BANANAS—THEIR CULTURE AND TRANSPORTATION.

BY CHARLES B. HAYWARD.

Thirty-five years ago there were few people in this country who could boast of having seen a bunch of bananas. The fruit was practically unknown; indeed, less was known about it than about the most rare fruits of the tropics at the present day. Now there is no crossroads store so insignificant or so far removed from the usual paths of civilization where it is not a familiar sight. Taking the present rate of importation as 400,000 bunches weekly in round numbers, this being rather below the actual amount than otherwise, and figuring the mean weight of the bunches at 50 pounds, which is also very moderate, 20,000,000 pounds of bananas are now provided for 75,000,000 people every seven days.

Despite the fact that the millions of bunches annually consumed are almost wholly composed of one member of the family—the common guineo—naturalists have recognized and classified as many as forty different varieties, ranging from the *Musa rosacea*, a purely ornamental group that does not develop fruit, to the *Musa ensete*, or giant banana—the *plátano* of the Spaniards. From this giant the size decreases more or less gradually until the diminutive "finger" banana is reached, the appellation of which is sufficiently descriptive of its size, but its lack of the latter is more than compensated for by its thin skin and unusual delicacy of flavor. Nor are all the varieties of the same shape; the *artón* and other species grown in the mountains of Central America are perfectly straight and almost as broad as long, and as a result do not lie along the stalk, but stick straight out from it, giving the whole the appearance of a bunch of short stubby spikes. This latter species, as well as the plantain, is most frequently grown in the interior between the rows of coffee trees, for the double purpose of shade and provision, and it is said to be most dangerous to partake of either shortly before or after indulging in spirituous liquor—a fact concerning the banana family of which few outside of the natives and resident physicians are cognizant. Alcohol in certain forms when brought into contact with any kind of banana produces violent fermentation; but it is the firm belief of the natives of the interior, particularly in Costa Rica, that dining on one of these stubby caricatures of the banana with which we are familiar, and topping it off with a dose of *aguardiente*—the native strong water—is productive of fatal results within a few hours.

When a coast native decides to loose his bridled ambition and become a "planter," he selects a spot bordering on some lagoon or river, and with the aid of that universal tool and weapon, the *machete*, supplemented by an unwieldy Spanish ax, he levels brush, trees, and vines for the space of an acre or so, and there they lie until the tropic sun and the trade winds give further vent to his ambition by rendering the pile as dry as tinder. A match completes the task of clearing, and after the embers are cold and the smoke has died away, the ground is ready to receive the suckers, shoots, or settings, as they are variously called according to the locality. It is a matter of common observation that the banana of commerce is absolutely seedless, cultivation through innumerable generations having led to the atrophy of these organs through the substitution of a vegetable method of propagation, much to the advantage of the eater of the fruit at least. Some of the primitive seed-bearing varieties are still said to exist in isolated regions of the Far East. A description of the tree itself is necessary to a proper understanding of the planting operation and its subsequent developments.

The term is a misnomer, as it is not a tree in the ordinary application of the word at all, but a tight roll of leaves which pushes upward, at the same time unfolding the delicate green banners to form its leafy crown. This is quite ornamental at first, but wind and rain soon whip the tender leaves to shreds, leaving but a mass of ribbons to rustle in the trades. The base of a well-grown plant presents a bulb-like appearance, and will carry from one to three or more knoblike excrescences, which are termed "buds" or "eyes." They develop upward first, and after throwing out several leaves, soon grow independent roots, so that they may be severed from the parent plant without injury. These are the "suckers," and form the planter's chief capital. He sets them out in two-foot holes spaced fifteen to eighteen feet apart until his acre or so is covered, and then rests once more to await further developments, which nature is not slow in supplying.

The rapidity of development from the newly-planted sucker to the tree in full bearing is little short of marvelous, and can be appreciated only by one who has witnessed it. Within a space of six or seven weeks the two or three foot plant has more than doubled in size, and a month or so after this the leaves cease to unfold, and a spike appears out of the center of the crown; this is the future stalk of the bunch, and carries a huge red blossom at its end. It develops rapidly, continually bending more and more, until in a short time it has turned completely upon itself, so that the bananas grow end up, or in a position the reverse of which they are usually hung here. At irregular intervals along the entire stalk, and only extending part way round it at any place, the bracts break forth—tiny ridges of flower which are almost immediately replaced by nine to twelve or fifteen embryo bananas. These are the future "hands" of the bunch, so called from their resemblance to that member when held in a certain position, and are separable from the stalk without disturbing their individual components. It is by means of these "hands" that the fruit is classified for shipping. A bunch of nine hands or over, the average being ten to twelve, constitutes a "first"; between seven and nine a "second"; anything under this minimum being discarded by an inspector at the wharf. The writer has seen bunches of seventeen hands, but this abnormal size is equally unfit for shipping, owing to the inconvenience of stowage in the steamer's hold.

After having put forth ten to twelve bracts, the stalk continues to grow and develop the latter. These, however, are sterile, but by a wise provision of nature serve to fertilize their neighbors on other trees through the medium of the humming birds, which abound on the banana farms. When ready for cutting, the stalk and original blossom extend two to three feet beyond the bunch. The spike bearing this gaudy flower appears when the tree has reached a height of ten or twelve feet, but this varies greatly with the locality, unusual fertility of soil, such as is afforded by the alluvial river bottoms, being productive of an abnormal amount of trunk and leaves, but unattended with a corresponding increase in the fruit. The trees in the Matina River district in Costa Rica reach a height of thirty feet or more.

Ten to eleven months after the suckers are placed in the ground the bunches are ready for cutting, and it is here that another peculiar feature of which the banana apparently has a monopoly becomes evident. Practically nine persons out of every ten give expression to the opinion, "How much better a banana must

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HOW THE NATIVES CARRY THE FRUIT.

CUTTING A BUNCH OF BANANAS WITH THE MACHETE.

TRANSPORTING BANANAS BY MULES. FRUIT STACKED READY FOR THE TRAIN.

LOADING HARD, GREEN BANANAS ON FREIGHT CARS.

TIMING AUTOMOBILE RACES.

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be used on a single line wire with ground return. The telephones, owing to their high resistance, as compared to that of the relays, would not interfere with the operation of the system. However, a magneto call could not be used, and in place of it Mr. McMurtry uses a "hummer" call.

At the Eagle Rock hill-climbing contest, the distributor was not used, as it was not found necessary in that style of race. One of our illustrations shows the simple apparatus employed at this race. Our other illustration shows the complete apparatus. The distributor may here be seen at the rear of the board, and the five timing watches are shown in the immediate foreground. The operator with telephone harness applied is seen at the left of the apparatus.

BANANAS.

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taste when allowed to ripen on the tree!" But the contrary is the case, because the fruit will not mature to perfection on the tree; the skins burst, attracting innumerable insects and birds, and the weight of the bunch itself becomes too great for the tree, either one or both coming to the ground. So the bunches are cut when the fruit is half to three-quarters full, i. e., matured, though still green and hard as nails, according to the length of the journey it is to undergo. It continues to feed from the cut stalk, which contains a great amount of sap, until fully ripe, but should the cutting have occurred too soon, while the fruit will turn yellow, it will never attain the flavor or softness or flesh requisite.

With the cutting of the bunch ends the life of the tree, for it bears but once, and is usually cut down to obtain the latter, or succumbs a few days later to the cleaning process, which is merely bringing the spent trees to the ground. A new tree springs from the center of the old stump, and thus there is an everlasting succession without further effort on the part of the planter. Cutting the fruit itself involves the only careful labor on a banana farm, as the bunches weigh fifty to sixty pounds, and even slight knocks are followed by bruised spots, under which the fruit quickly ripens and decays. It is for this reason that land adjacent to a watercourse is most valuable for planting, owing to its accessibility and easy transport by canoe. However, by the liberal use of trash (dried banana leaves) the fruit is safely brought to the railroad on packhorses. Several of the large plantations in Costa Rica have been equipped with complete outfits of light portable railway imported from Germany, this being moved about as the cutting progresses.

At Bluefields the steamer goes up the river and ties up at the farm, moving to the next as soon as the crop is loaded, and so on until a cargo is obtained. But this is one of the few places so favored. At Port Limon, the outlet of the Costa Rican trade, which is of considerable importance, the farms line the railroad for a distance of almost fifty miles, and the bunches are piled along the track, as shown in the accompanying photographs, to await the banana trains. It is not unusual for snakes, tarantulas, and similar unpleasant customers to find a lodging in a bunch of bananas, and when discovered at the loading point, the fact "snake in this car" is usually chalked on the outside, and the carriers handle the bunches very gingerly at the wharf.

At the end of the second year a banana farm is well developed, and there are at least four trees where but one was set out, so that with even a moderately small acreage fruit may be cut practically every week in the year, and the income is continuous. Rotation of crops is unknown, and unless the land be subject to overflow, it is almost valueless at the end of ten years, but many a farmer has become independent before that stage is reached, and the risk of the land giving out seldom causes him much worry. A plantation of forty *manzanas* (about sixty-nine acres) will, after the second year, produce more than fifty thousand bunches annually, and these at the prevailing prices—thirty to fifty cents silver—will be worth between twenty and thirty thousand dollars, or more than double what it usually costs the farmer to buy the land, clear and plant it, and pay the first year's expenses. The cost of running such a farm after the first crop is almost wholly confined to the "cleaning," which does not exceed ten to twelve dollars per acre annually in the majority of banana-growing districts, and considerably less in some.

To the average northerner the banana is but a fruit, seldom eaten in any other manner than raw. To the native of the tropics it is a *multum in parvo*, often his entire sustenance for weeks at a time, his daily bread, and the uses to which he puts it are innumerable. Taken *in toto*, dipped in lye and afterward dried in the sun, it becomes a moldy, shriveled, and most unlovely-looking morsel, but thus prepared it will keep indefinitely, and is instantly ready for use by peeling and baking or boiling, whereupon it expands to two or three times its original size, and forms palatable food. This is a practice of the mountain natives of Nicaragua, and it forms a large part of their diet, supplemented by the inevitable *tortilla*, when on their travels. When almost ripe the fruit is cut into slices and placed in the sun, which causes a certain amount of its sugar to crystallize on the surface; thus prepared it is an excellent conserve. Baked, boiled, or fried in cocoanut oil, it is a staple article of diet the year round, and the last named is quite a delicacy, particularly fried plantains. Banana flour, or rather meal, as it is not ground to the consistency of the former, makes very acceptable cake and bread, and frequent mention is made of its use by the natives by Stanley in "Darkest Africa." The great value of the banana for this purpose is universally appreciated, and numerous attempts have been made to produce banana flour on a commercial basis.

A German firm was said to be about to undertake the production of banana flour, conserves and other similar products, in Nicaragua a few years ago, but whether the project was ever carried out is not known. However, there is little doubt that this will become an actual fact sooner or later. Thus it will be seen that it is only his ignorance of the value of the fruit other than in its raw state, that causes the northerner's lack of appreciation.

Engineering Notes.

An electric station which will be one of the largest and most modern on the Continent is now being erected just outside of Paris. It will figure among the stations which supply current for the city. A point to be specially noted is the use of steam turbines which drive the dynamos of the station. These turbines are of the type which has been lately brought out by the Swiss firm, Brown, Boveri & Co., and they are now coming into use in different countries, especially for central station use. In the present plant the turbines are designed to use superheated steam at 12 atmospheres pressure, heated to 350 deg. C. The tests show that the turbines consume 15 pounds of steam per kilowatt and per hour, at most. The turbines develop 7,000 horse-power each and are direct-connected with an alternating-current generator mounted on the same base. The speed is 750 revolutions per minute. Each unit thus formed is provided with a surface condenser. The circulation and air-pumps for the latter are operated by electric motors. Lubrication of the working parts is carried out by an oil pump. The alternators are all of the same pattern and deliver three-phase current at 5,000 volts and 25 cycles.

At the last general meeting of the Afri-

can Concession Syndicate some interesting points were brought out relating to the water power which could be obtained from the Victoria Falls. The total amount of power which the falls can furnish in times of high water is estimated at no less than 35,000,000 horse-power, or five times that of Niagara. If the present plans of the Syndicate are realized, an important industrial center will be developed in the neighborhood of the falls, and they hope to see a flourishing town arise there which will have numerous industries employing electric current generated by the falls. The price of the current would be very low, which will be an inducement for different enterprises, once the hydraulic station is running. According to the first project which the engineers of the company have drawn up for the electric plant, it can be installed at a cost of $250,000 for a total output of 10,000 horse-power. But little energy would be lost in the transportation by overhead lines, on the contrary, to many of the existing hydraulic plants. The Transafrican railroad is now built as far as the falls, so that this will assure a market for the products in South Africa.

An interesting feature of the recently announced developments in Baltimore electric power is the exclusive adoption of steam turbines as the prime mover. A contract recently closed by the Baltimore Electric Power Company with the Westinghouse Machine Company provides an initial equipment of 4,000 kilowatts in two generating units of 2,000 kilowatts each. A Westinghouse electrical equipment, complete and modern in every particular, has also been contracted for. Officers of the company state that the power plant will embody the latest developments in steam and electrical engineering. Being located outside of the congested districts of the city, all the boilers and heavy machinery will be on the ground floor. Floors and roofs will be of steel-concrete construction. The steam turbine plant will operate with a boiler pressure of 175 pounds and a superheat of about 100 deg. F. A high vacuum condensing system will be installed, capable of sustaining a vacuum of 28 pounds at full load on the plant. The plant in its entirety has been designed on the separate unit plan, which virtually consists of a number of distinct power plants placed side by side, each entirely separate from the other, but each capable of helping out the other in case any link in the system should be disabled. This holds good through the entire apparatus, from the coal pile to the customer's building. In addition to this precaution against interruption of service, which is thus insured, the company will install a large storage battery which will ordinarily "float" on the system. The construction work is already under way and will be pushed as rapidly as possible in order that the plan may be complete in all respects and running smoothly by July next.

The Deutz Gas Engine Works have, according to a recent issue of Elektrot. u. Polyt. Rundschau, recently designed a motor locomotive to be driven by internal combustion engines. Experiments so far made have shown such a locomotive not only to be rather suitable for hauling small loads at a moderate speed, especially for mining purposes, but even to possess some special advantages. The engine is the four-cycle type, receiving with each double stroke the required amount of benzine through a small pump driven by the engine, the explosion of the air-benzine mixture being effected by a magneto-electric igniter. The engine turns at 300 revolutions per minute. The locomotive can make as much as 6 kilometers per hour, or 100 meters per minute. The weight of the locomotive, including the cooling water, is about 2,400 kilogrammes. The consumption of fuel is at full load, in the case of benzine or benzol operation, 0.3 to 0.35 kilogramme of benzine or benzol; the corresponding figures being 0.35 to 0.38 kilogramme in the case of alcohol or petroleum operation.

Electrical Notes.

A safety device for the protection of persons from the electric current, upon the rupture of a trolley wire, has been placed on the market. By the employment of this arrangement the current is cut off and the wire rendered harmless. The device is fitted to each section of the wire, and consists of an ordinary connecting ear, held in its proper position by the strain on the trolley wire. Directly this tension is released, as by the breaking of the trolley wire, the current is immediately cut off the broken section without any shorting sparks whatever.

In a paper presented to the Academie des Sciences, M. Einthoven describes a new form of sensitive galvanometer which he has devised, together with some experiments which he carried out by applying this very sensitive method of measuring electric currents to the study of the electrical condition of the human body. In the latter case it is especially the electric effects produced by the heart which he observes. The new galvanometer is one of the most sensitive which is known, and at the same time very precise, so that the smallest variations of current can be measured, down to 10^{-12} ampere. It is formed of a silvered quartz fiber which is stretched like a violin cord between the poles of a powerful electro-magnet. When a small current passes in the wire it is deflected perpendicular to the lines of the field and the deflection can be measured directly by means of a microscope carrying a micrometer. The sensitiveness of the instrument can be regulated by adjusting the length of the wire, so that it will measure in the region of 0.001 down to 10^{-11} ampere. The movement of the wire and its variations can be registered by the photographic method. The image of the middle of the cord, magnified 600 diameters, is projected upon a slit which is placed perpendicular to the image. In front of the slit is a cylindrical lens whose axis lies perpendicular to the slit. A photographic plate receives the image which is thus concentrated to a point, and by moving the plate a curve is obtained which corresponds to the current variations. The image of a scale is projected on the plate at the same time in order to measure the curves. The new instrument allows of making measurements which could only be observed heretofore with the electrometer. One of these is the study of radium, which is now made with a gold-leaf electrometer. It will prove especially useful in physiological work. The electric action of the human heart has been observed heretofore with the Lippmann electro-capillary instrument. The muscular shocks of the heart-beats are known to produce variations in the electric potential of the organism, and this was brought out by Waller in 1899. The currents are registered with the Lippmann instrument, but this has many disadvantages, owing to the inertia in the oscillations of the mercury column. The present instrument is more sensitive and works more quickly, as the light quartz fiber, in spite of its length, has but little inertia and can register the variations of current more exactly, and again, the displacement is proportional to the current. M. Einthoven has obtained a series of curves in the shape of regular waves which correspond to the heart beats and show how the electrical effect varies. The effect is, in fact, quite considerable and indicates the great variations of electric potential in the different parts of the body which accompany the muscular shock of the heart. The waves he obtains are similar in form to those of the Marey cardiograph register.

In a series of experiments made by Jeantaud with an electric motor car a tractive effort of 42.7 pounds per ton at 10.8 miles per hour was observed on a dry road. On a very muddy road the tractive effort rose to 74 pounds per ton at 9.32 miles per hour. Thus the resistance on a dry road is 42.3 per cent less than on a muddy road.