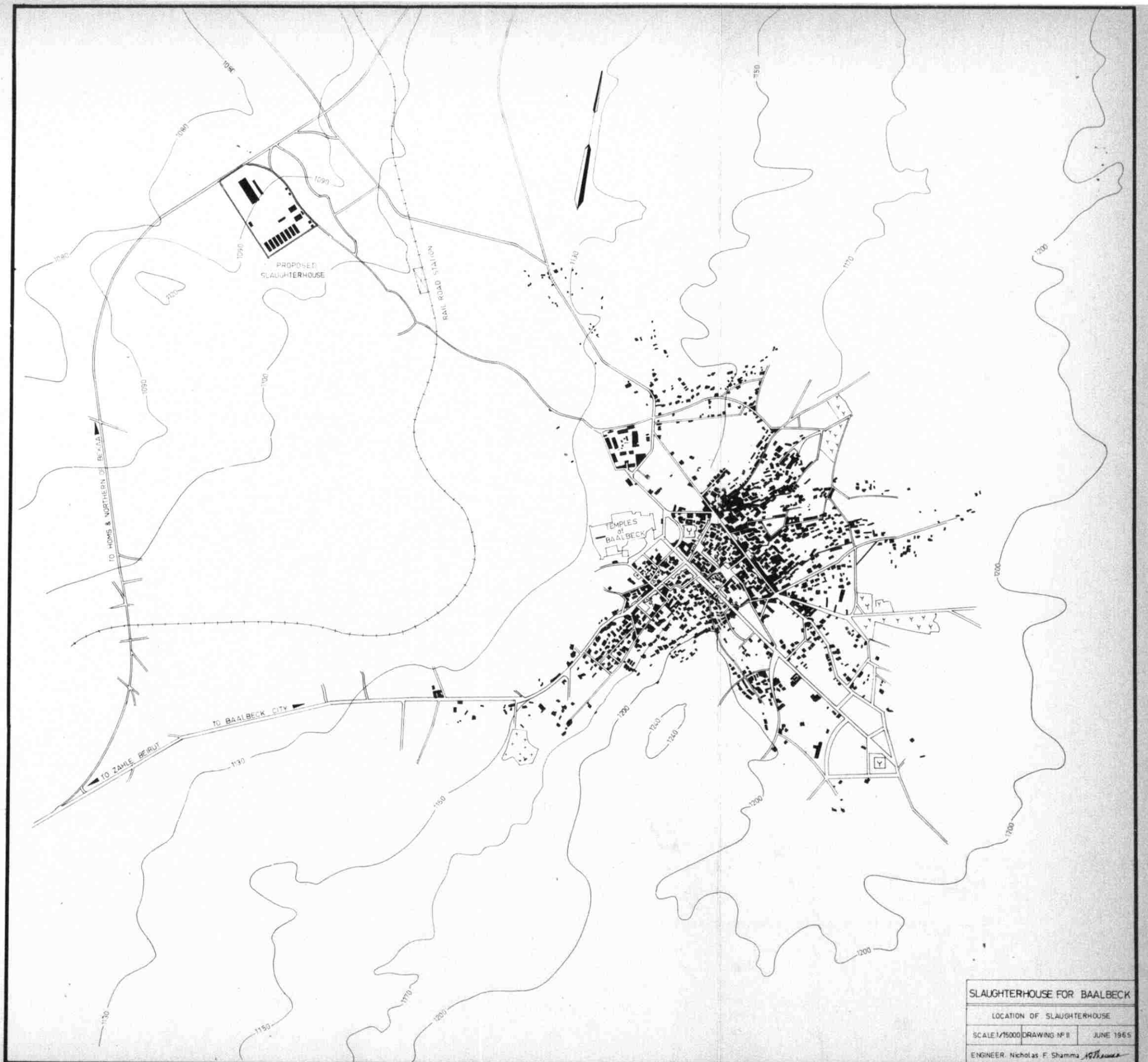
SLAUGHTERHOUSE FOR BAALBECK

BAALBECK KADA

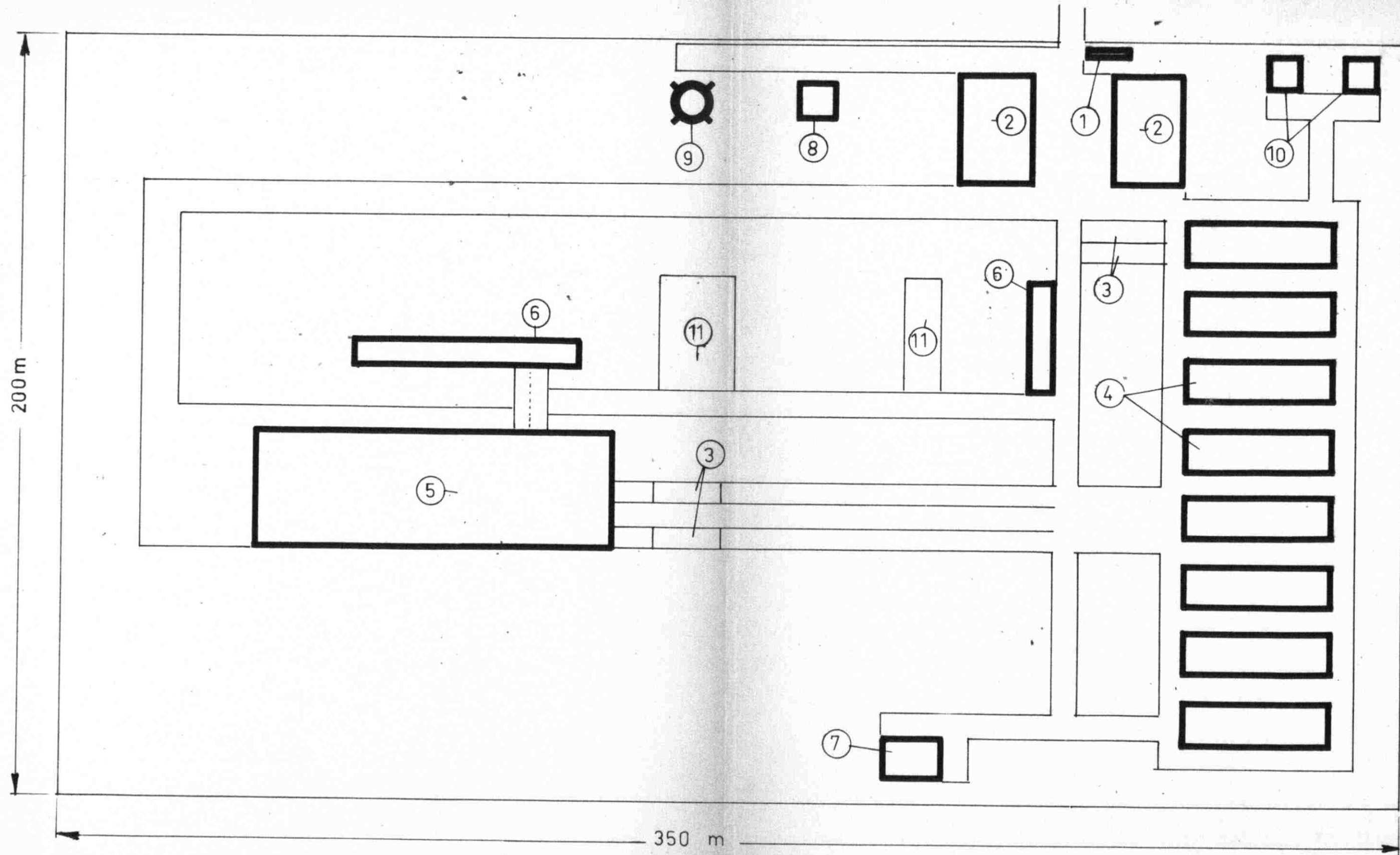
SCALE 1/400000 DRAWING N°1

JUNE 1965

ENGINEER: Nicholas F. Shamma *N. Shamma*



**SLAUGHTERHOUSE FOR BAALBECK**  
 LOCATION OF SLAUGHTERHOUSE  
 SCALE 1/15000 DRAWING NO II JUNE 1955  
 ENGINEER: Nicholas F. Shamma *N. Shamma*



1. Gate house
2. Receiving pens
3. Spray races
4. Resting pens
5. Slaughter halls
6. Offices
7. Isolation block
8. Stores
9. Water reservoir
10. Manure hoppers
11. Parking area

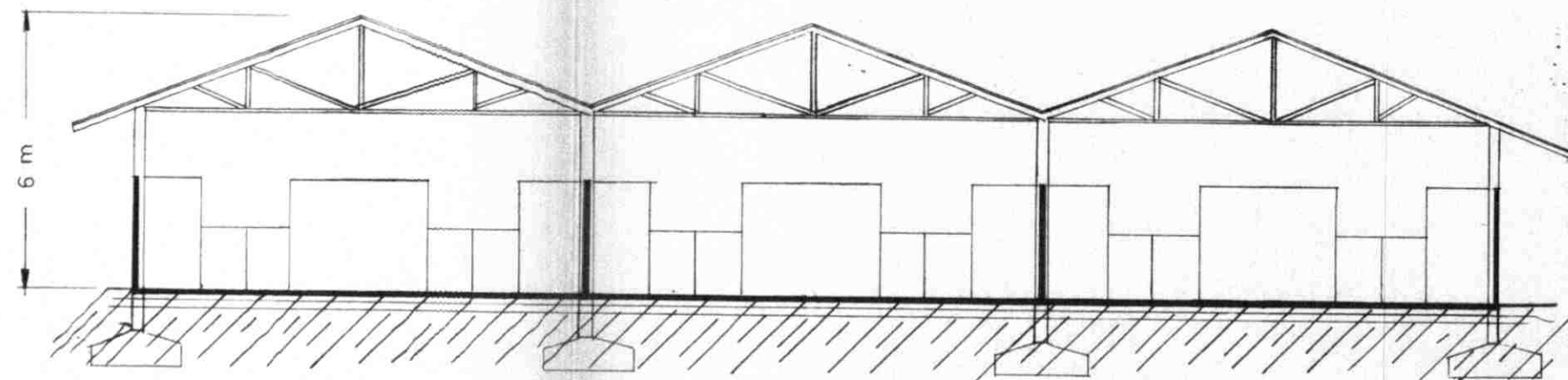
## SLAUGHTERHOUSE FOR BAALBECK

GENERAL LAYOUT

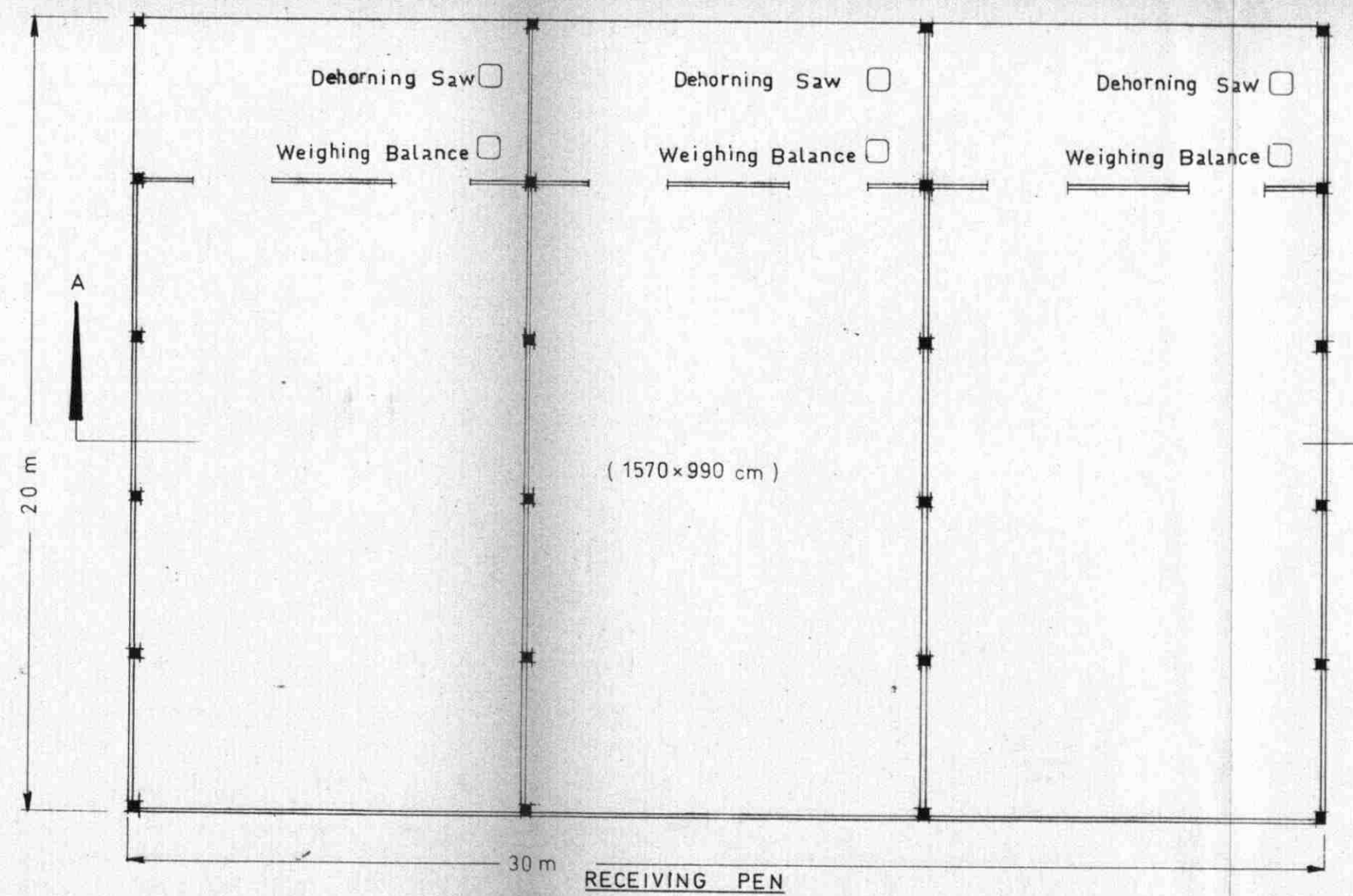
SCALE 1/1000 | DRAWING N° III | JUNE 1965

ENGINEER, Nicholas F. Shamma *NF Shamma*





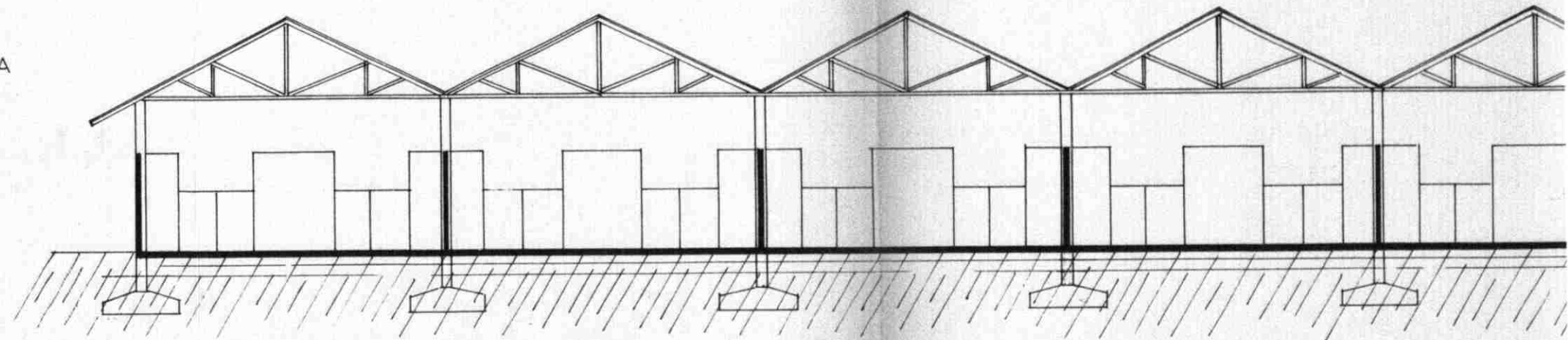
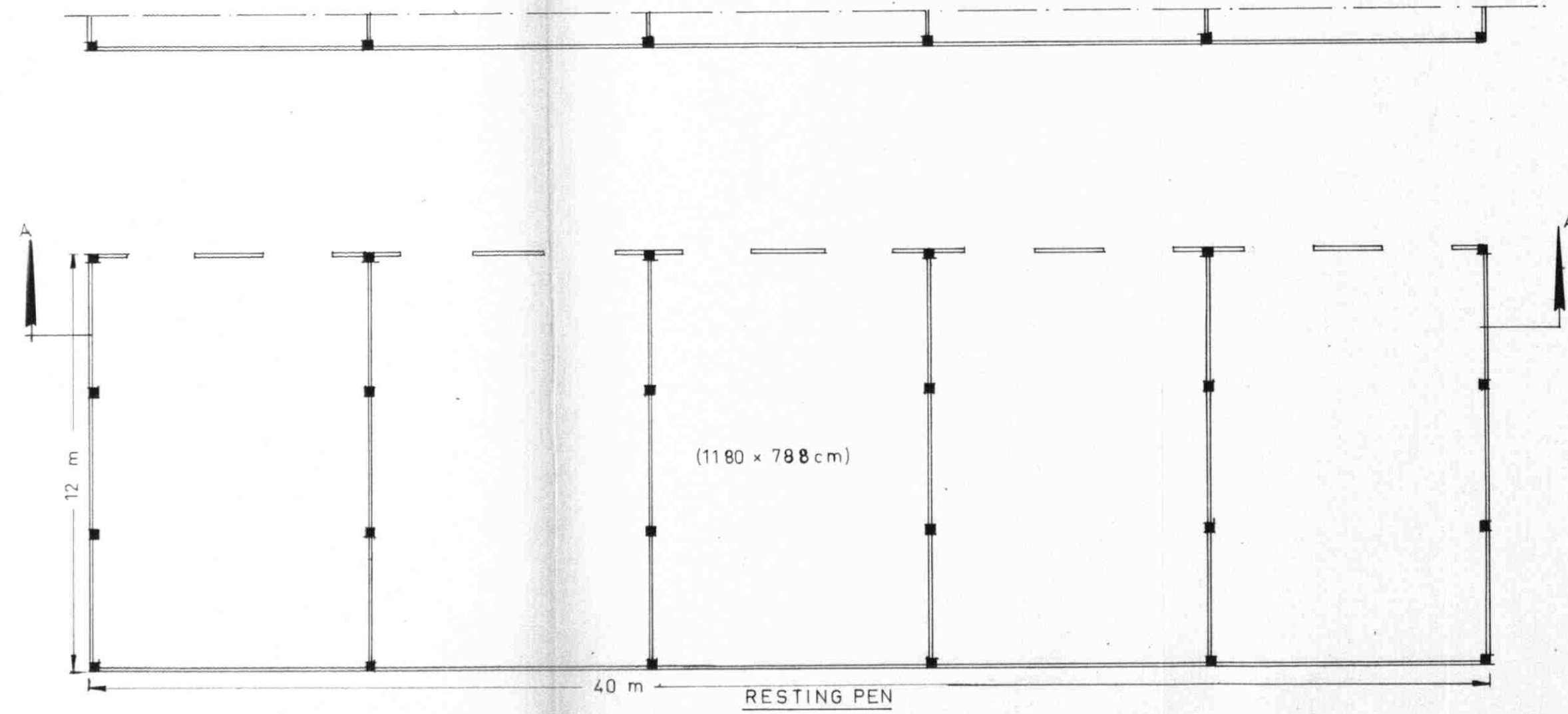
SECTION AA

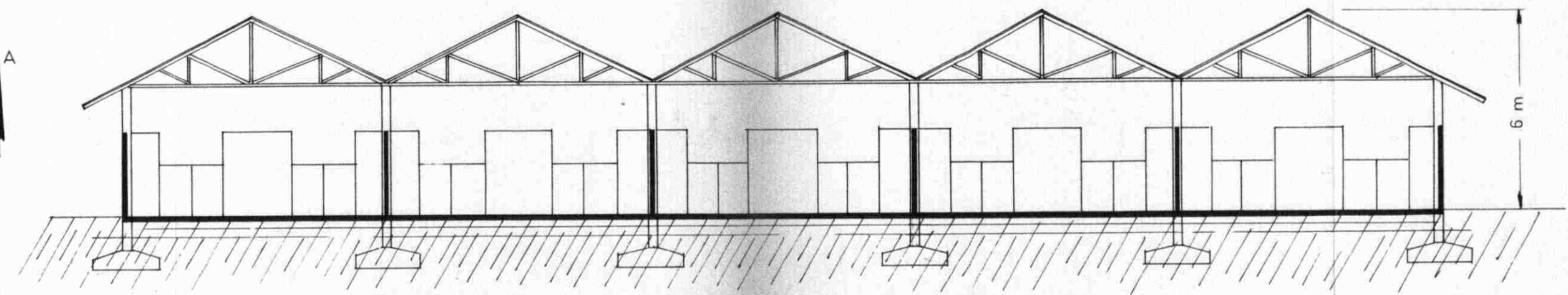
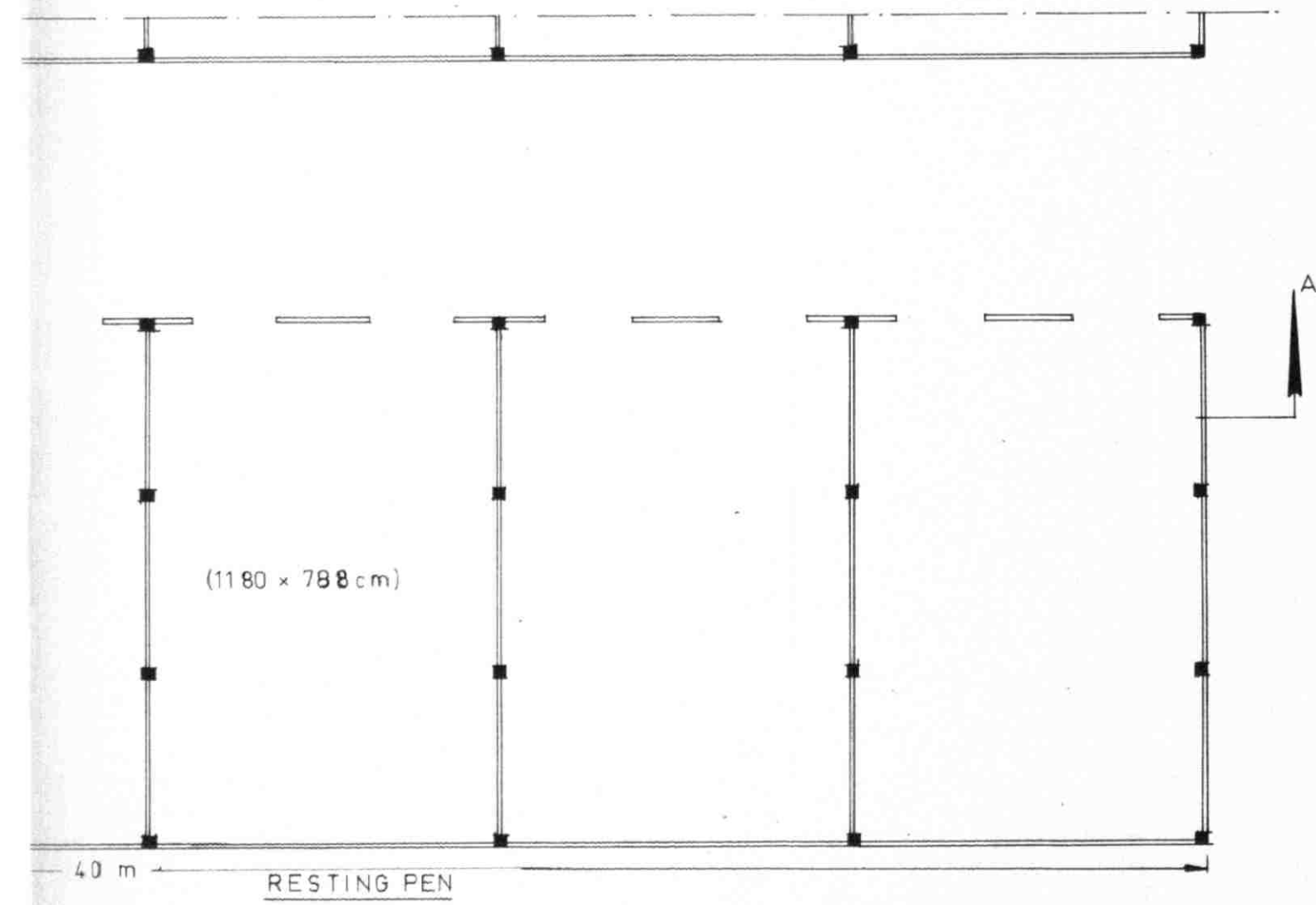


SLAUGHTERHOUSE FOR BAALBECK		
RECEIVING PEN		
SCALE 1/100	DRAWING N°IV	JUNE 1965
ENGINEER : Nicholas F. Shamma <i>N. Shamma</i>		

10 Cms

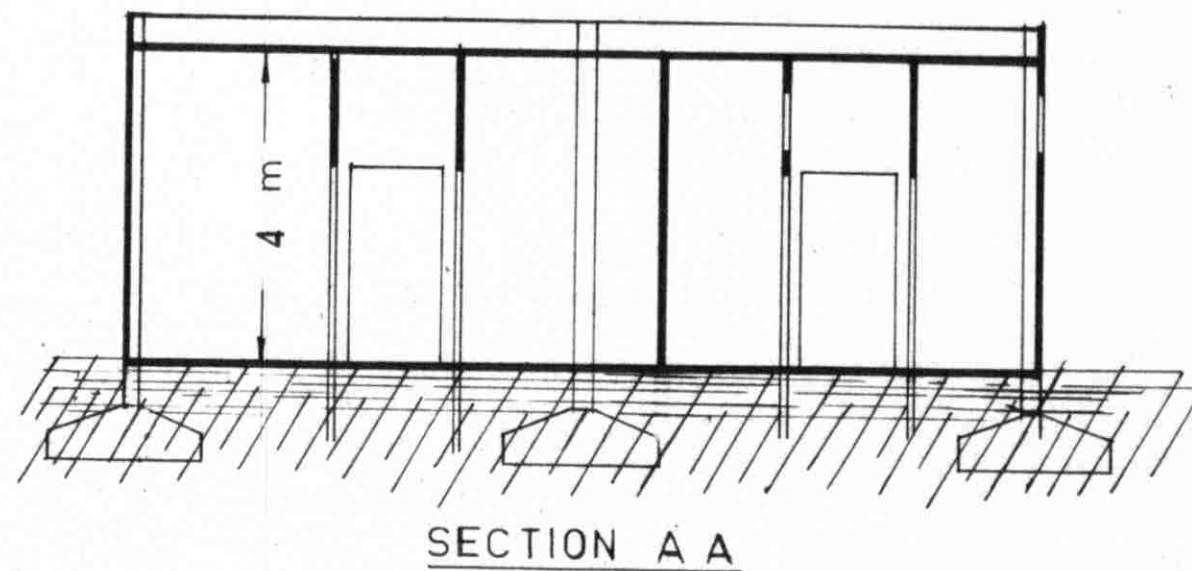
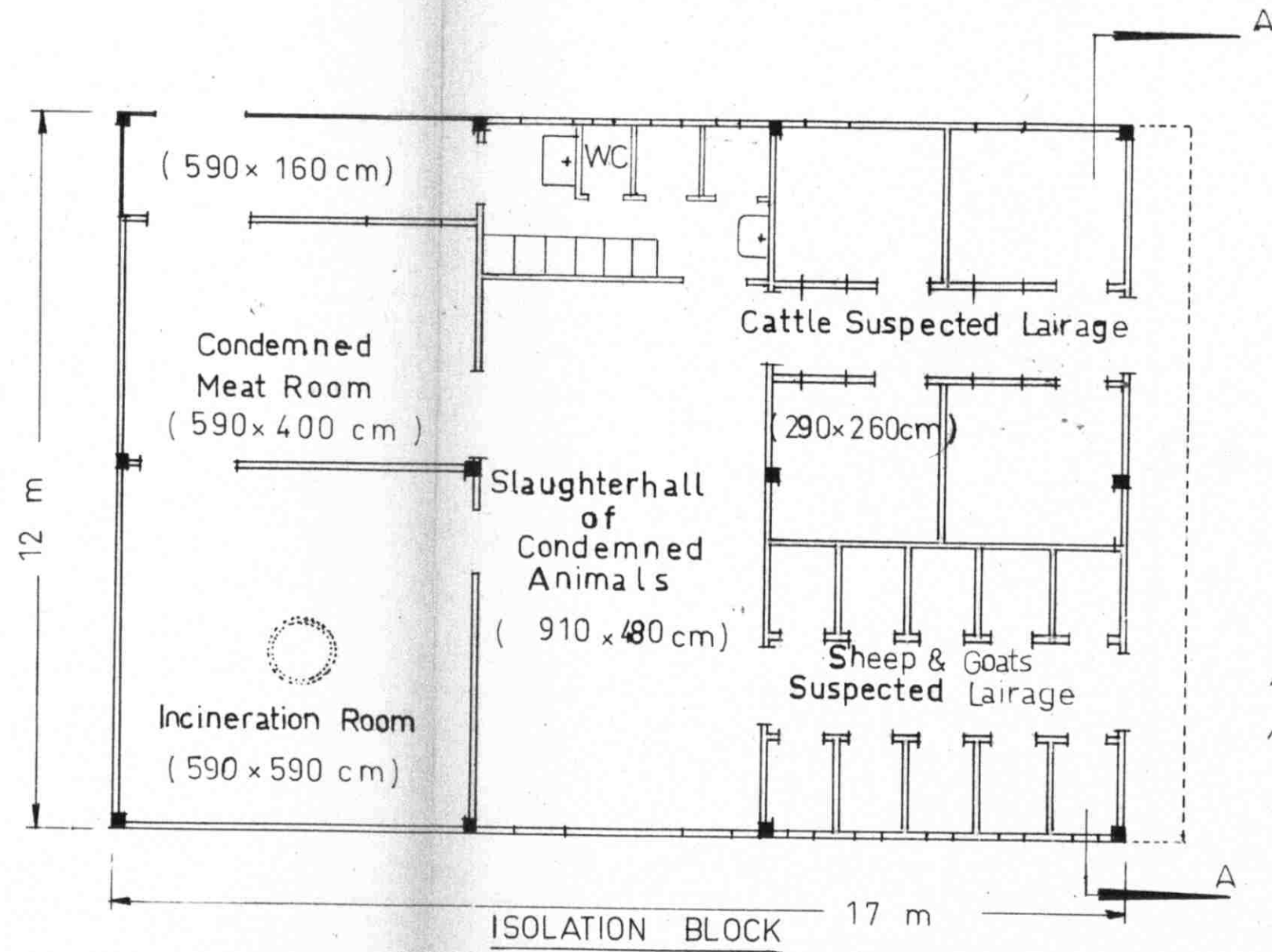
1/2





SLAUGHTERHOUSE FOR BAALBECK		
RESTING PEN		
SCALE : 1/100	DRAWING Nº V	JUNE 1965
ENGINEER : Nicholas F. Shamma <i>NF Shamma</i>		





SLAUGHTERHOUSE FOR BAALBECK

ISOLATION BLOCKS

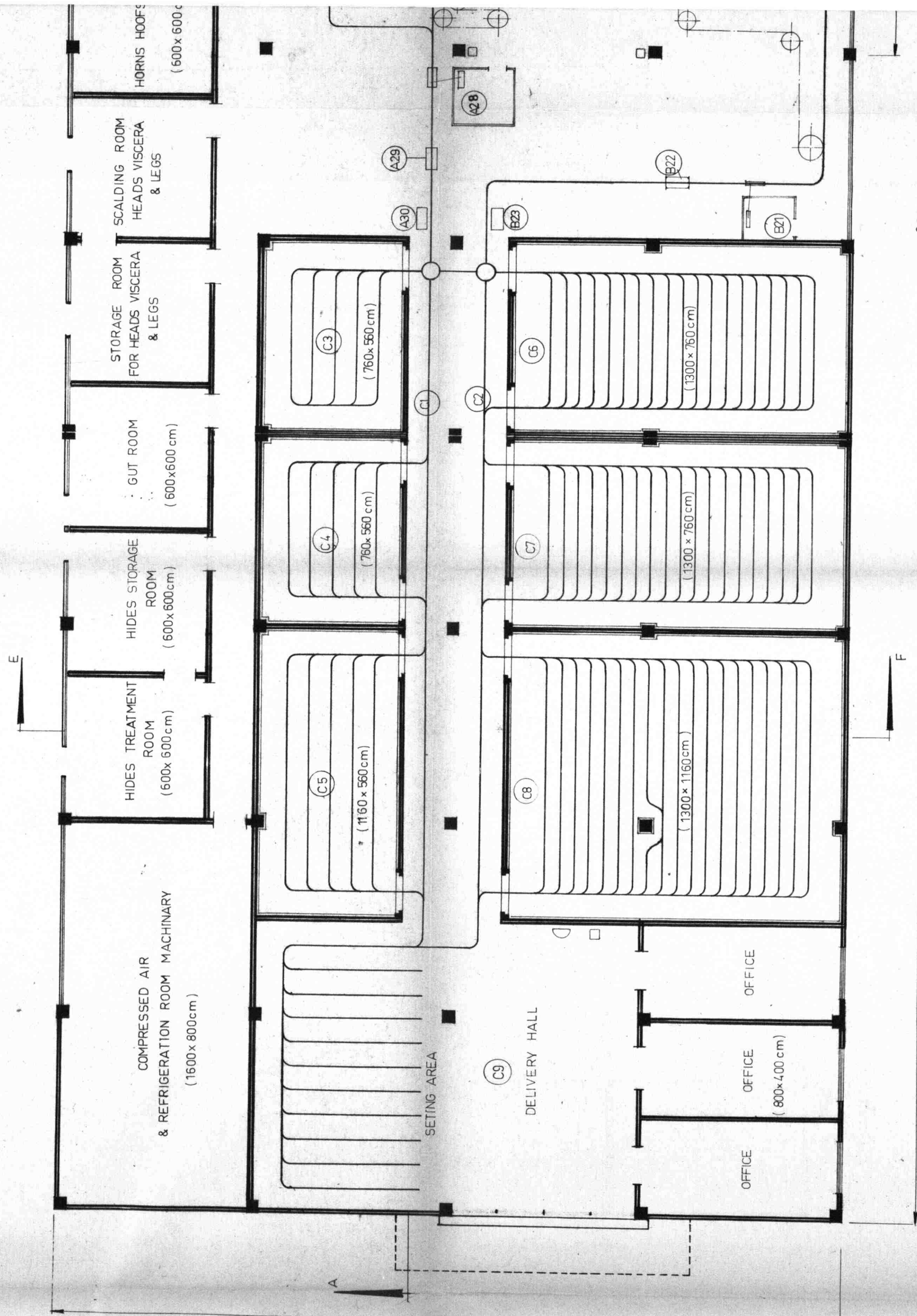
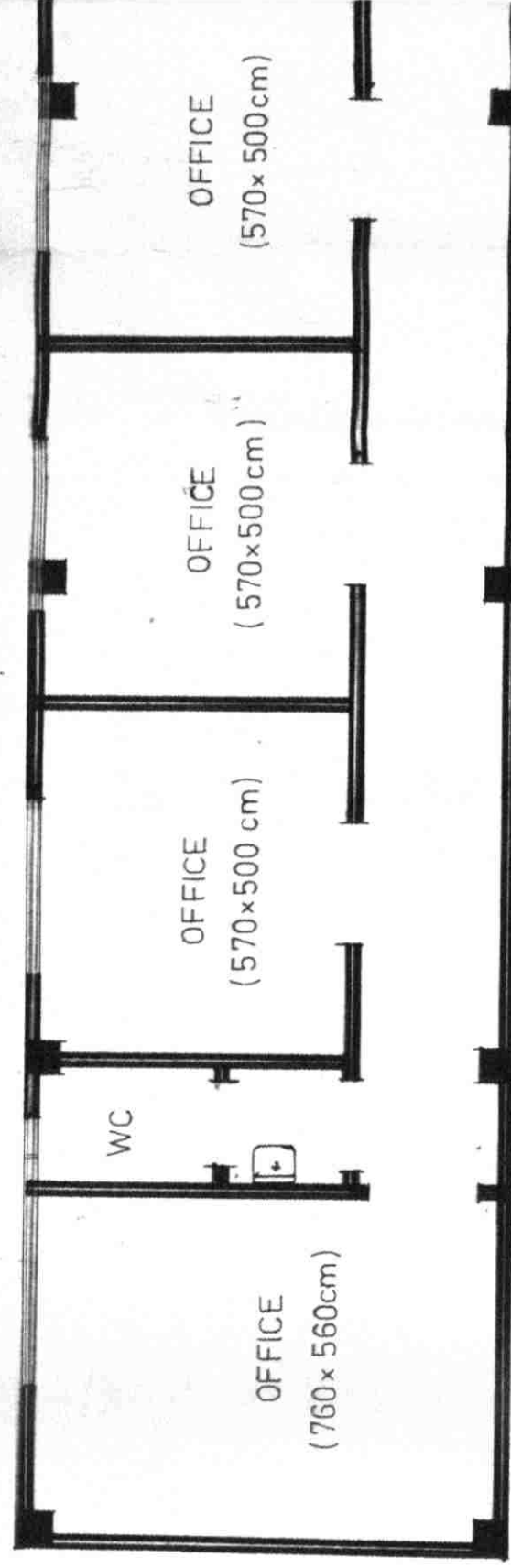
SCALE 1/100

DRAWING N°VI

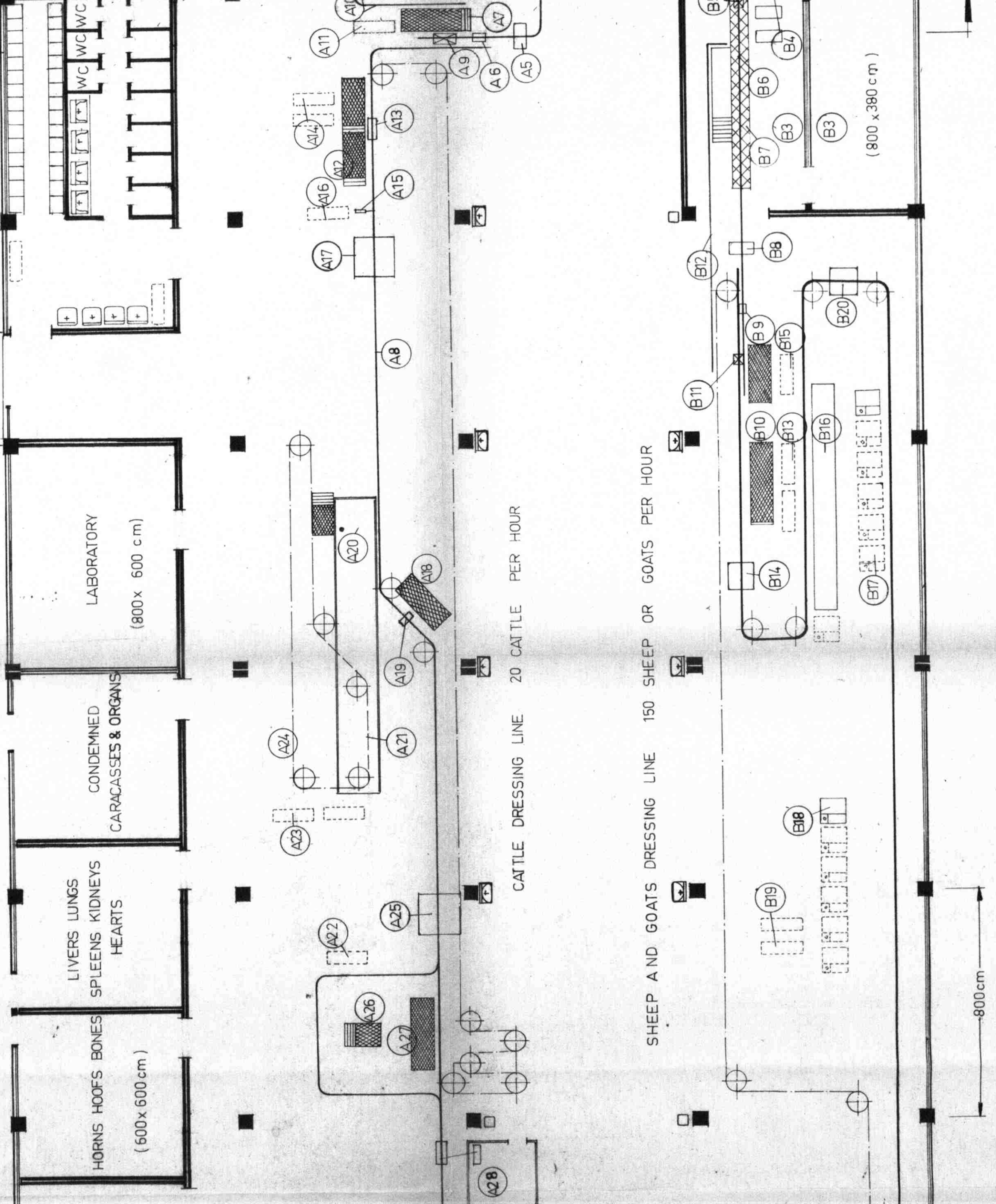
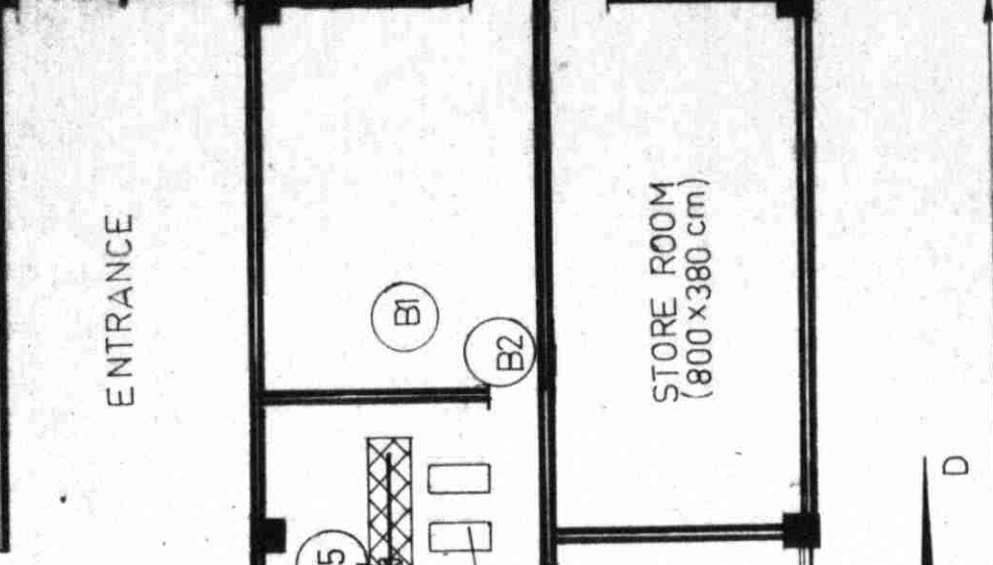
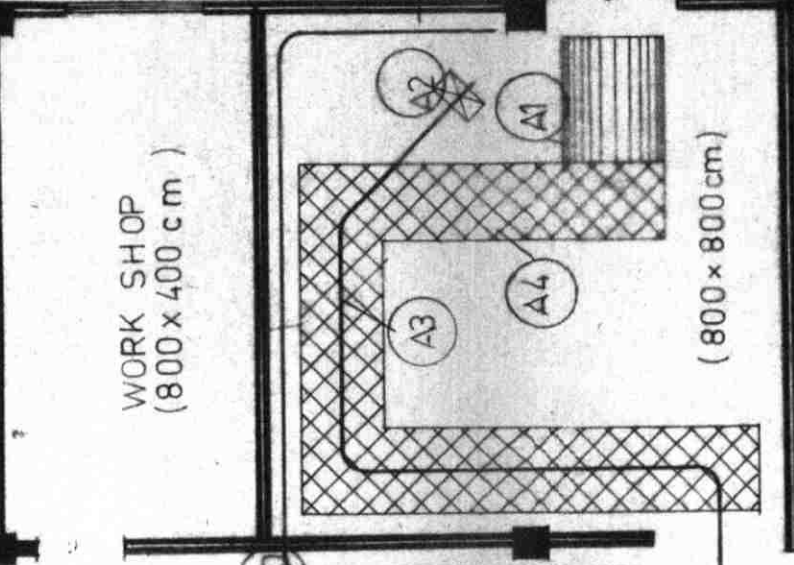
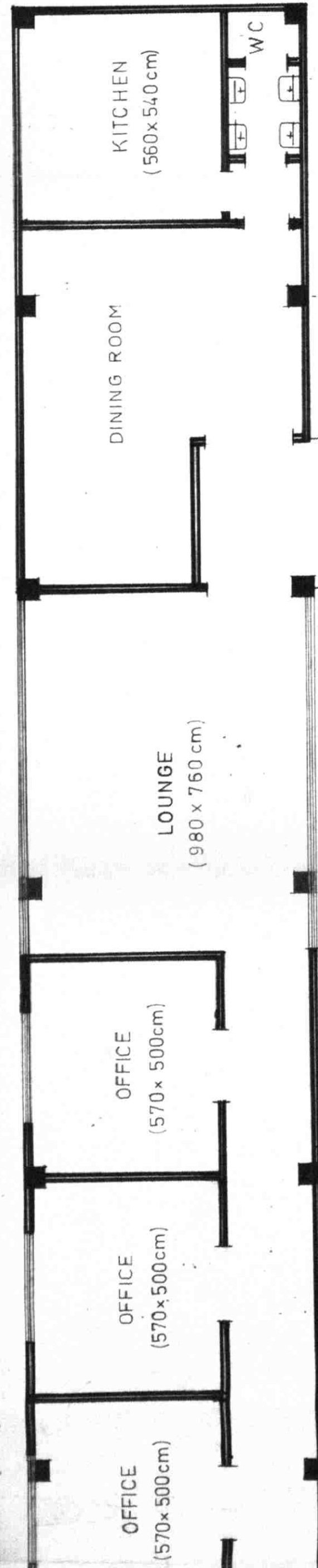
JUNE 1965

ENGINEER: Nicholas F. Shamma *N. Shamma*

← 10 cms







**SLAUGHTERHOUSE FOR BAALBECK**

SLAUGHTERHALLS AND OFFICES, Plans

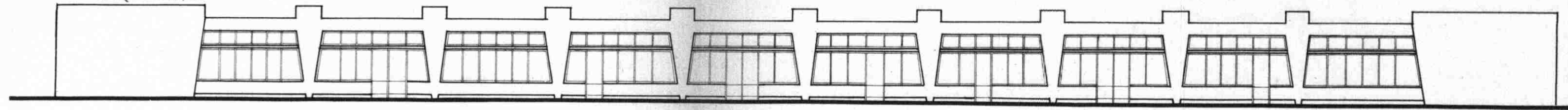
SCALE 1/100 DRAWING N° VII

JUNE 1965

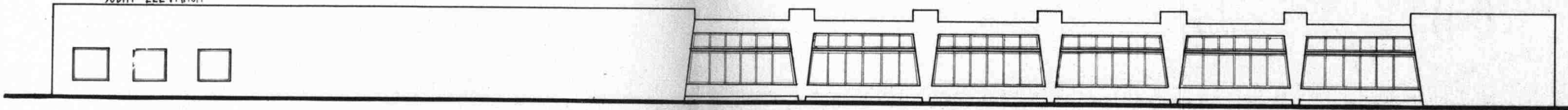
ENGINEER, Nicholas F. Shamma *N. Shamma*



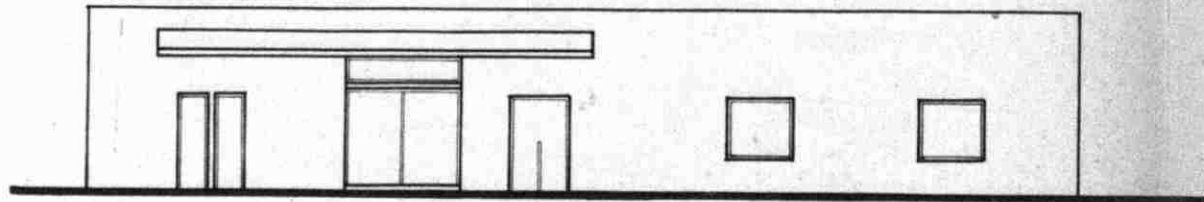
NORTH ELEVATION



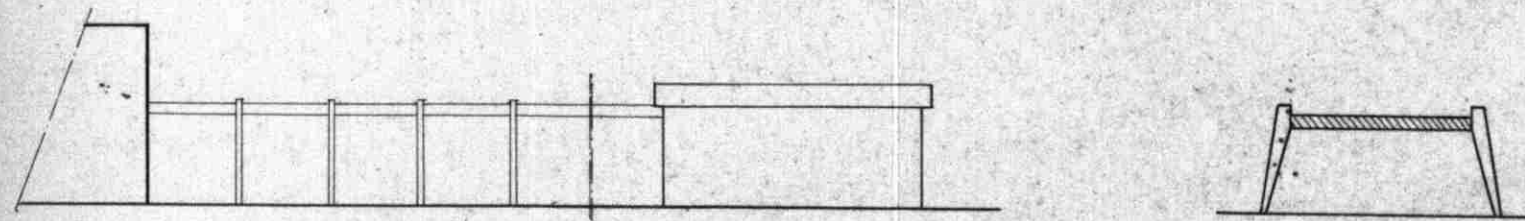
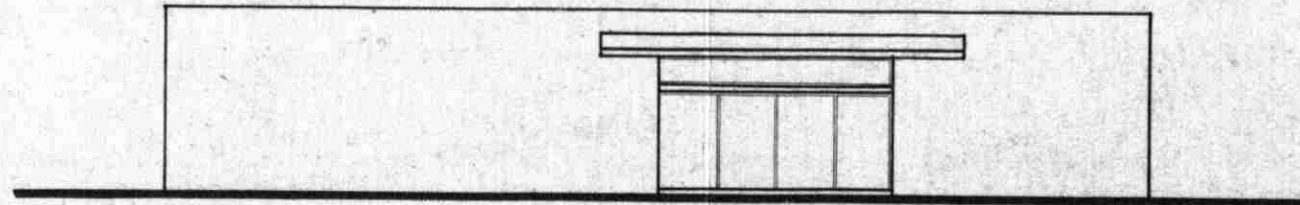
SOUTH ELEVATION



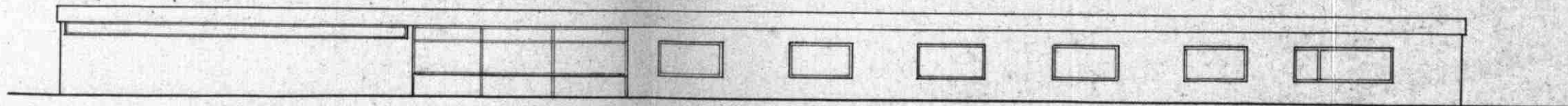
EAST ELEVATION



WEST ELEVATION



NORTH ELEVATION

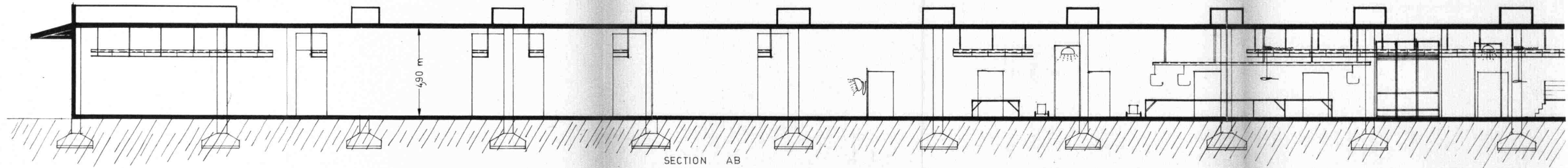


SOUTH ELEVATION

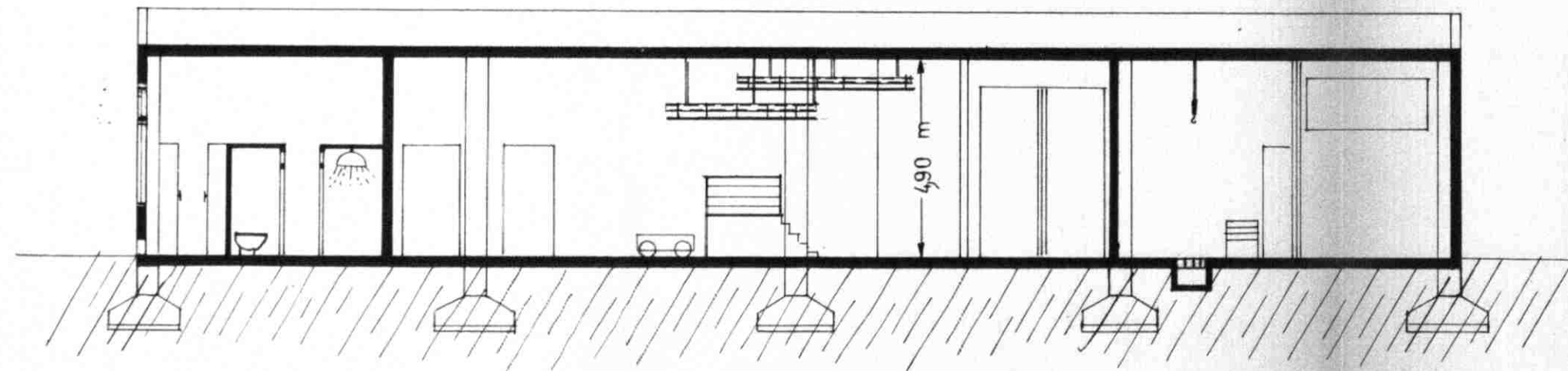


SLAUGHTERHOUSE FOR BAALBECK  
 SLAUGHTERHALLS AND OFFICES, Façades  
 SCALE 1/250 DRAWING NO VIII JUNE 1965  
 ENGINEER Nicholas F. Shamma

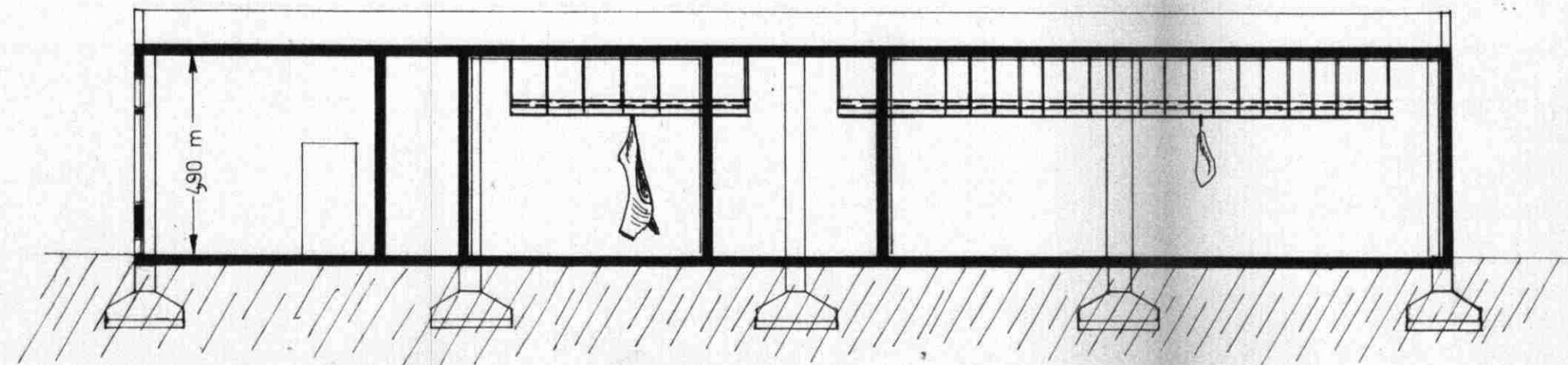
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SECTION AB



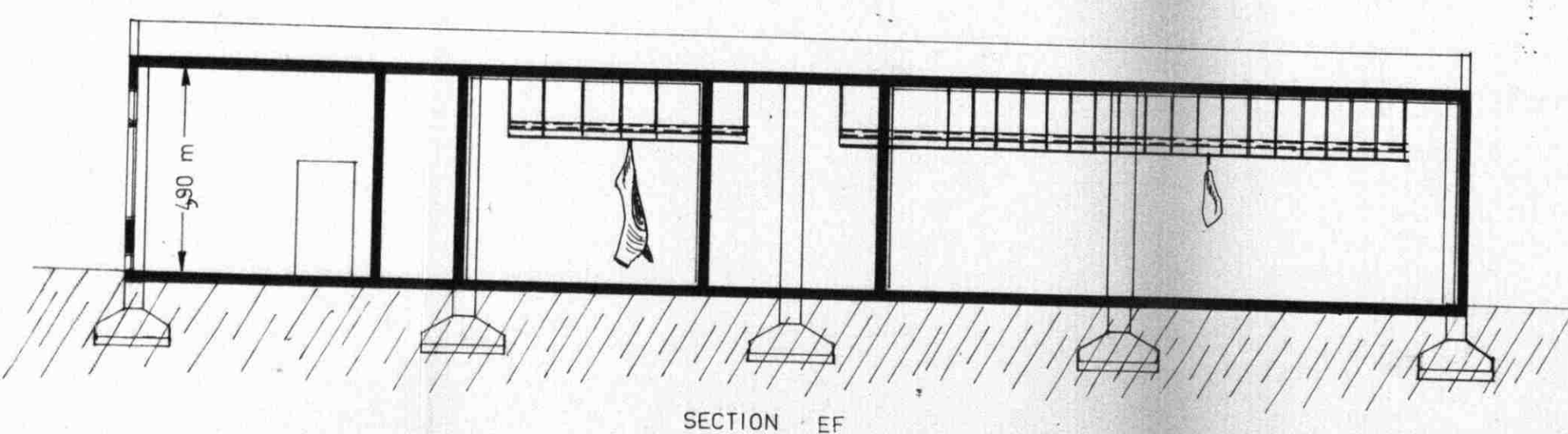
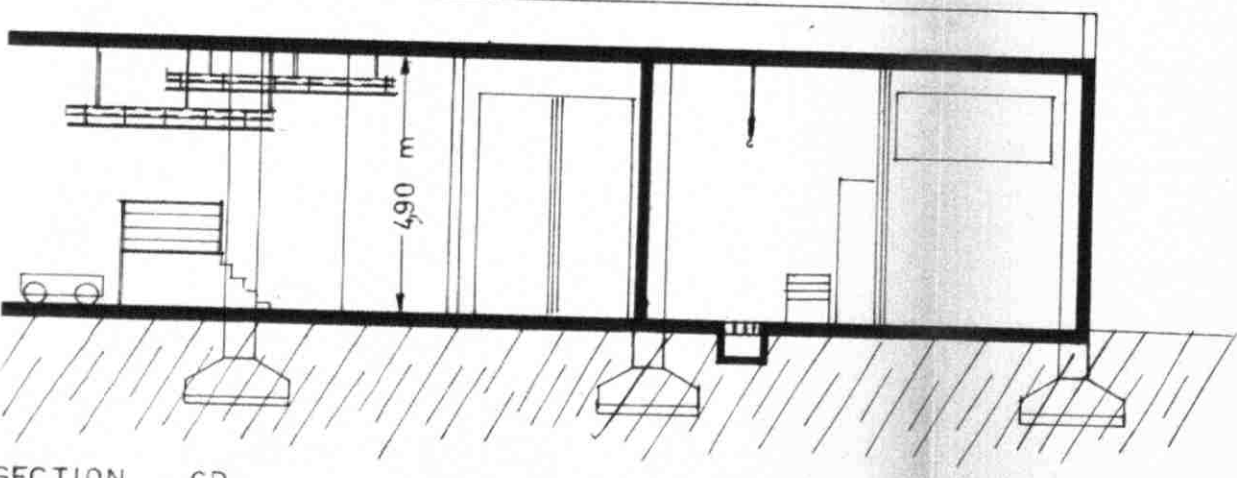
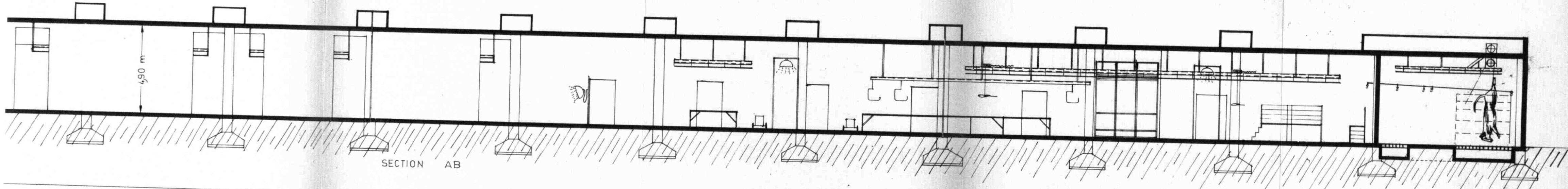
SECTION CD



SECTION EF



2/2



SLAUGHTERHOUSE FOR BAALBECK		
SLAUGHTERHALLS : Sections		
SCALE: 1/100	DRAWING N° IX	JUNE 1965
ENGINEER: Nicholas F. Shamma <i>N. Shamma</i>		



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## AMMENDMENTS

1. In the design phase the following points should be considered:-
  - a. The south facades should be shaded from direct sunlight by overhangs.
  - b. Roof covering materials of the receiving and resting pens may be made of corrugated asbestos sheets, (Eternit), since plastic sheets are either transparent or translucent and would transmit sunlight and cause excessive heat.
  - c. Cork is recommended for use as insulating material for the refrigeration area. However, precautions should be taken to avoid contact of cork with any source of humidity which renders the insulating material ineffective. Fiberglass, though a good insulator, is not recommended because of its relative high cost.
2. Alternatively, the delivery hall indicated in Appendix A, Drawing VIII, may be divided into cubicals, each of which would be designed for the sale of a specific type of meat product. This would facilitate and organize the sale of the meat products.
3. In the design a one-story building was considered; however, a two-story building may be adopted if it is deemed more desirable to separate the slaughtering and dressing area from the by-product plant, then the latter is to be located in the lower floor which should also include the toilets. Accordingly, organs, and by-products would have to be transferred into their appropriate compartments by means of chutes.
4. In the text (page 55), it was mentioned that pork is eaten by the Jewish community. But subsequent investigation yielded information that contradicts this statement and establishes the fact that the Jewish faith prohibits eating pork.