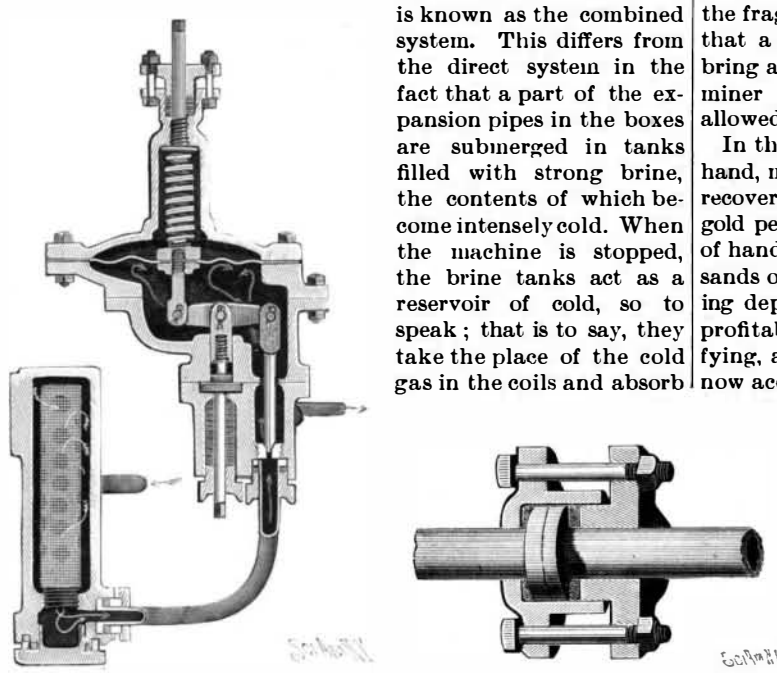
zero F. it liquefies at the normal pressure of the atmosphere, and, of course, at higher temperatures it liquefies at higher pressures.

The refrigerating apparatus shown in the accompanying cut is an extremely compact and self-contained machine, all of whose working parts are inclosed, and run in a bath of oil. It is provided with a heavy flywheel pulley, which may be belted direct to an electric motor or any suitable power shaft. At one end of the pulley shaft is a wrist plate which by means of a connecting rod and a rocker arm operates a rocker beam. Attached to the ends of the rocker beam are the piston rods of the two compressing cylinders, which are placed in the vertical position to avoid the uneven wear which would occur if the cylinders were placed horizontally.

The compressors are single acting and work with the smallest practicable clearance between the cylinder head and the piston. Particular attention has been paid to the design of the suction and discharge valves, which are provided with offsets on the stem which permit the passage of the gas but prevent the valve falling into the cylinder should any breakage occur. The discharge pipe from the compressor cylinders is led into a high and low pressure oil trap, located behind the cylinders, which is divided by a diaphragm into two separate receptacles. The compressed gas, at 150 pounds pressure, more or less, depending on the temperature of the condensing water, enters the high pressure half of the trap, where any oil which may have been carried over is deposited, and collects in a receptacle at the bottom. From the trap the gas is led down to a condensing coil located in the "condenser base" of the machine. This is simply a tank in which the coil is cooled by a constant circulation of cold water. Here the gas is condensed and passes down to another tank beneath it, known as the liquid receiver. The liquid ammonia is now ready for use in the refrigerating box.

The boxes may be one or more, close together or widely separated, and of any size (within the capacity of the machine) or shape desired. One of our illustrations shows the interior of a refrigerator such as might be used in a meat market, large grocery, or in any establishment where it is desirable to refrigerate a considerable amount of material in bulk. The liquid ammonia is led by a small pipe from the machine to the refrigerator, where it passes through a very ingenious automatic expansion valve which controls the flow and adjusts itself to any pressure at which it may be set. The regulation is effected by means of a flexible diaphragm controlled by the pressure of the gas, which acts on a needle valve at the mouth of the liquid ammonia supply pipe. The moment the liquid enters the regulator, which is set for a pressure of fifteen pounds to the square inch, more or less, according to the amount of refrigeration required, it volatilizes, and in so doing produces extreme cold which absorbs the heat from the surrounding atmosphere. At this lowered temperature the gas then passes into coils of pipe which are arranged on the walls or ceilings of the refrigerator. When the expansion valve has been set at the proper tension, it will admit just sufficient ammonia to insure the refrigerator being maintained at whatever temperature is required. Moreover, when the compressor is shut down it will automatically shut off the supply of gas to the coils. After the gas has traversed the coils it is led back to the refrigerating machine and passed through a coil in the condenser and then led into the low pressure receptacle of the "trap." From the trap it is again drawn into the compressors and sent on its course through the pipes.

The method above described is known as the direct expansion system. The Atlantic Refrigerating Company also make use of what is known as the combined system. This differs from the direct system in the fact that a part of the expansion pipes in the boxes are submerged in tanks filled with strong brine, the contents of which become intensely cold. When the machine is stopped, the brine tanks act as a reservoir of cold, so to speak; that is to say, they take the place of the cold gas in the coils and absorb the heat from the refrigerator box, maintaining the low temperature until the machine is again started. The company also makes use of the brine system, which differs from those already described in the fact that the ammonia pipes are not placed in the rooms or boxes to be cooled, but in a brine tank (located usually in the basement of the building), and the cooled brine is circulated through another set of pipes placed in the rooms or boxes.



SECTION THROUGH REGULATOR, AND COUPLING.

The uses to which these compact and self-running machines can be put are many and various. The accompanying illustration shows a six ton plant, installed in a city meat market. At the far end is seen the large refrigerator box divided into a large beef room, a room for general storage and a freezing room, the temperature of which may be reduced to zero. At one side of the room is another box containing four large corned-beef tanks and tubs of high-class salted meats, and a further and entirely novel application is shown in the construction of the horseshoe shaped counter. This is nothing more or less than a continuous refrigerator box with a plate glass top, in which are shelves upon which plates of cut meats, chops, steaks, etc., may be placed and inspected by the buyers. Another form of installation which is likely to meet with extended application is the refrigeration of apartment buildings.

Plans are being prepared for the equipment of a large six story apartment building with some thirty domestic refrigerators—one to each suite of rooms—all of which will be operated by a single machine in the basement. The refrigeration will be included, like the light and steam heat, in the rent. Such an arrangement would insure the abolition of the ice box with all its attendant inconveniences, a relief which would be greatly appreciated by the average householder.

DREDGING FOR GOLD.

Gold mining operations in the country lying west of the Rocky Mountains are just now being carried on by two very different systems. In the frozen North the pioneer is searching for the rich placer deposits where the fragments of gold are so large and so thickly strewn that a single season's work with the miner's pan may bring a fortune. In his feverish haste to grow rich the miner pays no attention to the finer gold, which is allowed to run to waste in the tailings.

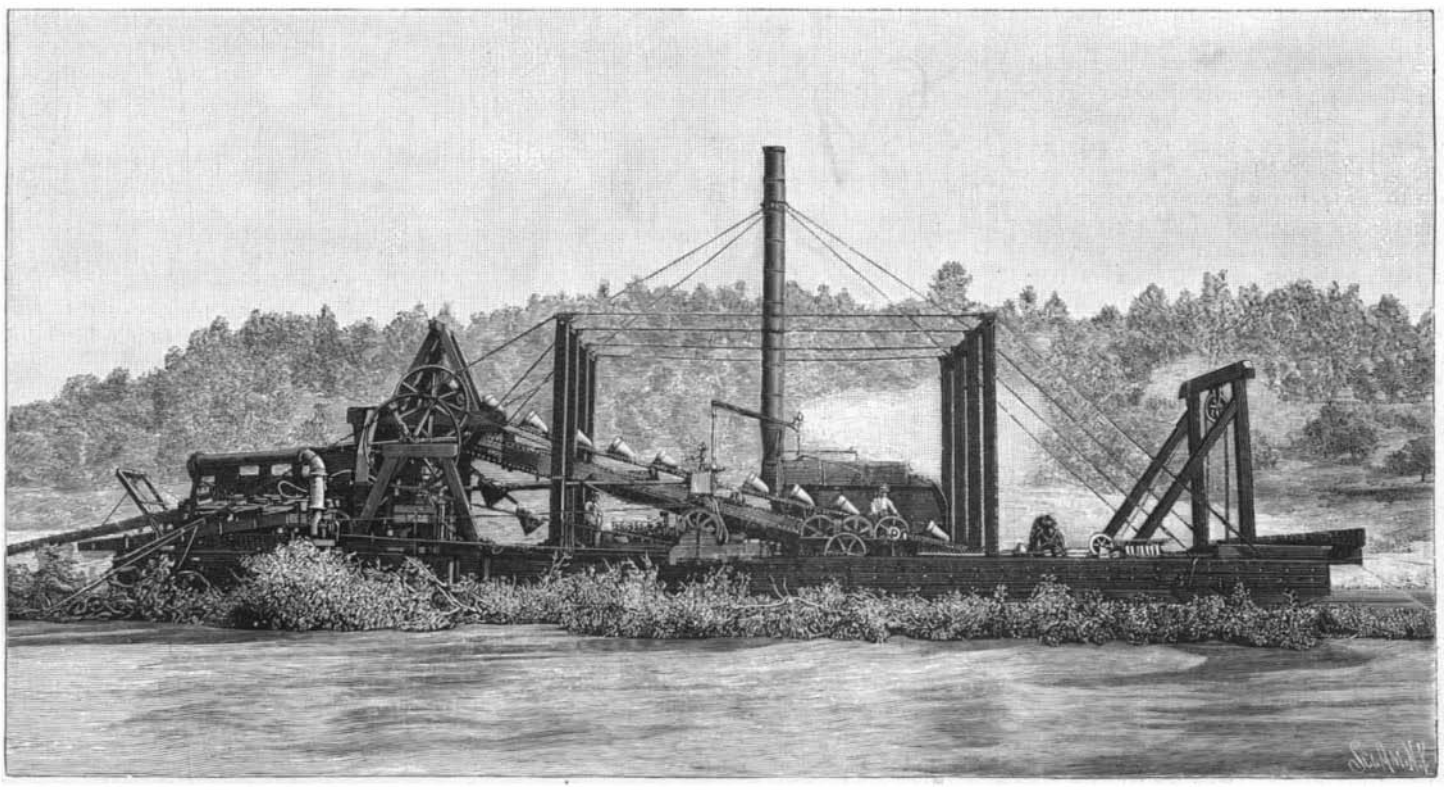
In the historic gold fields of California, on the other hand, mining men are giving increased attention to the recovery of gold from placer deposits, where the yield of gold per ton is very low. Improved machinery, capable of handling the auriferous material at the rate of thousands of tons per day, is being employed on gold bearing deposits which hitherto it has been considered unprofitable to work. The results have been very gratifying, and many discarded or neglected districts will now acquire a positive value.

The accompanying cut represents the Risdon Improved River Gold Dredge, as designed by R. H. Postlethwaite, consulting engineer, of San Francisco, California, patents for which are held by the Risdon Iron and Locomotive Works, of that city.

These dredges are the result of a process of evolution and many years of experiments by the designer and others in New Zealand, now recognized as the leading gold dredging country of the world, from which country Mr. Postlethwaite arrived in April last for the purpose of introducing and operating his dredger in this country.

One of these dredgers is now operating on the Yuba River, in California, and is lifting and washing over 93 cubic yards of gravel per hour from a depth of 45 feet, and extracting and saving the gold therefrom, some of which is so fine that it cannot be seen by the naked eye, at a cost of 3 cents per yard. The dredger consists of two long pontoons, each 96 feet long by 9 feet beam. These are connected at the stern by a small pontoon 17 feet long and 5 feet wide, the bow being connected by a heavy overhung beam. This practically makes one boat 96 feet long and 23 feet in width, with a well hole 5 feet wide running through the center for some 75 feet.

The dredger is fitted with a power winch with six drums, all being under the control of one man. Four of these drums carry lines running from the four corners of the dredger, the other end of the lines being affixed to "dead men" or backers on the beach. The fifth drum carries the head line. With these five lines the dredger can be made to rapidly take up any position necessary, one man handling her with the greatest ease and nicety and with no loss of time. The sixth winch barrel carries the ladder line, raising or lowering the ladder as required. A ladder 67 feet long, built up as a heavy lattice girder, is hung at the stern end by a bar fixed across a heavy wooden framing. The lower end of the ladder carries a five-sided tumbler and is suspended by blocks and tackle to a cross beam. By means of a wire rope and blocks the winch can raise or lower the bottom end as required. The top tumbler is carried by the timber framing some 3 feet above the top end



RIVER GOLD DREDGE ON THE YUBA RIVER—CAPACITY, 2,000 CUBIC YARDS PER DAY.

of the ladder. The continuous bucket chain comes up the top side of the ladder on rollers round the top tumbler and back in a catenary curve to the lower tumbler. The top tumbler is driven through a rope transmission and heavy gears by the engine, a vertical compound condensing one, which also drives the pump and indicates 35 horse power.

The buckets discharge the material onto a delivery plate, down which it shoots into a revolving screen or grizzly. The centrifugal pump, throwing 3,000 gallons per minute, supplies water to a perforated pipe inside the screen. This water thoroughly washes the material, the finer wash dirt and gold going through holes in the screen and falling into a distributing box. From the distributing box it passes onto a set of gold-saving tables, 11 feet wide, over which the wash dirt runs in a thin or shallow stream, and thence into a flume. The tables are covered with cocoa matting and expanded metal, a finer gold saver than which was never used. The stones and rocks pass through the screen down a stone shoot, either direct into the river, or, when working into a high face of gravel, onto a tailings elevator.

Broadly speaking, with such a dredger as is above described, any ground which is not deeper than 60 feet below water level nor more than 20 feet above, and which contains bowlders of not more than say one ton weight, can be handled at from 3 to 5 cents per cubic yard. The ground need not be in a river, provided the seepage is sufficient to float the dredger and keep the water clean enough to wash the dirt with. The introduction of this dredger will revolutionize placer mining in this country and will render valuable large tracts of land heretofore, on account of their low grade condition, unworkable and consequently worthless.

How it Feels to be Asphyxiated.

Philip Rearden, superintendent Abbott Quicksilver Mining Company, of Illinois, Sulphur Creek, California, relates his experience with mining gas in The Mining and Scientific Press, San Francisco, as follows:

In our mine we sometimes have to contend with sulphureted hydrogen, chlorine gas, carbonic acid gas and marsh gas, sometimes called fire damp; and lately have had all these to contend with at the same time and place. We had struck the ledge, finding, in addition to these gases, some petroleum, with a heavy flow of water equal to about 4 miner's inches when we were driven out of the tunnel by the excess of sulphuric acid gas, called by our miners sore eye gas, owing to the fact that it affects the eyes so that the men are temporarily blind, and suffer great pain while the eyes are affected. We had discontinued work temporarily, while preparing to put in artificial ventilation. I and my brother went in to examine the tunnel. He had stopped to look at something about 250 feet from the breast. I went ahead to the breast carefully trying for carbonic acid gas along the floor with a candle, also along the roof of the tunnel for marsh (or inflammable) gas. I found neither with the light, but within a few seconds after reaching the breast, where a large flow of water was coming out of the ledge, I found that I was getting very short of breath. I tried to recover, but could not do so. My candle was burning brightly. I turned and ran back toward the mouth of the tunnel, perhaps 100 feet, at the same time calling to my brother to come to me. I began to get weak, lose consciousness, and fell to the floor. I could not rise again, although trying hard to do so. I felt just like one in a nightmare, trying to move, but unable to do so; but felt no pain whatever, not even strangling or coughing sensation. At this point my brother reached me, and pulled me back toward better air, where I revived within a minute or two. In this case asphyxia was probably caused by chlorine gas.

I have several times helped to take men who had been suffocated out of mines, and their faces and positions showed no signs of pain or any suffering. I had wondered at this, but now I know how a person might be asphyxiated while his light burned brightly, and would suffer no pain whatever to warn him of approaching danger.

Feeding Plants.

The following note by Mr. Paul, of Cheshunt, in The Gardeners' Chronicle, October 23, 1897, on the method employed by M. Georges Truiffent of administering artificial food to plants, is of considerable interest to horticulturists. After an analysis of the ash of the living plant, the necessary salts for a given time, such as six months, are weighed out and inclosed in a metal cover to form what is called a "pill," which is presumably inserted in the pot, diffusion of the salts taking place through the folds of the metal, and the thicker the metal, the slower the diffusion. As the salts dissolve and disappear they are replaced by a core which expands until it completely fills the "pill." The salts have no action on the metal cover, which remains firm and hard. It is stated that the solubility of the salts can be so regulated that a "pill" may be made to last three or six months, as may be desired. By this method of feeding large well colored plants are grown in pots of less than half the usual size.

A LATEEN ICE BOAT.

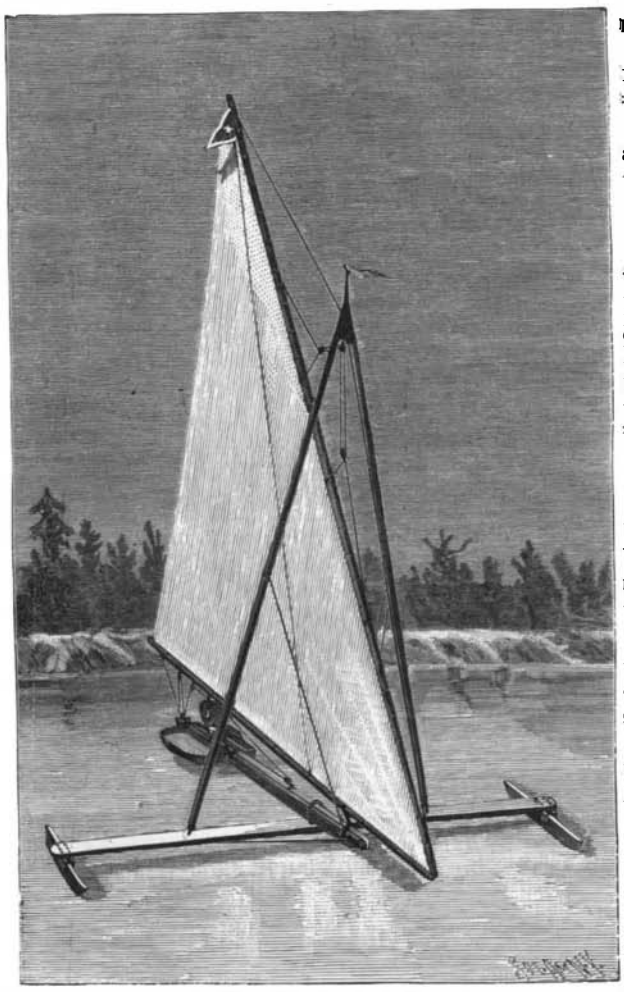
During the past few years much study has been given to the best form of a sail for an ice boat for the purpose of obtaining the greatest propelling result under a given force of wind pressure.

One fault of the ordinary square sloop sail was that the force exerted above the center of the sail was so great at times as to cause the windward runner to rise from the ice and tilt the sail to such an angle that the wind would spill over the top of the sail and prevent the attainment of high speed.

Lately it has been the study of ice boat experts to overcome this defect and provide a sail and rigging which would remain in a vertical position and prevent the leakage or loss of wind power. This has been successfully accomplished by the adoption of the lateen triangular sail especially rigged and designed by H. Percy Ashley, of this city.

It will be seen from the illustration that the center of pressure is quite low near the boat, and by making the sail taut or by bagging it the proper wind angle can be easily ascertained. The area of the top of the sail is so small as compared with the lower portion that there is never top pressure enough to raise the windward runner off the ice.

The mast, it will be observed, is composed of two parts forming an inverted ∧, or it may be called a wishbone mast. The sail is held by a bridle which is raised and lowered by a halyard in the usual way. The runners are of the rocker type, curved at each end.



AN IMPROVED ICE BOAT.

Practical trials of lateen boats on the Shrewsbury River, Hudson River and in Canada have proved them to be more comfortable and speedy than the ordinary style. A model of one was exhibited at the Sportsmen's exhibition in this city lately and attracted considerable attention.

Working plans of this ice boat will be found in the current issue of the SUPPLEMENT, No. 1154.

The Largest Steamship Companies of the World.

According to the latest edition of the "Repertoire General" of the Bureau Veritas, there existed upon the registers of the various maritime nations at the time of the publication of the work 29,315 sailing vessels measuring 8,894,732 register tons (against 29,348 ships and 9,136,560 tons in the previous edition of the book), as well as 11,271 steamers measuring 17,889,006 register tons (against 11,155 steamers and 17,089,596 tons). These figures show that steam tonnage is still increasing at the expense of sailing tonnage, but that the latter is decreasing in a smaller proportion than was noticeable a few years ago.

The publication of this new volume renders it possible, says The Marine Record, with the added assistance of Lloyd's Register and other authorities, to complete a list of the most important steamship companies of the world, and to show precisely how they compare with each other. According to the statistics thus available, it appears certain that the claim which has been frequently put forth on behalf of the Hamburg-American Packet Company of being the largest shipping company in existence is a just claim, beating as it does the largest British company (according to tonnage, the Peninsular and Oriental Steam Navigation Company) by 3,805 tons gross and 10,154 tons net. The following is the list:

Companies.	No. of vessels.	Gross tonnage.	Net tonnage.
British.			
P. & O. Steam Navigation Co. (London)	60	282,140	164,836
British India Steam Navigation Co. (London)	97	251,429	162,482
T. Wilson, Sons & Co. (Hull)	82	159,793	103,450
Pacific Steam Navigation Co. (Liverpool)	41	128,336	77,774
Cunard Steamship Co., Limited (Liverpool)	27	119,471	65,011
Ismay, Imrie & Co. (White Star Line) Liverpool	21	114,290	68,264
Union Steamship Co. of New Zealand (London)	52	65,239	39,371
Irrawaddy Flotilla Co., Limited (Glasgow)	42	20,393	12,367
German.			
Hamburg-American Packet Co. (Hamburg)	69	286,945	174,990
North German Lloyd (Bremen)	67	265,613	152,126
Hamburg S. American S. Nav. Co. (Hamburg)	32	100,646	65,422
Hansa Steamship Co. (Bremen)	37	84,867	54,446
French.			
Messageries Maritimes Co. (Marseilles)	63	229,837	114,000
Comp. Generale Transatlantique (Paris)	64	166,701	72,713
Italian.			
Navigazione Generale Italiana (Rome)	96	171,041	105,598
Austrian.			
Austrian Lloyd (Trieste)	72	146,560	87,800
Spanish.			
Compania Transatlantica (Barcelona)	36	121,161	78,702
Danish.			
United Steamship Co. (Copenhagen)	109	85,525	50,719
Russian.			
Russian Steam Nav. and Trading Co. (Odessa)	75	80,659	53,342
Turkish.			
Idarei Massousich (Constantinople)	69	57,842	35,664
Japanese.			
Nippon Yusen Kabushiki Kwaisha (Tokio)	68	161,698	101,383

The following are seven of the largest steamers afloat:

Name.	Length, feet.	Breadth, feet.	Depth, feet.	Gross tonnage.	Net tonnage.	Displacement, tons.
Kaiser William der Grosse (Ger.)	625	66	43	14,349	5,521	20,500
Lucania (Brit.)	601	65·2	37·8	12,952	4,975	18,000
Campania (Brit.)	601	65·2	37·8	12,950	4,974	18,000
Kaiser Friedrich (Ger.)	600	64	41	12,000	..	17,000
Pennsylvania (Ger.)	560	62	42	12,261	7,861	23,500
Pretoria (Ger.)	560	62	42	..	..	23,500
Augusta-Victoria (Ger.)	529	56	33·8	8,479	3,568	15,260

Washington's Tree.

The great court of the pension office at Washington has, since the advent of the present administration, been turned into a scene of tropical beauty and freshness second only to the government greenhouses of the capital city. Through the efforts of Commissioner Evans, Chief Clerk Bayly, and especially Superintendent Barnes, donations of trees and plants have been secured from the National Botanic Garden and other sources.

A valuable addition to the collection was recently made by Col. Bingham, who has charge of the White House conservatories. As the palm house adjoining the Executive Mansion was needed to accommodate the Marine Band on state occasions, the largest trees were transferred to the pension office. Among the number are some noble specimens of Sabal, Cocos and Seaforthia, but by far the most interesting tree is a venerable sago (Cycas revoluta) which once belonged to George Washington. This priceless relic is known to be at least two hundred years old, and yet it appears to be in its prime, putting forth regularly every two years a new crown of beautiful, feathery leaves and a mass of woolly, yellowish-white flowers and fruit.

Many unsuccessful attempts have been made to obtain a complete history of this tree, which is perhaps the oldest specimen of its kind in the United States. The following facts were obtained from Mr. Pfister, head gardener of the White House, and it is probably all that will ever be known of the past life of the wonderful old sago:

About the year 1780, a Baltimore merchant, owning a line of small vessels plying between that city and Havana, brought over from Cuba this tree, which was then of advanced age. As it was probably the only specimen of its kind in this country at that time, it was a genuine curiosity, and the merchant presented his prize to the first president. The tree stood about ten years in the grounds at Mount Vernon, and then it went back to Baltimore, Washington having given it to a lady of that city. For many years it remained in her family.

Fifty years ago there was a public sale of this lady's estate. Hearing of this, the head gardener hastened to avail himself of the opportunity to gain possession of the historical tree. He attended the auction for that purpose, and, after some sharp bidding, secured the prize (at what figure is now unknown) and placed it in the conservatory at the Executive Mansion, where it has stood ever since, until removed to the pension office.

The tree stands about six feet high above the surface of the earth in its box.

For these particulars we are indebted to Mr. L. S. Perkins, of the pension office.