of such varieties as the Lahaina, Rose Bamboo, Yellow Caledonia, Ribboned Singapore and Black Java, which is known locally as Bullock's Heart.

The ripened product is transported to the mill by V flumes having a combined length of twenty miles, the water to operate the flumes being one of the features of the property and obtained from streams and gulches upon its own lands. The area planted in 1900 was 1929 acres. The cane is stripped at least twice a year and sometimes thrice. In the cane fields and about the vast works of the company some 1100 men find employment, the living headquarters or plantation camps being situated as close as possible to the various cane fields or scene of labor.

The remainder of the lands controlled by the company and not under cultivation is forest land.

The greatest width of the plantation, extending along the ocean front, is six miles. It reaches back to the forest lands for a distance of fully three miles. This year quite 1600 acres will be planted, and from the time of plowing to harvesting the product for the mill, thorough cultivation is resorted to, much more extensively in fact than is usually practiced at other plantations in the same district or elsewhere on the island, the result of such thorough and systematic cultivation being quite observable in the general appearance and growth of the cane. In the plowing of the land and the general preparation of the soil for planting the management has introduced the disc plows, which have a subsoiler. In the cultivation of the soil the Horner segment cultivator has been introduced, which machine will get away with more weeds than any other known cultivator. By the end of the grinding season for this year, which commenced about the first of January and ended about the latter part of June, there will have been put through the mill the product from 1400 acres, one-half of which was Lahaina cane, and the remainder Rose Bamboo and Yellow Caledonia.

At such places as Keawehala, Mukoniki and Kalaoa the cane is fully one year old and will be ready for cutting next year.

The mill has a capacity for turning out eighty tons of sugar in a day of twenty-four hours, and was the second nine-roller mill of the kind erected on the Island of Hawaii, and was constructed by the Fulton Iron Works of St. Louis, while the vacuum pans were furnished by the Honolulu Iron Works of Honolulu.

Last year the mill sugar extraction of the sucrose contents of the cane was 93 1-2 per cent.

An electric plant has been installed for the purpose of lighting the mill buildings and grounds, as likewise supplying power to drive machinery in machine shop, saw mill, barley crusher and cane fodder cutters.

The method employed to transport the sacked sugar from mill to steamer is performed by a system of cables, whereby 6000 bags of sugar can be loaded directly into the hold of the steamer in a day during fair weather.

The company conducts its own store at Papaikou as a matter of convenience for its employes. John Moir, the manager of this prosperous plantation, has been identified with the sugar industry on Hawaii for thirteen years and for the last three years has managed the Onomea properties.

Following are the officers of the Onomea Sugar Company, Limited:

P. C. Jones, President.
C. M. Cooke, First Vice President.
O. M. Vesper, Second Vice President.
G. H. Robertson, Treasurer.
E. F. Bishop, Secretary.
T. R. Robinson, Auditor.
A. P. Welch, Assistant Treasurer.
G. R. Carter, E. Pollitz, Directors.
Brewer & Co., Honolulu Agents.

About one-half of the stock of this company is held in the San Francisco market, where stock can be transferred.

Kukaiau Plantation Co.

Located some forty miles from Hilo and in the Hamakua district, are the vast holdings of the Kukaiau Plantation Company, which practically controls 50,000 acres of land, of which area 2560 acres have been planted in sugar cane, one-half of which is plant cane and the remainder rattoons. Three varieties of cane are grown upon the plantation, consisting of Rose Bamboo, Lahaina and Yellow Caledonia. The average yield from all cane put through the mill each year or season is four tons of sugar to the acre, or a ton of sugar to every nine tons of cane. The area planted at the present time is greater than it has been in former years, while the yearly output of raw sugar is approximately 3500 tons.

The land devoted to the growing of cane lies on a beautiful slope, and has its beginning at the broad Pacific ocean at an elevation of 200 feet above sea level, and extending back to the forest lands to an elevation of 2000 feet, at which altitude the cane shows a remarkable growth.

The first sugar cane planted on any of the land owned by this company was in 1883, at which time the Lahaina variety was planted exclusively. Some ten years ago the Rose Bamboo was introduced and was found to be an excellent cane to rattoon, in addition to which it stools well and is a rapid grower. The Yellow Caledonia has been grown upon the lands to more or less extent, and has been found to be a desirable variety. The soil upon the plantation is from good to fair and is characteristic to the adjoining plantations. The surface soil is a black loam, while the sub-soil is a yellowish red.

At the present time the company is plowing and planting 600 acres of Rose Bamboo seed principally, while a small area will be given over to Lahaina and Yellow Caledonia. The plowing of the soil upon the above plantation is most thoroughly done by the aid of disc plows, which plow with the disc and sub-soiler penetrating the soil to a depth of twenty inches and leaving the soil thoroughly pulverized and mulched. With the aid of the disc plow and sufficient horses, from one and one-half to two acres of land can be turned over in a day of ten hours. By the use of the disc plow little or no harrowing is found necessary.

In the thorough cultivation of the sugar cane between the rows the Horner cane cultivator (patented) is in use, and has been generally adopted throughout the plantations on the island of Hawaii, while a recent shipment has been made to the Island of Maui, in addition to which quite a number have been shipped to the plantations in Louisiana. The cultivator consists of a

Method of Fluming Cane to Mill on Plantation of the Onomea Sugar Company, Hawaii

semi-circular iron frame, with curved steel teeth, and curved in such a manner as to perform successfully the double work of gathering the grass between the cane rows and cultivating the soil and burying the grass which rots. In the operation of the cultivator weeds are not only torn up, but are gathered by the teeth as the machine moves along, and are turned under the soil when the cultivator is discharged of its load. The forming of a segment in the plow construction and teeth permits enough dirt being lifted with the weeds to turn the latter under completely. The discharging of the cultivator is performed without stopping, by simply lifting the rear of the cultivator by the handles.

With this cultivator fully one-half of the labor and expense incident to the hoeing of the land is saved, if properly handled.

The method of transporting the ripened cane from the fields to the mill is a very interesting one, and practically solves the question of reducing to a minimum cost the handling of the product. The system is known as the Horner gravity cane transmission system by wire cable (patented), and has proved a simple and economical means of delivering the bundled cane from all parts of the plantation to the mill by gravitation. It consists of stationary cables supported upon pulleys above the ground, upon which cables the trolley hooks or carriers are hung with their load, having also certain specific means of supporting the cable-carrying pulleys, whereby the cable adjusts itself to the passing loaded trolley.

Mill Kukaiau Mill Company, Paauilo, Hawaii

This system is for use especially in a rolling or hilly country, as it is dependent upon gravitation, and will operate on any grades above 4 per cent. The only wire that has been found suitable for use in the above system of cable transportation is the patent locked wire rope, manufactured by the Trenton Iron Company of Trenton, New Jersey, of which concern Newton M. Bell, of 308 Market street, San Francisco, is the Pacific Coast agent. The plantation company, after having practically tested several leading and highly recommended wires, finally adopted the above mentioned rope for use on their system, which is peculiarly adapted for the work it has to perform, as the trolleys run smoothly, do not stick or jump, and it does not wear out so quickly as ordinary wire rope. The system has been applied with particular advantage on the Islands of Hawaii and Maui, where the nature of the ground is very uneven.

In many places where the system has been introduced, it has been found possible to transport as much as 250 tons of cane in a day of ten hours over a single cable to the mills, which are located at the lowest elevation on the plantation.

Previous to the introduction of this system upon the Kukaiau plantation there had been constructed some twenty-five miles of roads throughout the various cane fields, the cane being handled by teams over these roads to the mill at an enormous expense. Owing to the cost of further road construction, much good cane land remained non-productive, which is now and has been for some time devoted to cane culture, owing to the successful introduction and operation of the above system. The earlier introduction and installation of this cane transporting system would have effected a saving of fully one-half of the total road construction, which is about the amount of roads that are entirely out of use at present.

The cables are suitably anchored at both ends of the system, and have spans varying according to the contour of the country from seventy-five to 1800 feet. The size of the trolley wheel varies according to the grade; the steeper the grade the less the diameter of the trolley wheel, while the average weight of the bundles is generally from 250 to 300 pounds. The spiral spring and vertically movable eye-bolt, chain, drop holder and pulley offer a flexible, anti-frictional support for the cable, and relieve any jar or bump of the passing loaded trolley, while the cable is prevented from leaving the sheave support by reason of the clamp hook secured to the cable.

At the present time there are three of the above systems in separate operation upon the Kukaiau plantation, having an aggregate length of eight miles. The longest line from field to mill is three and one-quarter miles, over which is handled 150 tons of cane in a day of ten hours. The cost of handling the cane by this system can be figured as follows to wit: Five men will cut and deliver enough cane in a day to manufacture one ton of raw sugar, while each horse connected with the system is estimated from a wage point of view to cost as much as a man, and is included in the five men, as estimated above.

On plantations where inaccessibility and lack of water for fluming the cane to the mill exist, the Horner transmission system occupies an important position. It is also a valuable acquisition in connection with flumes, as likewise the delivering of the cane product to plantation cars propelled by steam power from distant points on the level land to the mill. No organized attempt has been made by the patentee, Albert Horner, to install the system, but gradually the plantation managers, as likewise the agents, are beginning to figure with the idea of adopting the system. Recently a complete plant was installed upon the Kona sugar plantation in the Kona district on Hawaii, the manager of which property is very much elated with the system from the point of economy and results obtained.

A simple device patented by Mr. Horner and designed for the collection into bundles and the holding of cane in position for transportation on the cable system is also in operation. It consists of a hinged iron and steel framework operated by handles, so curved or shaped as to be adapted to receive the cane which can be laid into it, and a means for closing up the hinged portion with a relation to the other part so as to clamp the bundle of cane firmly in place. The binding chain can then be taken up to fit the reduced size of the bundle by a simple movement of the two lever handles, and the operation thus carried on until the bundle is in as compact a state as may be required. For work on plantations it has been found that bundles of 250 to 300 pounds are very satisfactory, but there is no limitation to the size that can be made for this purpose. The question of loading the bundled cane upon wagons in the field and conveying same to the cable station has been practically solved by the introduction of Horner's cane loader (patented). It consists in combination with a derrick mounted on a wheeled platform, of means by which the mast of the derrick may be maintained in an essentially vertical position irrespective of the nature of the ground traveled over, and an adjustment seat for the inner end of the boom whereby the boom with its load may be automatically moved to discharge the load of cane at any desired point. By means of two horses attached to the whiffle trees, the derrick is moved to any desired point in the field, and the ground is cleaned of the previously bundled cane, within the radial sweep of the boom. The important feature of this loader is the means employed to move the boom automatically in a horizontal direction, and, secondly, in order that this means may always be effective irrespective of the slope of the ground, as to the manner in which the platform is mounted upon the forward axle, so that the platform may be maintained in a horizontal plane and the mast accordingly kept vertical.

In derricks of ordinary construction the load is lifted, as in the Horner patent, vertically by means of the cables and drum; but in order to swing the boom around to and over the cane wagon, it is necessary to attach a cable to the load or the end of the boom, or by equivalent means exert a force in the direction of the wagon. Such a method not only requires the use of a special operator, but is slow and tedious, and particularly arduous when the ground is rolling or hilly.

Another feature of the loader is the manner in which the brake is operated in relation to the tilting of the frame, it being strong, quick and positive in its action, so that the loader can be stopped on any particular spot, and is so arranged that it can be operated by the driver seated at the tiller.

At suitable intervals along the line of the cable system are loading stations where, in order to give a proper impetus to the loaded trolley it is frequently necessary to elevate the cable at these points. By means of a hoisting mechanism consisting of a block and tackle, the cable is lifted to the necessary height by the aid of a single horse, which operation, previous to the introduction of the above invention, required the labor of many hands. The trolley is then released and it carries its load to the mill or terminus by gravitation.

As the initial loading point may be several miles from the mill, it becomes necessary from time to time to transfer the load of cane from one cable to the other. At these points of transfer from one wire to another, the bundles of cane are lifted from the wire by the use of a simple lever swung from an overhead support by a flexible connection. The operator readily swings the bundle of cane from cable to cable, the flexible connection and the length of the arm of the lever giving sufficient latitude for all purposes. The introduction of the above mechanical device in connection with the cable system was found necessary, as on long lines or runs it is desirable that the trolleys be re-oiled.

As to the adoption of the above system it has reached beyond the experimental stage, and is now in successful operation upon a number of plantations throughout the island group. Taking the original cost for loading wagons, keeping up roads and delivering cane to the mill and comparing these conditions with the wire-rope transmission, one realizes the great advantage from an economic standpoint.

Like all new innovations in a mechanical line, the Horner system had its defects, but by constant application and study upon practical lines the patentee and inventor has succeeded in perfecting a series of mechanical appliances that has reduced the cost of producing a ton of raw sugar far below the figure in past years. Upon the plantation there are 160 head of horses and mules found necessary in plowing the soil and preparing it ready for planting, and in operating the various mechanical appliances in daily use upon the land. The company has erected the necessary buildings in various parts of the plantation for the accommodation of their employes, together with ample stable accommodations, blacksmith and machine shops, horse-shoeing and wheelwright shops, and such other buildings as are required for the proper conduct of the daily affairs of a model plantation.

The product of the Kukaiau Plantation Company is reduced to raw sugar in the mill of the Kukaiau Mill Company, which is situated upon the lands of the Kukaiau plantations at Paauilo and owned and controlled by the estate of Theo. H. Davies and J. M. Horner & Sons of Kukaiau, the former being likewise the agents of the mill property.

The factory is a nine roller mill operated by steam power, admirably arranged and supplied with Ross cane cutters, one 5 and