Correspondence.

Construction of the Panama Canal.

To the Editor of the SCIENTIFIC AMERICAN:

As a subscriber of many years to your paper (through our local dealers) I take a deep interest in the Panama Canal. In offering the following plan to lessen its cost, shorten the time for its completion, and simplify its sanitation, I hope that I will not be considered presumptuous. Make the excavation from both termini on the sea-level plan. The canal itself to furnish all the transportation for the excavated material by means of flatboats or lighters. These as fast as loaded to be towed either to the jetties or to be dumped out into the deep sea. The work to be pushed as rapidly as possible to connect the two seas without regard to the width or depth, in order to obtain the scouring benefit of the rushing tides. Drain all intersecting streams into the canal. Slide or tumble the sand and rocks into the boats. Waste no time upon technical measurements, amount of rainfall, or the disposition of the overflow of the Chagres River. They can await a more opportune time. B. S. P.

Savannah, Ga.

Changes in Glass in High Altitudes.

To the Editor of the SCIENTIFIC AMERICAN:

In the Science Notes in a recent number of the SCIENTIFIC AMERICAN, reference was made to some experiments upon the changes in the color of glass caused by subjecting it to the ultra-violet rays of the spectrum. The statements there contained bring to my mind a phenomenon sometimes observed upon very high mountains, where old glass from bottles, presumably originally green, after exposure to the light of a great elevation in the regions of perpetual snow attains a beautiful pale purple tint. A number of specimens from Mount Ranier or Mount Hood may be seen, I think, in the museum of the Natural History Society in Portland, Oregon.

The same interesting results may also be observed in connection with the glass insulators used on telegraph or telephone lines in mountain districts. During a period of years I have found it very interesting to watch the changes in hue of the insulators on the telephone line connecting Laggan Station of the Canadian Pacific Railway with the Châlet at Lake Louise. The elevation is between 5,000 and 6,000 feet; and while the line runs through the forest almost all the way, the actinic effect of the light has changed the green glass of those insulators that have been up for several years to a brilliant purple. Those that have been in service longest apparently have the deepest tint. GEORGE VAUX, JR.

Philadelphia, November 20.

Engineering Notes.

The early boilers in sea-going vessels were of what has been called the "box" type; that is, the boiler was a cubical box with a thin shell, the real strength being given by braces running in three directions. When the surface condenser had made higher pressures possible, it was soon found that the multiplicity of braces, as pressures were increased, made an impossible condition of affairs, and this led to the design of the cylindrical boiler whose shell was self-bracing and left the only braces those needed for the heads and flat surfaces. This boiler so thoroughly met the conditions arising that it has remained the favorite even up to the present day. At one time an effort was made to save room by making the boiler elliptical, but this was soon found to be unsatisfactory and impracticable, and was abandoned after only a few examples.

It has been for some time a question in France as to how the main lines of railroad were to join on to the Simplon route. This question has been set back for a long time, mainly owing to political reasons, but there seems no doubt that the new trunk line will be constructed in the near future. The route which is proposed is to pass from Lous-le-Sannier to Geneva and it will be necessary to run a long tunnel through the mountain known as La Faucille. This will give a much shorter and better route from Paris through Switzerland than at present. The solution adopted by the French government is the one which has been already favored by the Paris-Lyons-Mediterranean Railroad Company and also by the city of Geneva. The cost of the work will be some $24,000,000, of which the railroad company will give $6,000,000, the Swiss government $2,000,000, and the French government the remainder.

The first wind- and water-mills were introduced into France, Holland, and England some time during the twelfth century. The first saw-mill in England was erected by a Dutchman in 1633; the spinning-wheel was invented, 1530; the diving bell, 1538; and great improvements were made in ships during Elizabeth's reign. Numerous canals were dug in all these countries. The New River was ditched to London, a distance of 60 miles, in 1608-13. This copious supply of water gave rise in England to fire insurance companies and to an organized fire department which was paid by the companies. The canal which connected the Loire and Seine was begun in 1605, and completed in 1640. Two thousand square miles of swamp lands were drained in Lincolnshire, etc., 1629-52. Tramways were invented at Newcastle in 1602. The steam engine was invented by Blasco de Garay of Barcelona, 1543; an armored paddle-wheel vessel, moved by crank and hand power, was employed, 1574, in the relief of Leyden (Motley); the experiments of Giambattista della Porta were made in 1601; of Solomon de Caus, a Frenchman, 1615; a wheel driven by steam was exhibited by Branca, an Italian engineer, 1629; the Marquis of Worcester's steam engine was seen in motion by the Grand Duke of Tuscany at Vauxhall in 1656, and is described by the Marquis in his "Century of Inventions," 1663; Gilbert produced frictional electricity in 1600; Schwenger, a German, planned an electrical machine, 1636; and Otto von Guericke constructed one in 1647. Coach is an Hungarian word, meaning a covered carriage suspended on straps. In modern times coaches and carriages were first constructed in France, 1547; and England, 1555. In 1619 the Duke of Buckingham drove six horses in a carriage, and in 1620 the Duke of Northumberland drove eight. Carriages were first let for hire in Paris at the Hotel Fiacre, whence the name of fiacre, in 1650. In 1550 there were only three pleasure carriages in Paris; in 1580 only two in England. Turnpike gates were introduced in 1663.—Delmar's "History of Monetary Systems."

LABOR-SAVING DEVICES UTILIZED IN THE MANUFACTURE OF TEA.

BY C. SMITH.

The rapid development that has been made during the last decade in labor-saving devices and their introduction in the Far East made it inevitable that the old, cumbersome, and primitive methods used in the manufacture of tea would be superseded by western ideas and modern machinery. Coolie labor is no longer essential to the extent it has been in the past, and the modern methods are not only more economical and quicker but also more sanitary, the hand and foot of the coolie being happily eliminated from the work.

The leaves of the tea plant are picked and gathered by the coolies and brought in baskets to the factory in a crisp and brittle condition. Here they are first carefully weighed and then spread out on racks or shelves in what are known as the "withering lofts" until they become soft and limp. It is a recognized fact that a good wither is essential to the manufacture of high-class teas, but, owing to climatic conditions, this process has presented one of the most serious obstacles with which planters have had to contend. The modern method of tea withering, however, is entirely independent of any such atmospheric influence. Fans specially constructed for the purpose are employed to control the air in the withering lofts and direct it over the leaves as they lie spread out on the shelves, the exact arrangement of the apparatus depending on the factory in question. The time which is required depends on the quality of the leaf, the extent of its saturation, the amount of heat and moisture in the currents of air passing through the lofts, and the state of the outside atmosphere. Under the most favorable conditions a good cold limp wither can be produced in six hours, but ordinarily twelve hours are necessary for the process. Formerly forty-eight to sixty hours were required, or even more when the air was exceptionally moist. The tea leaves are left in the withering loft until they are limp enough to be twisted without breaking, when they are put into the rolling machine. This machine, which can be seen in Fig. 1, has a capacity of 300 to 350 pounds of withered leaf and does the work which formerly required about 100 coolies. One attendant is necessary to operate it, and when working with a full charge of 350 pounds it requires but 2 horse-power. The object is to break up the cells of the leaf prior to fermentation. The table under the hopper of this labor-saving device is fitted with "plows" and a cone-shaped projection which subject the leaves to a very strong lateral pressure and impart such a motion to the center of the mass that each leaf receives a remarkably equal and well-twisted rolling, while at the same time the entire mass is kept completely aerated and cooled. About half-an-hour is usually sufficient to effect the rolling operation of 350 pounds of the withered leaf. The tea is discharged by opening the door of the leaf chamber while the machine is running, the rolling table automatically ejecting the tea onto the discharge shelf in front. Any leaf or juice which escapes through the clearance space between the lower edge of the leaf chamber and the upper surface of the rolling table is automatically swept around to a delivery spout on the table where it can be gathered and replaced in the leaf receptacle. The speed and economy with which this type of machine does its work are especially noteworthy when compared to the primitive methods formerly employed for this purpose.

The wet roll, as the leaf is now called, next passes through a rotary sieve which sorts and cools it, at the same time breaking up any lumps there may be in it. The leaf as it comes from the rolling machine is emptied into the bin or hopper on top of this machine and is drawn forward by rakes into a chute which delivers it directly into a sorting cylinder. The cylinder is fitted with screw adjustment for raising and lowering the angle at which it works so as to give a quick or slow passage to the leaf. It also has wire webbing of two sizes of mesh which separate the fully rolled and fine from the medium-sized leaf, the coarse leaf being thrown out at the lower end of the cylinder so that it can be further rolled. In this way each of the three classes can be fermented separately and the best results thus obtained, as the finest qualities, which always ferment most rapidly, can, when thus separated, be dried off as soon as they have fermented sufficiently without waiting until the coarse, which requires a much longer time, is ready.

The most important feature of the manufacture of tea is the drying process to which the leaf is now subjected. For this work drying machines are used, their capacity ranging from 40 pounds to 350 pounds of fully dried tea per hour. There are two distinct forms of machines in use, known respectively as the "updraft" and "downdraft" types.

The former type of drier, as its name indicates, works with a self-acting upward current of heated air which passes up and through the drying chamber containing the trays of tea. The temperature and strength of the air current are controlled by valves fitted in the air-duct above the trays. There are also two distinct types of updraft driers, the side-drawer and the end-slide forms, depending on the position of the drying chamber. In the latter machines the trays are inserted at one end of the machine while in the former type they are placed at the side of the machines. In all updraft machines, however, the same method of working the trays is employed, the trays with wet roll being first inserted into the drying chamber through the top slide and then in rotation into each of the lower slides, the drying process being completed in the bottom slides, where the trays are finally withdrawn and then reinserted at the top with a fresh charge.

In the downdraft drying machines the hot air passes down instead of up and over the trays holding the wet roll, a centrifugal fan being used to obtain the downward draft. The trays are placed in the bottom tray port and slowly raised by means of levers till they reach the top, when they are withdrawn, the tea being by then thoroughly dried. A coolie attendant is necessary to withdraw and insert the trays. In the downdraft drier, seen in Fig. 4, there are two drying chambers, each fitted with ten trays and having a total output of 320 pounds of dried tea per hour, a temperature of 220 to 230 deg. being maintained. The fans in this machine are driven at a speed of 400 revolutions per minute and require 1.5 horse-power each.

A newer and more improved type of machine has recently been designed with a capacity of 350 pounds of fully dried tea per hour. In this machine the leaves are automatically discharged when they are thoroughly dried, one coolie being required to feed the leaves into the trays. Special attention has to be paid in these machines to efficiency and economy in working as well as to rapidity of operation. Various classes of fuel are used in all driers, the particular kind depending on the price in that particular vicinity.

Of late considerable attention has been paid both in Ceylon and India to the manufacture of green tea to supply the demands of the western trade, and this has led to the requirement of a machine to glaze or polish the tea in large quantities after it has been dried. The glazing machine consists of a vertical-flue air-heater, so connected to a large revolving drum that a self-operating continuous flow of hot air enters same. The drum is driven by belt through a very simple arrangement of worm gearing. The tea is carried round in the drum by a series of ledges fastened to its inner circumference, and falls in a continuous stream over the central baffles, below which the hot air enters the drum. The tea which is thus subjected to a constant rubbing action under the influence of air at a high temperature gradually attains a grayish green bloom which is characteristic of the best qualities of green tea. It is not known what chemical effect takes place in the tea during the glazing process, but it is undoubtedly the case that the tea thus treated has better keeping qualities, and gives, when infused, a more pungent liquor than prior to this operation. The hot air escapes from the drum at the opposite end to that at which it enters, and the volume allowed to escape is regulated by means of a valve in the outlet pipe so that any temperature can be maintained in the drum from 180 to 240 deg., the latter temperature being the proper one for the glazing. Two doors are provided in the drum, through which the charge of tea is inserted, and when the glazing process is completed, the drum is stopped and the doors taken off, and when the machine is then started the tea is automatically dis-