

As late as 1883 grain in bulk was stored exclusively in flat floors without hoppers at the grain stores of Liverpool, though elevators and conveyors had been introduced to reduce labour costs. Since then modern methods have been introduced at the various import ports.

In India, though an enormous amount of wheat is grown, and a large amount exported, the conditions are so different from those in America that extensive collecting, storage and transfer facilities have not been developed. Extensive areas are not given up to wheat growing. The climate permits the grain to be stored in the open for several months without rent or fire insurance, while the extreme cheapness of labour greatly discounts the value of mechanical handling.

In Australia, though labour is scarce and expensive, the costly and crude system of handling in bags is the general system. The method used is mainly as follows:—

The grain is bagged at the farms in new or good bags, and, if teams are available, it is loaded into them and sent to the railway station, where, if trucks are available, the grain is loaded directly into them for transit to ports or mills. It is more frequent, however, that the bagged wheat has to be stacked both at the farms and at the stations.

Proper storage sheds, both at farms and railway stations, are usually deficient in capacity, or entirely wanting.

The lowermost layer of bags is placed on loose timbers, and sometimes even this protection is wanting. The tops of the stacks are covered by tarpaulins or loose galvanised iron, while the sides are open to the weather. An enormous total amount of damage is done every season through moisture from the ground, by rain on the sides, and through imperfect covering of the tops, torn bags, loose stack, rats and weevils.

At the railways the wheat is loaded into open trucks, the upper layers of bags overhanging the sides. Bags resting on the sides are frequently rubbed through, causing loss of contents. Tarpaulins are used to protect the contents of the trucks from the weather. These open trucks are very unsuited for their work, as they are expensive to load and unload, cause loss by spillage from the bags, are imperfectly protected from the weather, and afford little protection from pilfering.

At the mills the wheat is stacked in sheds or open stacks, unstacked, and used as required. It is not readily accessible for examination, cleaning, or, if necessary, drying, and is subject to damage and loss.

At the ports the wheat is stacked in sheds, or in more or less open heaps awaiting shipment, when it has to be again unstacked, conveyed to the vessel, and stowed by hand.

Further loss occurs at the ports through damage and loss of grain, besides the expense of re-bagging, spillage, and at times un-bagging, drying and re-bagging wet shipments. The wheat is sampled by inserting a narrow tube, which damages the bag, besides obtaining samples which may not be reliable.

At the port of destination it has again to be unloaded by the same expensive means. It will be thus seen that a very large amount of manual labour has to be expended on bagged wheat, while it is subject to much loss and damage before it reaches the British market.

Australian wheat is there sold in competition with other foreign wheat which has had the benefit of more economical and efficient means of handling, and lower freights. The selling price of the wheat paid to the Australian producer must therefore be smaller than if his wheat were handled in a more economical manner.

If the Australian farmer receives a higher average price for his wheat, it will be the means of extending the area of country from which a profitable return may be made, inducing a considerable extension of the industry, and increasing the population and general prosperity of the country.

Grain is stored in floor granaries, and open floor space, on which it can be placed either loose or in sacks, or in silo granaries containing large hoppers or bins, extending vertically for a considerable height, and in which the grain is stored in bulk.

Granaries of the former type are limited simply to the pre-determined working load on each floor, and require a considerable amount of manual labour to supplement any mechanical appliances that may be adopted. As late as 1883 all the grain stores in Liverpool were of this type.

Those of the later type have been developed in their modern form in the American grain trade, and constitute a reversion to the prehistoric method of preserving grain in a dry and sweet condition for long periods in closed pits or reservoirs. It is stated that wheat in good condition has been found in Egyptian tombs after being there for several thousand years.

It is essential that grain be dry when placed in silos for storage.

It is well known that green or damaged wheat will heat and go through a sweat, whether it is contained in a timber or other kind of bin. Samples should be drawn for inspection. Automatic appliances may be installed to show and record temperature in silo bins. Heated grain is changed from one bin to another, and aired in transit. This makes it necessary to have an efficient conveyor system and an ample number of bins.

Silo bins readily admit of bulk samples being drawn off for inspection.

During the filling of a bin the grain mounts up into a cone, and runs down the sides of it to the sides of the bin. During the progress of emptying, a column of moving grain extends to the surface, where an inverted cone is formed, the grain running down the sides of the cone at the surface, and down as a column through the body of the bin to the outlet. The grain at the bottom of the sides, though among the first put in, is about the last to come out. This action may be readily observed in an hour or sand glass.

The silo system ensures the maximum utilisation of space, and facilitates the storage of different kinds and grades of grain. The stocks of different owners may be kept separate, and the hopper outlets may be locked.

In America the grain trade is largely worked on the *warrant system*—that is, the grain is inspected, weighed and graded by Government officers, and the grain sent to bins for that grade. The owner receives a negotiable warrant, which enables the holder to claim the stated quantity and grade of grain.

In order to obtain maximum benefit from bulk handling, it should commence at the farm. It would not be difficult to do so instead of bagging the grain there for road transport to local collecting centres. If the grain is bagged at the farm, a comparatively small number of bags only would be required, as they would be used over and over again. The number of bags required would be inversely proportional to the storage capacity provided at local centres and terminals, and to the promptness of railway and shipping transport.

**Farm Silos.**—During the period of harvest many of the farms in a local centre will be simultaneously engaged upon the same operations, and delays take place in forwarding the grain to the local collecting silos at the railways. Small farm silos can be cheaply built to accommodate temporary accumulation of grain. For instance, three circular bins,

20 feet diameter and 20 feet deep, would accommodate the whole of the grain from a 1000-acre farm, averaging 15 bushels to the acre. These bins should be built on a platform sufficiently high to allow the wheat to run into the boot of a leg for elevating into waggons for transport to the railway collective centre, or, if the platform is high enough, the wheat may be run directly into the waggons.

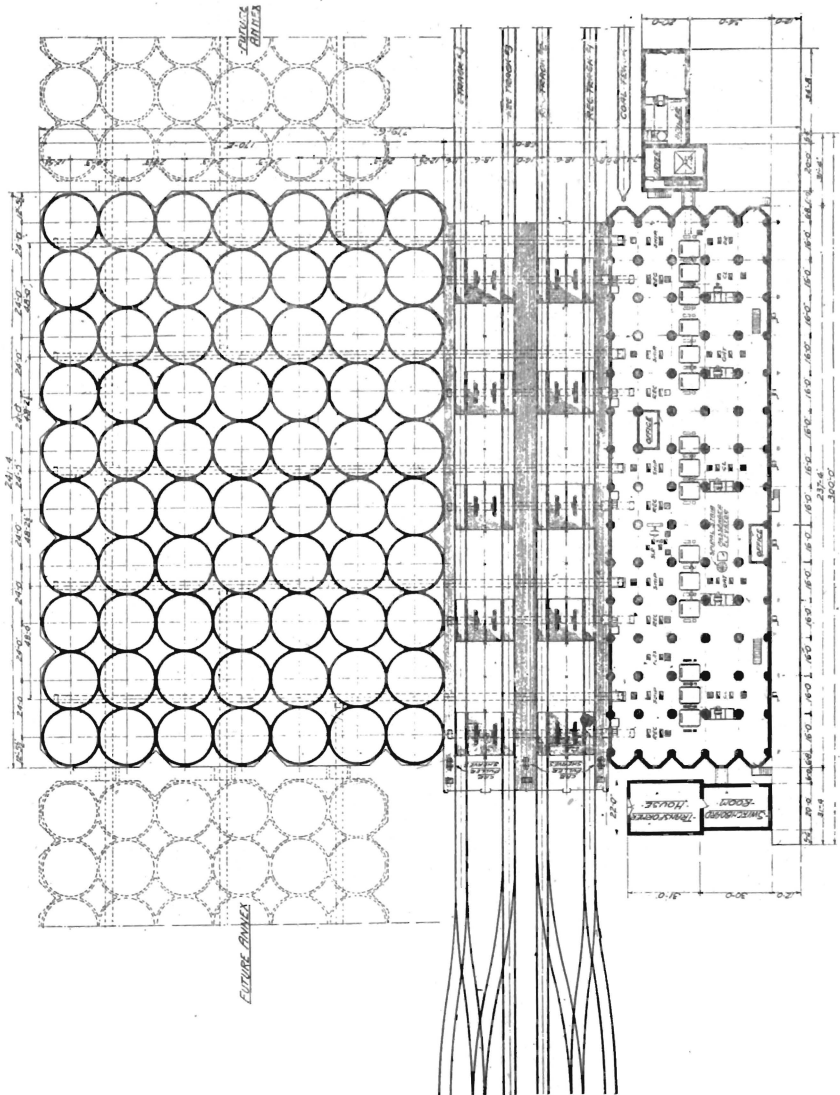
Considerable expense would be saved by having flat, instead of hopper, bottoms to the bins, the last of the wheat being shovelled out when cleaning up for the season.

The grain would be raised into the bins by means of a light bucket elevator driven by a portable engine. The elevator with its boot complete could be made portable, so that it could be transported from place to place with the thrashing plant. The installation of farm silos would enable farmers to make better terms for their cartage, or allow them to do their own as soon as their horses are released from harvesting operations.

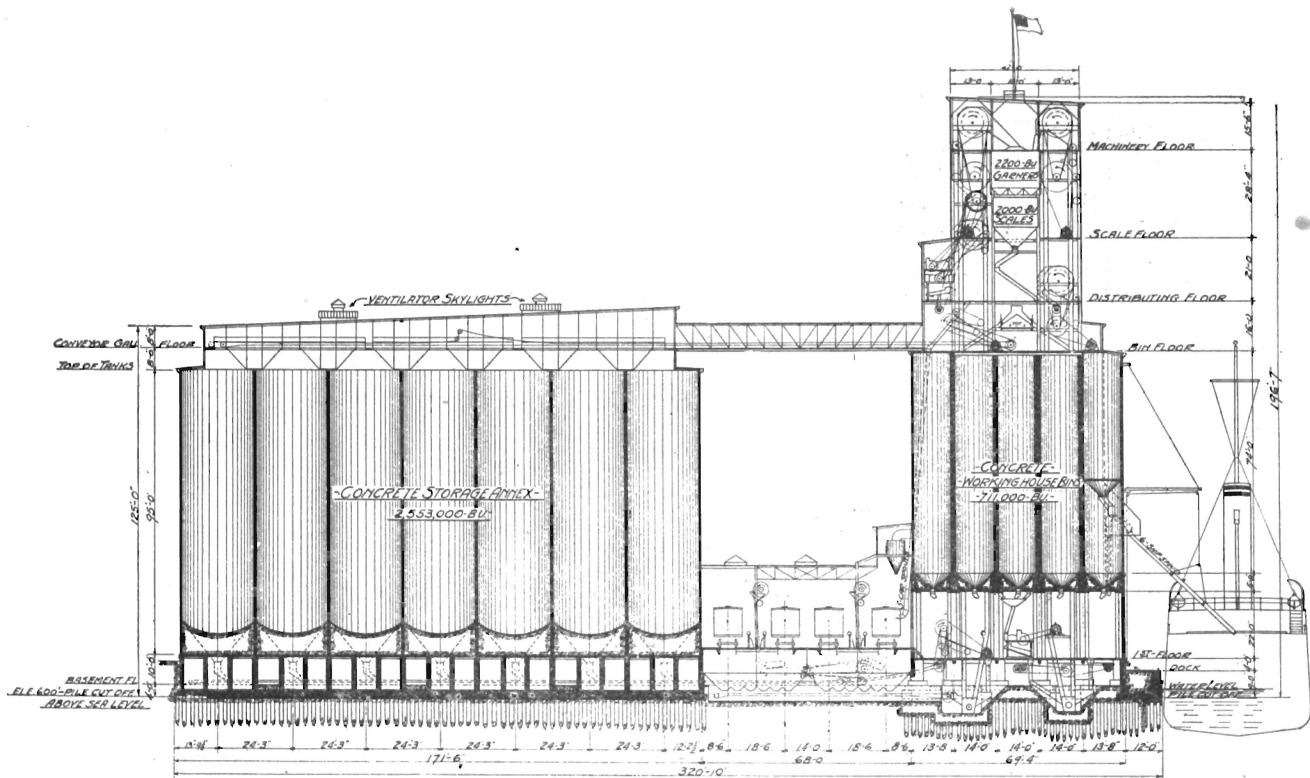
**Country Centre Elevators and Silos.**—These would be provided at railway stations and other collecting centres. They have a number of bins of moderate capacity, and provided with a receiving hopper and bucket elevator for raising the grain into the bins. They are also sometimes provided with a grain cleaning unit. The grain is received from the growers or agents, weighed and elevated into the bins, from which it is spouted into the railway waggons. The Government of Manitoba provides such silos in two standard sizes at railway stations. No. 1, of 45,000 bushels capacity, in 31 bins; they are built of timber, and cost about £2000 each, or about 11d. per bushel of capacity. No. 2, of 25,000 bushel capacity, in 20 bins. They are built of timber, and cost about £1600, or about 16d. per bushel of capacity.

The present custom in Australia at railway stations is to stack the bagged wheat in sheds or in large stacks protected from the weather by galvanised iron and tarpaulins.

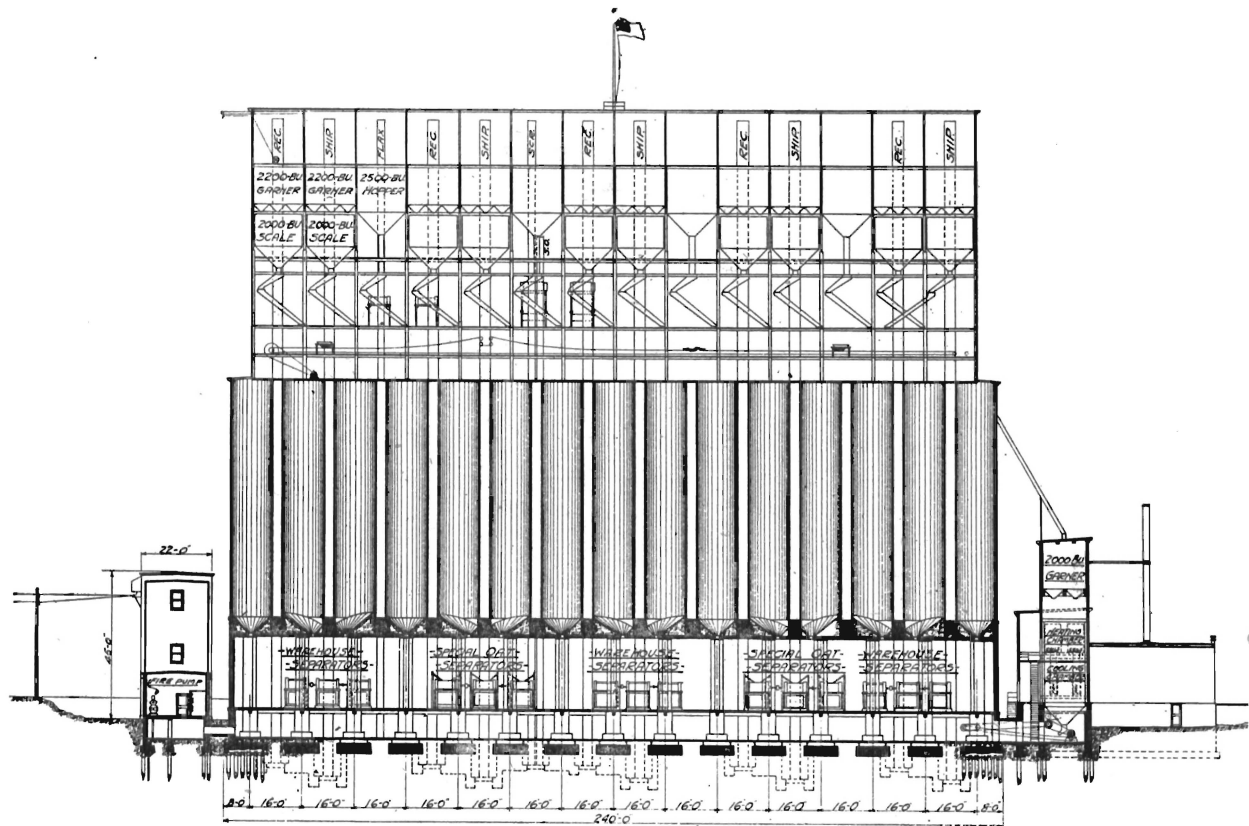
At a later date it is unstacked, wheeled or carried, and stacked in railway trucks, four distinct manual handlings of considerable cost, that would be avoided if a proper system of bulk handling were in vogue.



First Floor Plan, Grand Trunk Pacific Elevator, Fort William, Ont.



Cross Section, Grand Trunk Pacific Elevator, Fort William, Ont.



Longitudinal Section, Grand Trunk Pacific Elevator, Fort William, Ont.

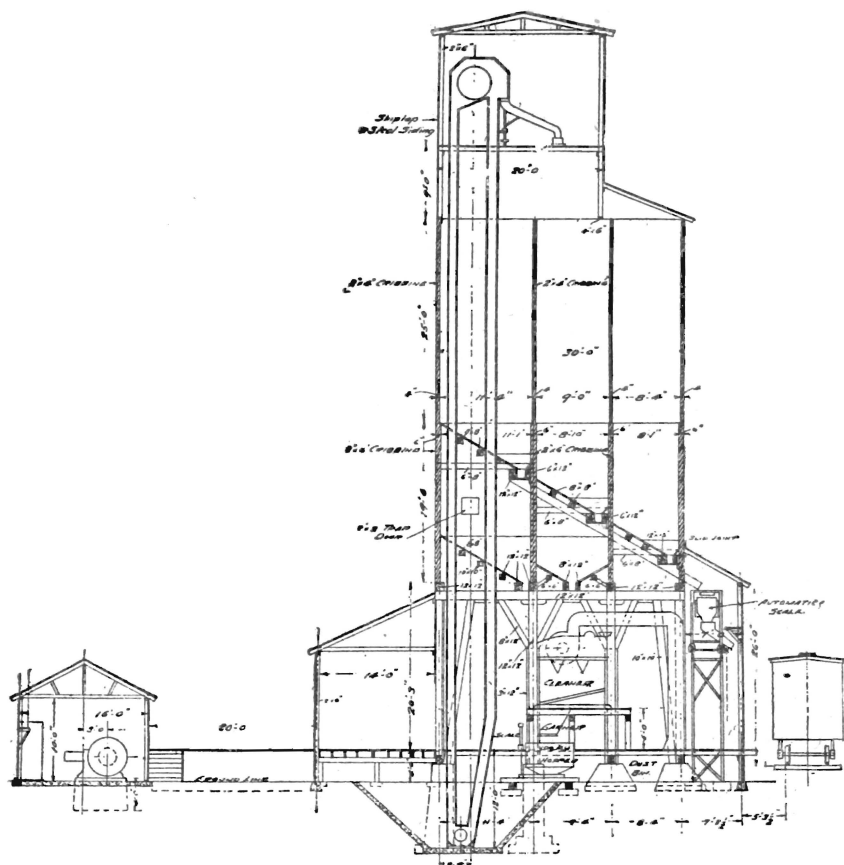


**Storage Silos at Flour Mills.**—At present very few mills in Australia are provided with storage silos. The present custom is to store the wheat in bags in sheds, or even portion of it in outside heaps protected by galvanised iron and tarpaulins. The advantage of storage silos is that they provide a very much increased storage for the same area, they may be absolutely fireproof, perfect protection from the weather, rat proof, weevil proof, enable inspection to be made at any time, and damaged grain treated. Grain may be drawn from any bin at will, and a very large saving in labour costs may be effected, and probably lower fire insurance rates obtained. Stacking and unstacking costs about  $1/3$  to  $1/6$  per ton for labour, whereas the mechanical handling to and from the silo would only cost about three halfpence per ton.

**Transfer and Terminal Elevators.**—These in United States and Canada range very considerably, both in equipment and storage capacity. They are mostly situated on the Great Lakes, St. Lawrence River, and various sea ports. These elevators contain three main departments—receiving shed, working house, and main storage bins—which may be included in one structure in the smaller elevators, or on three separate but adjacent areas at large plants.

The receiving shed, in small plants, occupies the track level and basement of the main structure, but is usually an adjacent annex. It usually consists of four railway tracks wide, each track usually having four track hoppers below rail level. Each hopper is long and large enough to accommodate the largest size of box car and take its contents of 40 to 50 tons. These cars are completely walled and roofed, and have sliding doors on the sides. Temporary barricades of tongued and grooved boards are placed inside the sliding doors. The grain is spouted in at country elevators, the sliding doors closed and sealed. The cars are grain proof,

weather proof, and secure from pilfering. At the terminal elevators the sliding doors are run back, the barricade removed, allowing a portion of the grain to run out; the rest is removed by power shovels. Three men can empty a car in 15 minutes. The effective working capacity of each hopper, including shunting of cars, is considered to be two cars per hour

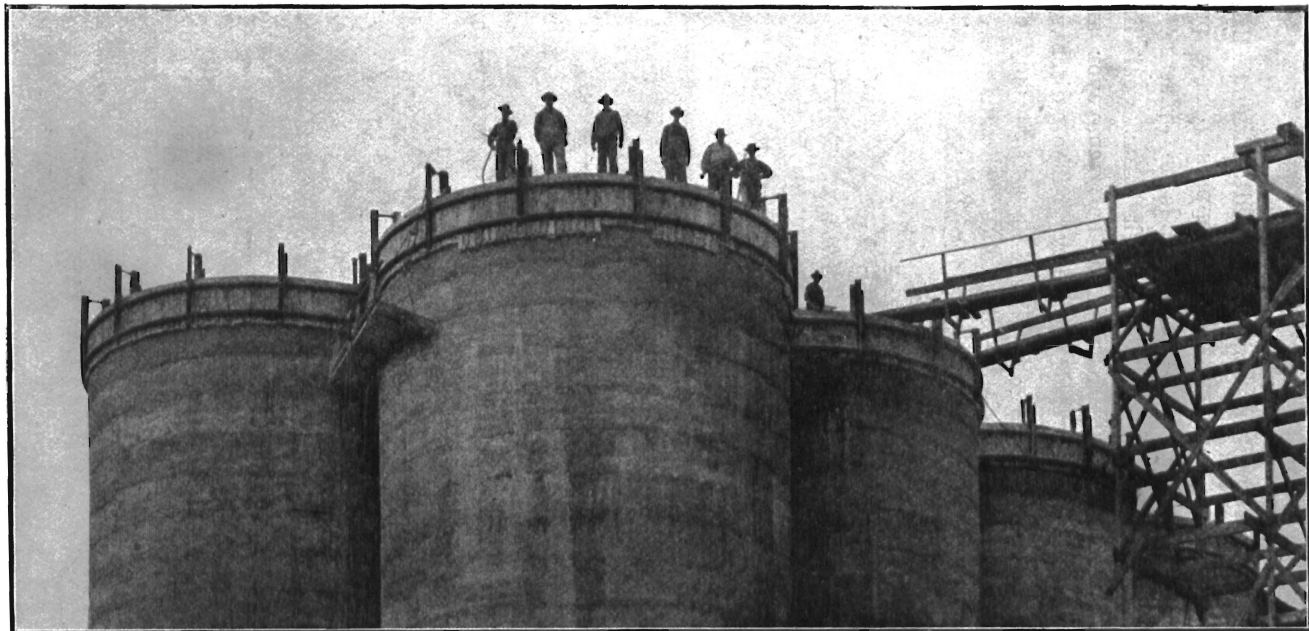


Cross Section of Manitoba Government Elevator. Capacity: 45,000 Bushels.

The grain cars are properly marshalled and handled by mechanical car pullers. The hoppers are provided with screens to remove large pieces of foreign matter and rubbish. Each transversal line of hoppers is provided with a belt conveyor and elevating leg of great capacity. The discharge valves of the hoppers are interlocked, so that only one hopper can discharge on the belt at once, and thus prevent mixing of shipments or grades. The wheat is graded at terminal elevators by State inspectors.

The working house contains nearly all the machinery. The wheat from the receiving hoppers is elevated to the top of the cupola of the working house. It is the uppermost part of the building, and is a tall, light structure, built of structural steel, covered with corrugated iron, and contains a garner or receiving hopper, a hopper weighing machine, and set of spouts for each elevating leg. The scale hoppers are of large enough capacity to receive a car load; they discharge into the distributing spouts. The garner hopper is of rather larger capacity, and is filling while the previous lot is being weighed and spouted to its bin. The working bins are comparatively narrow, and about 70 feet deep. They are usually circular in cross section, and built in contiguous rows, the interspaces between the circular bins being also used for storage. In smaller plants the circular bins are used for main storage, and the interspaces as working bins. The wheat is usually fed by gravity from the working bins to the clearing machines which are arranged below.

No grain, whether direct from fields or from an intermediate store, or from cargo, ever arrives at a granary in such a condition that it does not require considerable cleaning before it can be used. It is necessary to remove all extraneous objects, such as wood, stones, clods of dirt, twine, bagging, etc.; secondly, to remove loose dust and



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