A large combined machine for either loading to, or from storage, had recently been put into operation in America. The coal was picked up from the storage heap by a Conveyor similar in construction to the yard loader shown in the previous figure, this in turn delivered the coal to a Belt Conveyor delivering to cars. The machine was operated by two men, and under conditions which were suitable, viz., for storing and reloading very large quantities of small coal, running into thousands of tons, its operating cost, and cost of installation, was less per ton than any other system. The capacity of the machine was approximately 280 tons per hour.

PIVOTED BUCKET COMBINED ELEVATORS.

Pivoted bucket combined elevators and conveyors as a rule formed a portion of most modern power house equipments, and the same installation was frequently used to handle both ashes and coal. Pivoted Bucket Conveyors might be said to be divided into two types, viz., the contact, and the overlapping lip, the latter being most generally used, for the reason that, provided the delivery was only made from one point at a time, automatic fillers were not necessary. The cost of automatic fillers was therefore cut out and the depth of pit required by the bottom strand of the Conveyor was considerably reduced.

With the contact lip bucket, automatic fillers were necessary to prevent the material being handled from being spilled between the buckets.

The buckets were usually constructed of mild steel or malleable iron, and were mounted on long pitch chains. The speed at which this type of Conveyor operated must necessarily be a slow speed, rarely exceeding 50 feet of travel per minute. One of the main reasons why this type of Conveyor was usually adopted in power houses was that the material handled could be elevated vertically, carried horizontally, and automatically discharged at any point. The discharge was brought about by buckets passing over a tripper.

The trippers were made both of the stationary and portable types, the latter being adopted when it was required to get the maximum quantity into the receiving hoppers, the former type being used when the plant was so constructed that delivery from a few given fixed points would fill the hopper to the required extent.

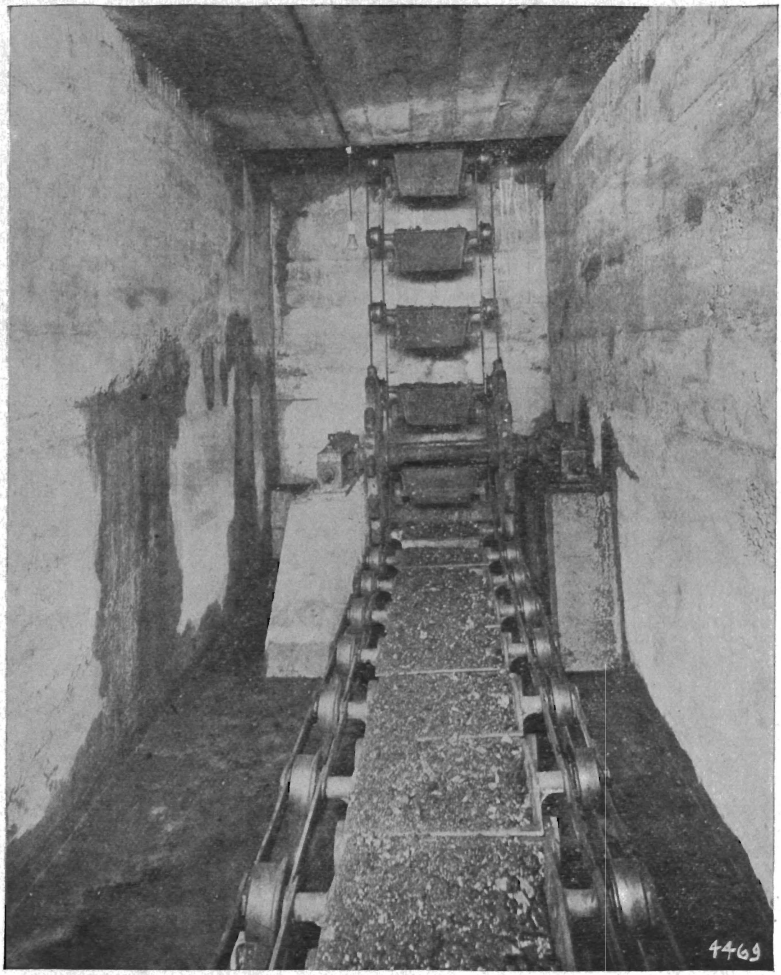


Fig. 7.

Fig. 7 showed a portion of the horizontal and vertical sections of a pivoted Bucket Conveyor, the buckets having been filled by an automatic filler.

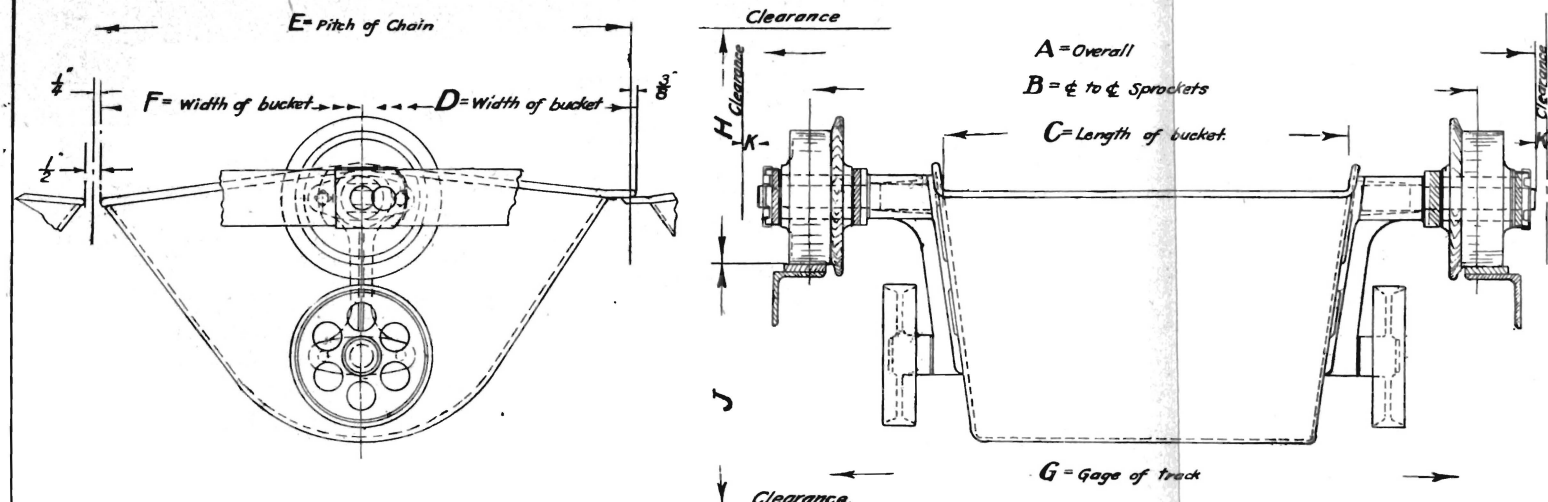
The position at which the drive was placed for this type of Conveyor varied considerably, but where possible the best position for it was as near to or at either end of the top strand, so that the weight in the driving connections did not have to be taken care of at any distance from the main walls of the building or end framing.

Local conditions had always to be taken into consideration, however, and frequently the drive was placed at one of the lower corners of the Conveyor in order that the extra weight of the driving connections did not have to be taken care of above the bunkers or storage hoppers. The capacity of this type of Conveyor was not very large and owing to the slow speed at which the pivoted bucket Conveyor operated the H.P. required to drive a plant of this type was small.

The capacity of various sizes of pivoted Bucket Conveyors operating at various speeds was given in the next Fig. No. 8, and also a good formula for calculating the H.P. required. These would doubtless be of some interest, having been developed by a series of tests extending over a considerable period.

SCRAPER CONVEYORS.

These were very widely used and could be installed for handling many varieties of material, but due to the H.P. required to drive them they were rarely used where the capacity required was large, unless the initial cost of the plant was a matter of first importance and the equipment was not required to be constantly in operation. The reason why this class of Conveyor was used in some cases for handling large capacities was due to its flexibility, as the construction permitted any easy method of dis-



Capy Per Hr in Tons (2000#)	BUCKETS SIZE C	E	Type	CHAIN Drawing Reference	No	Pitch	Working Strain	WT OF CONV PER FT (RUNNING PARTS) Filled	Empty	POWER FACTORS X	Y	STANDARD SPEC ON DATA SH No CONTACT LIP Standard	Thro Rod	OVERLAPPING LIP Standard	Thro Rod
30	16	18			375	18"	7500	91	67	.05	.009				
36	20	18		H-1816	375	18"	7500	110	79	.07	.010				
50	18	24		H-1340	634	24"	9400	105	63	.09	.010				
50	18	24		H-1323	422½	24"	11250	125	83	.10	.011				
50*	18	24		F-179	634	24"	9400	134	91	.11	.012				
50*	18	24		F-241	422½	24"	11250	154	111	.12	.014				
67	24	24			634	24"	9400	128	72	.12	.012				
67	24	24			422½	24"	11250	148	92	.14	.014				
85	30	24			422½	24"	11250	175	104	.18	.018				

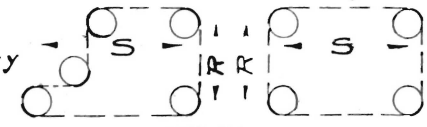
* Heavy Type — Contact lip, overlapping lip, through rods, standard or extra heavy, See spec.

A	B	D	F	G	H	J	K	L	M
30¼"	26⅝"	18¾"	17½"	25⅛"				3'-0"	2'-6"
34½"	30⅛"	18¾"	17½"	29⅛"				3'-0"	2'-6"
34½"	29⅞"	24⅝"	23½"	28½"				3'-8"	3'-0"
35¼"	30⅛"	24⅝"	23½"	28½"				3'-8"	3'-0"
34¾"	29⅞"	24⅝"	23½"	28¼"				3'-8"	3'-0"
35¼"	30⅛"	24¾"	23½"	28⅝"				3'-8"	3'-0"
40¾"	35⅞"	24⅝"	23½"	34¼"				4'-2"	3'-0"
41¼"	36⅛"	24⅝"	23½"	34½"				4'-2"	3'-0"
36¾"	41⅞"	24⅝"	23½"	40⅝"				4'-8"	3'-0"

NOTE:- Values in table based on standard speed of 50 ft. per min.
Capacities in table are for coal @ 50# per cu. ft. (2000# per ton)
For any material other than coal, Capy = Capy in table X $\frac{\text{wt of material per cu ft}}{50}$

When figuring H.P. for handling cement, clinker and other gritty materials, multiply per cent of wt. for moving by 1.5
Care must be exercised when figuring on handling hot materials to see that the bucket is adapted to the proposed service. Heavy type buckets are designed for this work.

FORMULA FOR APPROX H.P
H P = Rx + Sy See table for values of x & y
NOTE:- H.P. obtained from this formula is the amount required at engine or motor shaft



H.P. Diagrams

Space required for vertical section with casing.

Fig. 8.

charge at any required point. Scraper Conveyors could be, and are, constructed in many ways, but the type most frequently used in Australia was the Double Strand Conveyor, the scrapers being attached to two strands of chain, one placed at each end of the scrapers. For handling material of a gritty nature this type of Conveyor was most unsuitable, as every engineer at once realised, and even where installed for handling material suitable in nature, this type of Conveyor was in many cases being replaced by Conveyors of the carrying type. This was done on account of the power required to drive Scraper Conveyors, and this was most noticeable at the various collieries in Australia, where both large coal and small coal was dealt with by mechanical means in large quantities. The type of Conveyor being adopted in place of Scraper Conveyors was usually of the Metal Apron or Belt Conveyor type mentioned previously, provided, of course, that local prevailing conditions would allow of the installation of one of these types of Conveyors. Where it was necessary to use Scraper Conveyors the power required to drive them could be brought down considerably by adopting the construction shown by Fig. 9, viz., by placing large diameter rollers at the ends of the scrapers, thus carrying all the load of the Conveyor itself, and overcoming the unnecessary friction between the scraper chain, or chains, and the troughing. By this method the friction in this portion of the plant was reduced from between 20 and 25 per cent. to between 10 and 12½ per cent., or a reduction of approximately 50 per cent.

As steel thimble roller chains also had the effect of reducing the friction in the same proportion as just mentioned, where it is necessary to keep the H.P. down as low as possible and first cost was not of primary importance, this type of chain should be used on double strand

Scraper Conveyors, and the troughing so arranged that the material being handled could not come in contact with the chains.

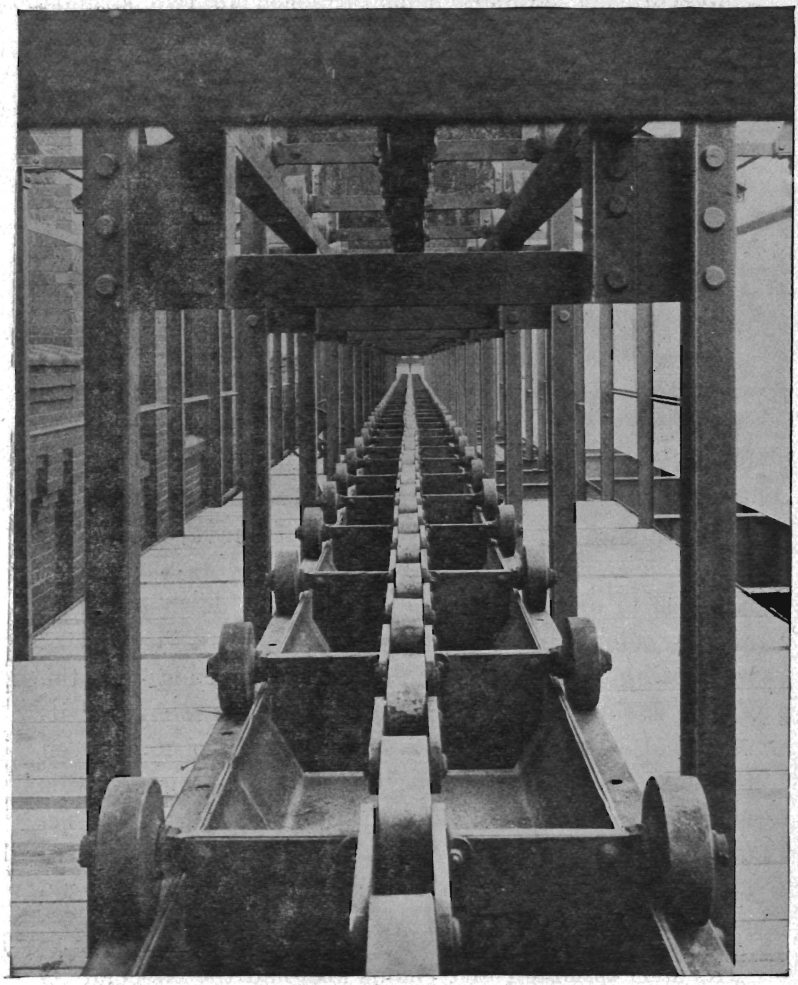


Fig. 9.

The ordinary Double Strand Conveyor was shown on the next slide, the illustration being that of the return strand of a Conveyor installed for handling run of mine coal.

A type of Scraper Conveyor not used to any great extent in Australia was the Wire Rope or Cable Conveyor, the scrapers or flights being mounted on a flexible wire rope. In Canada, however, where pulpwood had to be handled in very large quantities, this type of Conveyor had solved the difficulty of handling this material to and from the storage ground. The explanation of this was due to the long centres at which the Cable Conveyors could be operated and the rough usage they would stand. Pulpwood was one of the most suitable materials for handling by Scraper Conveyors on account of the timber being very wet and slippery when handled.

The writer, while in Canada last year, had the privilege of seeing one of the largest pulpwood handling plants installed in that country in operation. The plant referred to was in operation at the "Three Rivers," and the storage ground had a capacity of 12,500 cords of wood, every 300 feet of length the Conveyor being 80ft. above the ground level. In this plant a Cable Conveyor was used for delivering the wood to and from the storage ground, forming what was commonly known as a Run-around Conveyor. The centres of the Conveyor were 1100ft., and the size of the rope used was 1 1/8in. diameter.

The clamps or scrapers were of very hard C.I. 8in. diameter, and 10in. long, held in place on the rope by being clamped on, the two halves of the scrapers being bolted together with four 1in. diameter bolts.

The pulpwood was cut into 3 foot lengths by slashers, and delivered to the main Conveyor by a single strand Coil Chain Feeder Conveyor. The quantity dealt with was 1800 logs per hour, averaging between 12 and 18 feet in length, so that the capacity of the conveying plant was approximately 7000 logs per hour, each 3ft. in length, and anything from 3in. to 9in. in diameter.

The stretch in the cable was taken up automatically, the tension wheel being placed immediately behind the driving wheel, and expansion rim sheave wheels were used for taking up the stretch in the rope between the clamps and scrapers. A tunnel was formed with heavy logs under the storage pile through which the Conveyor passed when re-handling the logs, and the logs were thrown into the Conveyor by hand, commencing at the furthermost point of delivery, the tunnel being knocked down each time the storage ground was emptied, and being only roughly constructed the cost of re-building was but a small item. With a drop of eighty feet from the Conveyor to the ground forming the bottom of the storage, and the pile of logs having a great tendency to, at times, slide in a mass as the pile increased, it was desirable to have but few supports for the conveyor, and these were placed 300ft. apart, the distance between the towers being spanned by suspension cables, to which the Conveyor frame was attached. The design of the towers for a plant of this type was of very great importance, due, not so much to the crushing effect of the timber stored, but to the blows received by the towers during the period the storage was being filled and emptied. Heavy steel structural towers, cased in all round with very heavy timber for the first 30 feet, had proved the cheapest and best method of construction. The plant just described was driven by an 80 B.H.P.D.C. motor, and the two illustrations given by the Author showed how the troughing was constructed, and the way in which these Conveyors were loaded.

AUTOMATIC DISCHARGE ELEVATORS.

Automatic Discharge Elevators of various types were now to be found in most warehouses where large quantities of material had to be dealt with, because of their low cost of installation, very little power re-

quired to operate them, and their large capacity, so that they were undoubtedly amongst the most economical and greatest labor saving machines.

Where it was required to install elevators for elevating material only the elevators were installed with automatic discharge points on the up strand.

The elevators used for this work consisted of two strands of chain operating around sprocket wheels at the head and foot of the elevators, and to the chains cross bars or trays were attached for carrying the material. The method of discharge might be arranged in many ways, but it was essential that the discharge be constructed so that the material being handled might be thrown from the elevator without undue friction.

The capacity of this type of elevator depended very largely upon the size of the bales or packages being handled, for upon this depends the spacing of the trays or cross bars, but it had been found that 360 bales or packages per hour was as fast as it was practicable to load elevators handling packages or bales weighing over 300 pounds each.

The speed at which the elevator should operate should not exceed 60 feet of travel per minute, and the H.P. required to operate the machines of course varied according to the weight of packages being handled.

Elevators which had to combine the feature of lowering as well as elevating goods were mainly of the finger tray type, and these were constructed so that the material handled was automatically picked up from receiving trays and discharged at the required point by delivery, by deflecting trays, which relieved the carrying trays of their load and discharged it at the point required.

An elevator of this type in operation in a large warehouse in Sydney was 83 feet high, it had a capacity of 720 x 200 pound sacks per hour when operating at 60 feet of travel per minute, and it was driven by a 3½ B.H.P. D.C. motor.

The chain used on elevators of this type was usually of the ordinary detachable type of chain, but a steel riveted chain would give the best results if the elevator was required to handle heavy materials.

WOOD APRON CONVEYORS.

Wood Apron Conveyors were another type of Conveyor which was useful for handling many classes of material put up in boxes, packages, bags, etc., and owing to the first cost of Conveyors of this kind being very small they could be installed to advantage, even though the saving in labour effected was not in every instance of great moment.

Like practically every other type of Conveyor, upon the local conditions, and the material to be handled must depend very largely the type of equipment to be installed, as there were of course many ways of making up a Wood Apron Conveyor.

For light loads, wood slats attached to ordinary detachable chain was the most common type used, and a Conveyor made up in this way could operate with perfect success up to a speed of 200 feet of travel per minute. The wood apron forming the Conveyor could be made either continuous, or otherwise, according to the nature of the material to be handled, and the local conditions under which the plant was to be installed. With a Conveyor made up in the manner described, the wood slats, or battens, usually operated on the runways of the framing, and provided the slats and runways were made of tallow wood, or timber of a similar nature, it was not

necessary to line the runways with mild steel, as once a moderate amount of plumbago had been allowed to work in between the slats and runways a very smooth surface was made and the friction between the two timbers was very little more than the friction between runways lined with mild steel, and tallow wood slats.

Some idea of the H.P. required to operate a Conveyor of this type might be taken from the actual results obtained from a plant in operation in Sydney. The Conveyor was 14in. wide, 205ft. centres, operated at a speed of 100 feet of travel per minute, and handled 2000 cases per hour, each averaging 50lb. in weight. The actual power required to drive this plant under full load was 8 B.H.P., but as the initial power required to start the plant up was considerably more than that required to drive it when running, a 10 B.H.P. motor was installed. For handling heavy loads a steel thimble roller chain should be used, the chain being attached to each end of the slats forming the apron of the Conveyor, the rollers at each joint of the chain operating on the runways of the framing.

This type of chain had been very successfully installed on wool bale Conveyors of long centres, and in order to demonstrate what a small amount of power was required to drive a Conveyor of this type the result of tests recently made in South Australia might be of interest.

The plant on which the test was made was 425ft. centres, 3ft. wide, and was driven at the centre, this, because the Conveyor was arranged to run in either direction. A 25 B.H.P. motor was used to drive the Conveyor, the drive being through a friction clutch on the 2nd reduction gear shaft.

The chain used was an 18in. pitch S.T.R. chain with 5in. single flanged rollers at each joint of the chain.

The wood slats forming the apron of the Conveyor were 3ft. long, 1½in. thick, and there was a space of ¾in. between each slat. The Conveyor was loaded with 11 tons of wool, which was conveyed in either direction at 90 feet of travel per minute, and the actual B.H.P. required was 19.5 when running with a momentary increase of approximately 100 per cent. when starting up.

The many ways in which Wood Apron Conveyors might be applied would be demonstrated by a few slides, one of which was shown in Fig. 10.

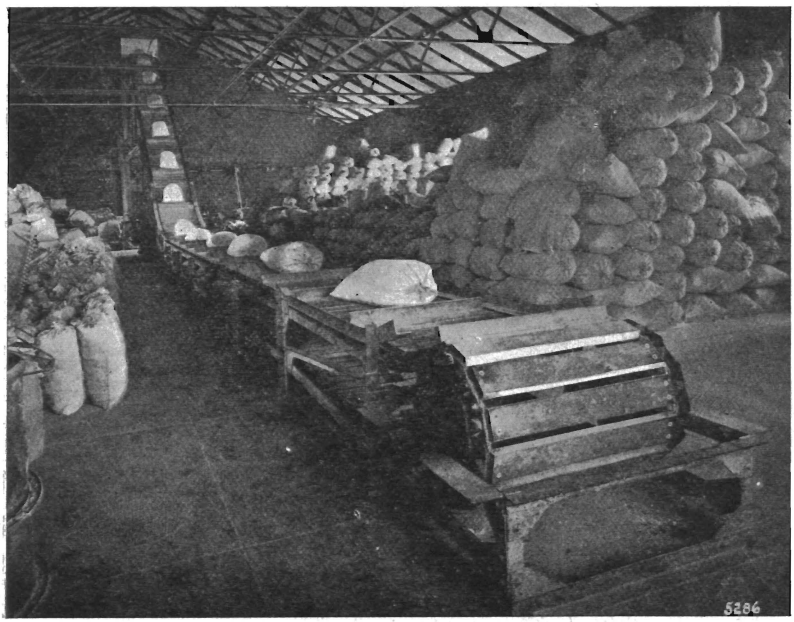


Fig. 10.

In conclusion might he say that when considering the installation of Elevating and Conveying Machinery it was most necessary that the chain used was one of suitable construction for the conditions under which it had to operate, and it should have an ample margin of

strength; also that the motive power by which the plant was driven should be equal to developing considerably more power than was actually required. The reason for this was that elevating and conveying machinery designed for a certain load was frequently overloaded, and as the load in many cases was delivered to the plant by ordinary labor, so long as there was room for more material to be loaded on to the Elevator or Conveyor it was put there irrespective of what the results might be, and further engineering knowledge not being required to operate this class of machinery the plant often did not receive proper attention.

Discussion.

Mr. J. W. Bragg, in moving a vote of thanks to Mr. Jones for his paper, said he thought the author was to be congratulated upon his selection of the various types of Conveyers he had shown members that evening. He had described and illustrated material being handled in bulk, from small coal up to big wool bales, and there seemed to be practically no limit to the extent to which such conveyers as he had described could be adapted.

Conveyers such as they had seen on the screen appeared to be very simple contrivances; they consisted of, apparently, a chain and some wood slats, buckets, or material of that kind; but they would probably all agree with him that when they came into closer touch with the handling of bulk material, it would be found that such had little ways of its own which required very careful handling indeed. Occasionally it appeared to be possessed of an evil spirit. Things appeared to do that which they should not do. They all knew how inanimate objects